



Breathing & Exchange OG Gas

Topic
Respiratory System Exercises

Syllabus

Breathing & Exchange OG Gas

Respiratory system

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DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

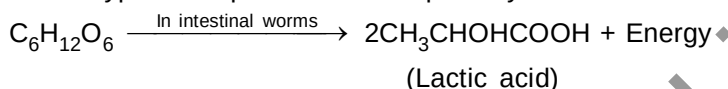
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

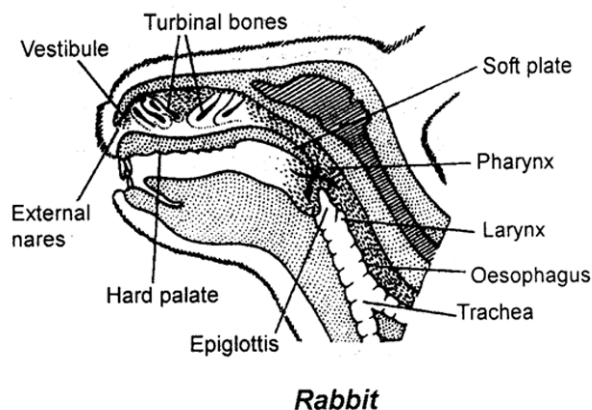
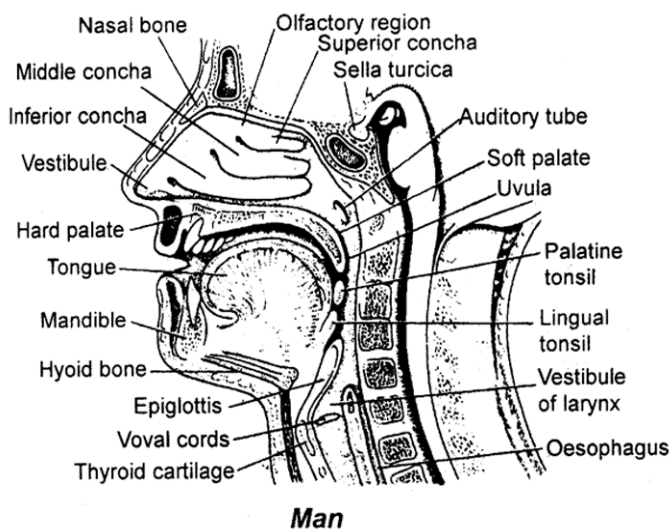
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

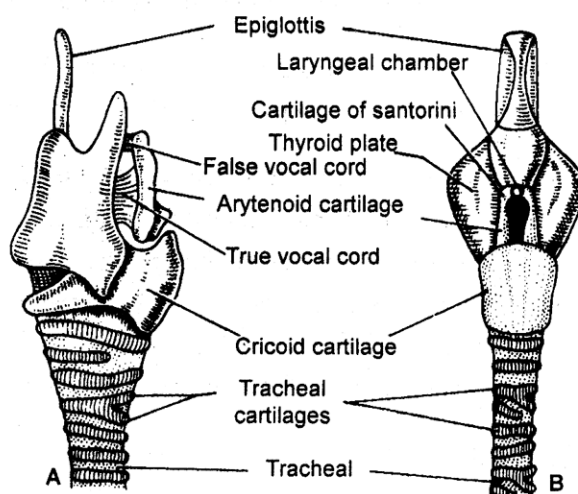
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

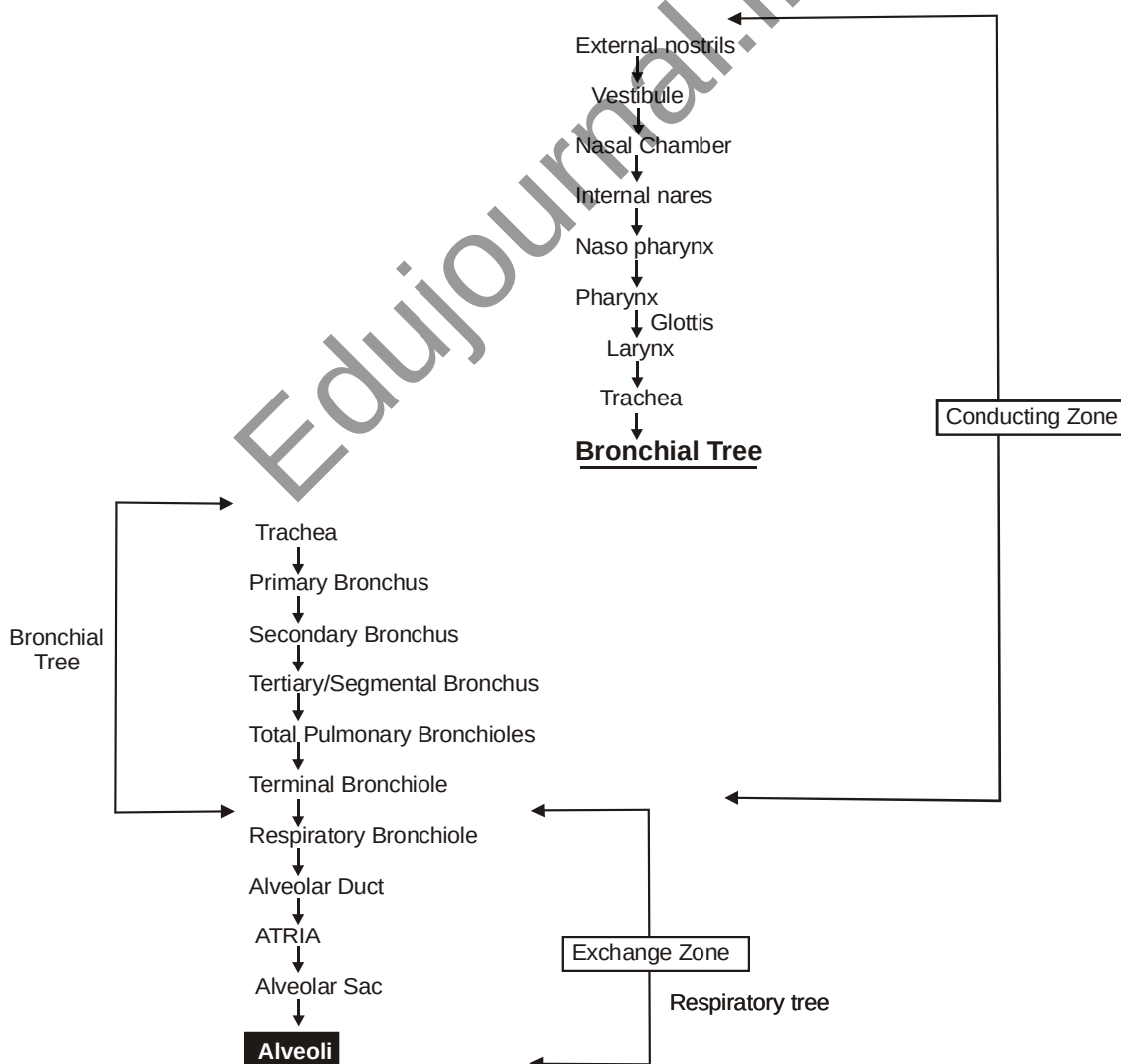
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

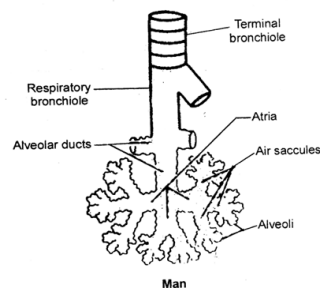
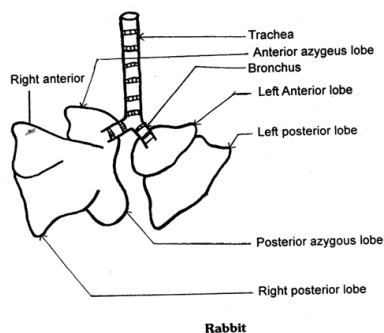
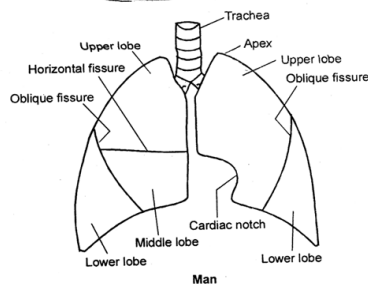
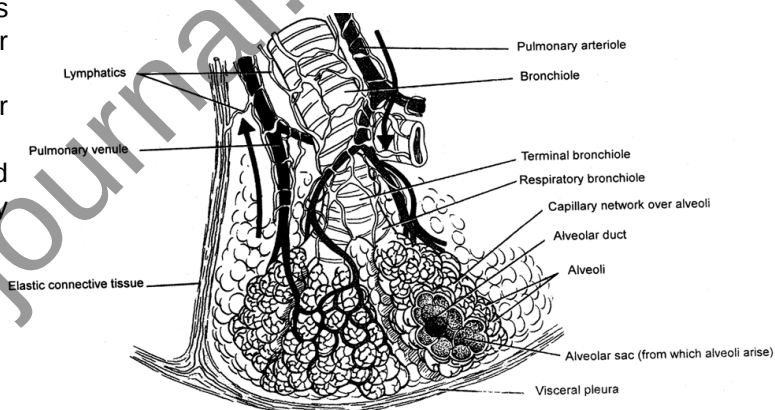
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

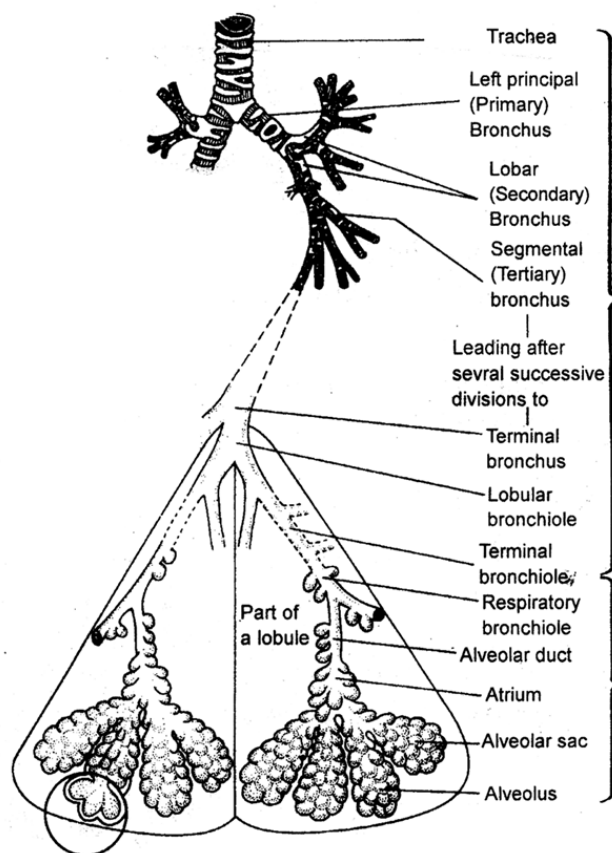
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

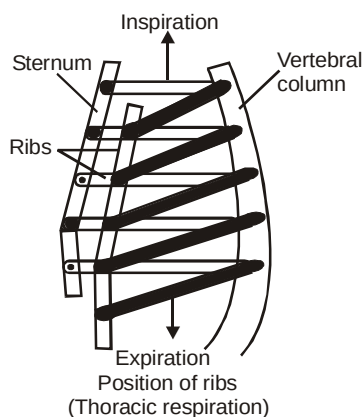
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

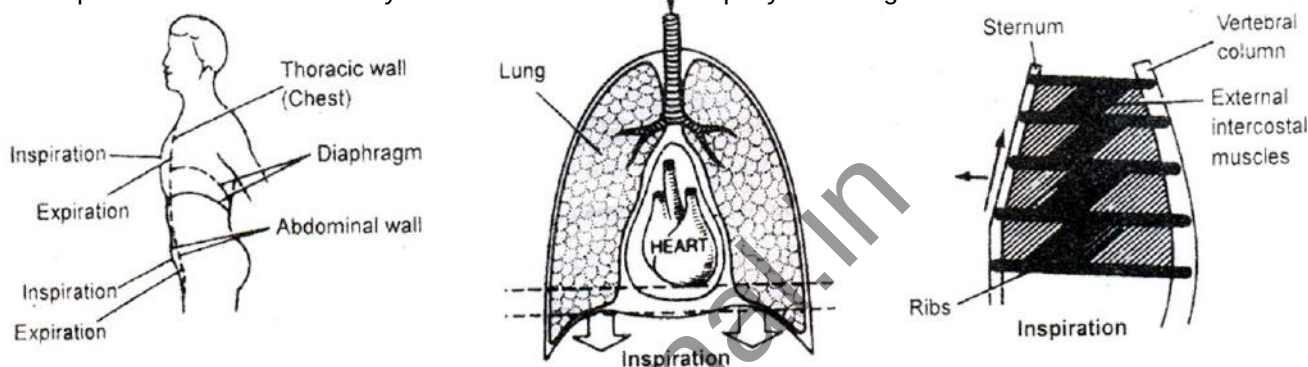
Inspiration

Expiration



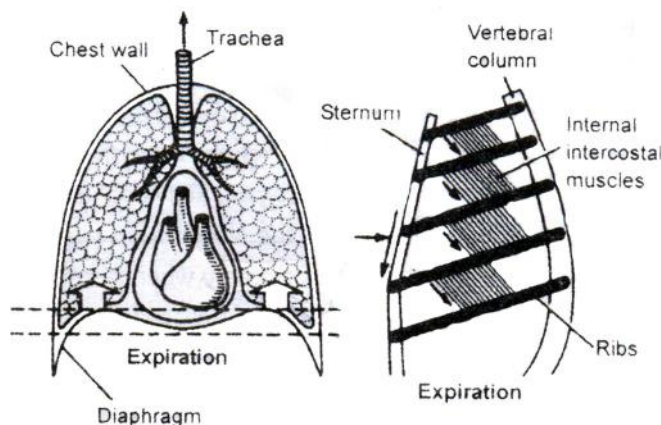
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

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Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

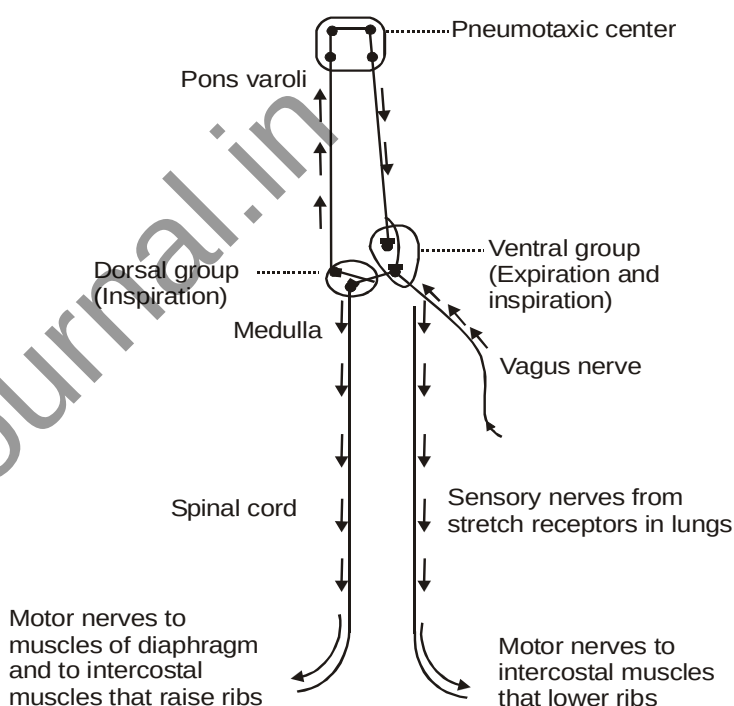


Diagram showing nervous control of breathing

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CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

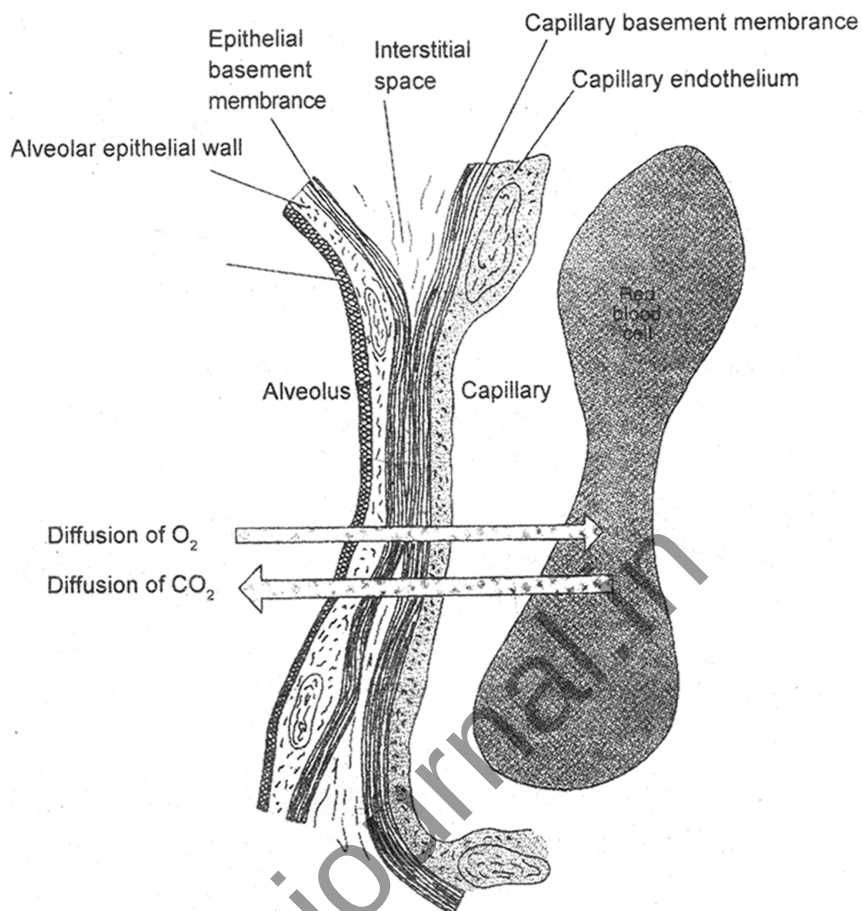
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

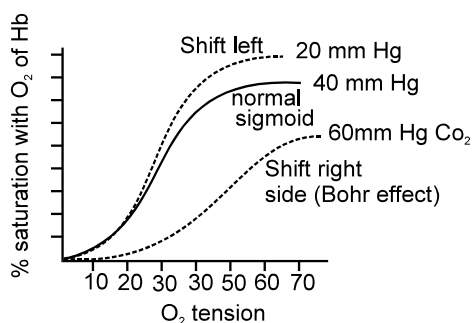
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25% O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

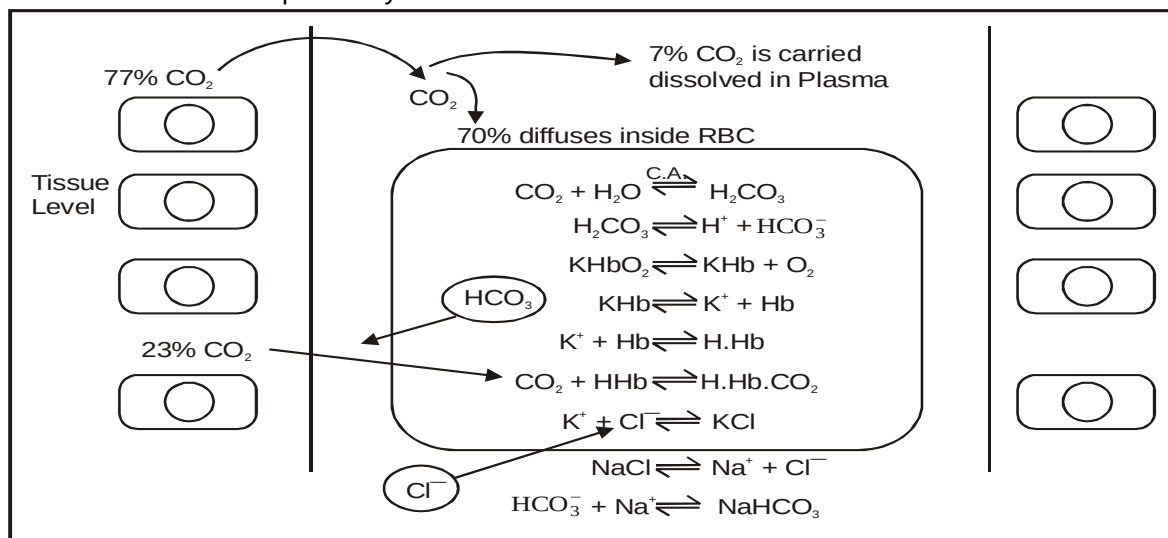
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

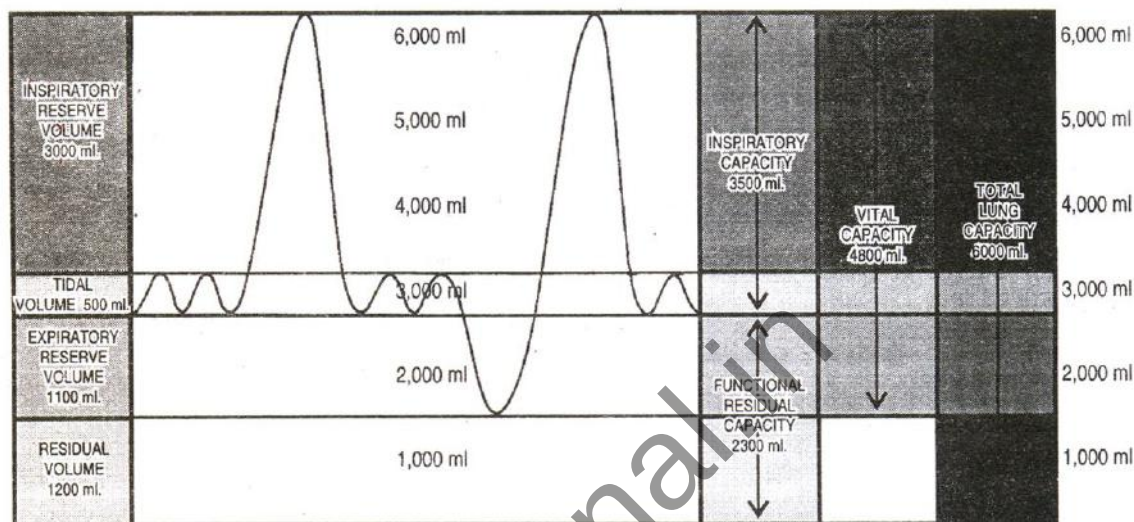
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box
 - (2) Vocal cord
 - (3) Trachea
 - (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue
 - (2) Larynx
 - (3) Trachea
 - (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million
 - (2) 450 million
 - (3) 750 million
 - (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney
 - (2) Envelop the lung
 - (3) Envelop the liver
 - (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi
 - (2) Tracheae
 - (3) Alveoli
 - (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis
 - (2) Tracheal valves
 - (3) Syrinx
 - (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three
 - (2) Four
 - (3) Two
 - (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid
 - (2) Larynx
 - (3) Trachea
 - (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries
 - (2) Alveoli
 - (3) Turbinates
 - (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

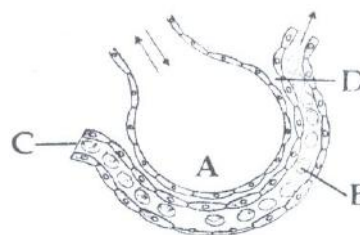
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

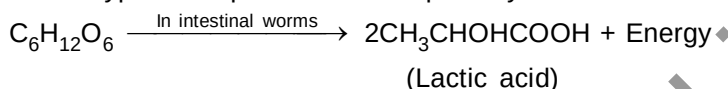
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

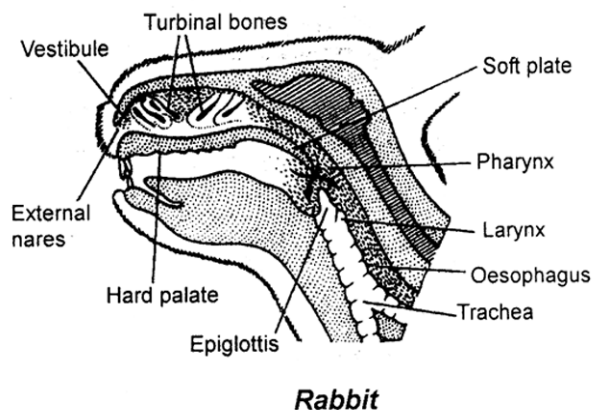
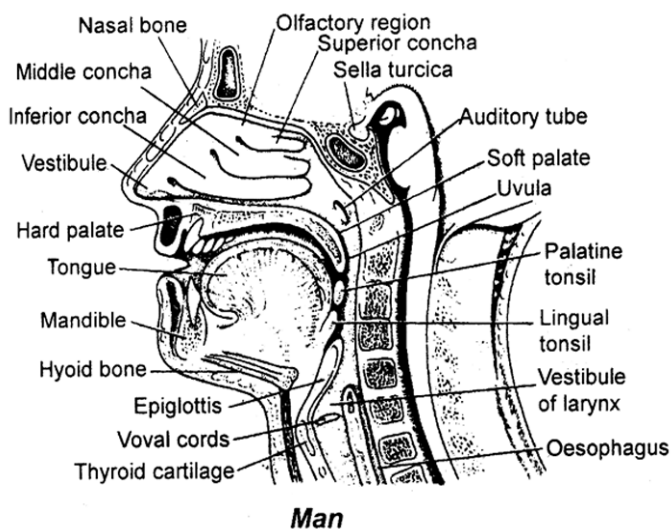
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

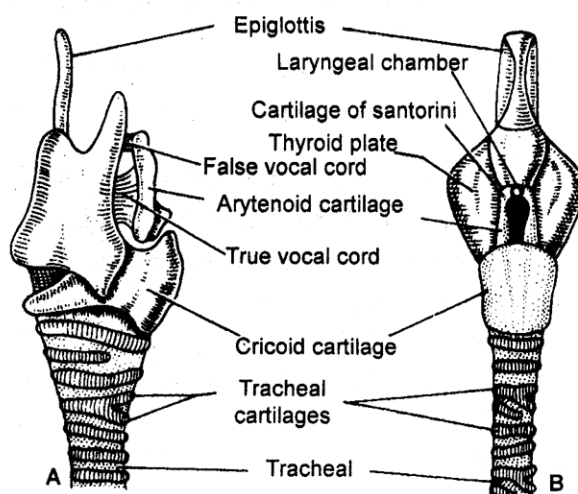
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

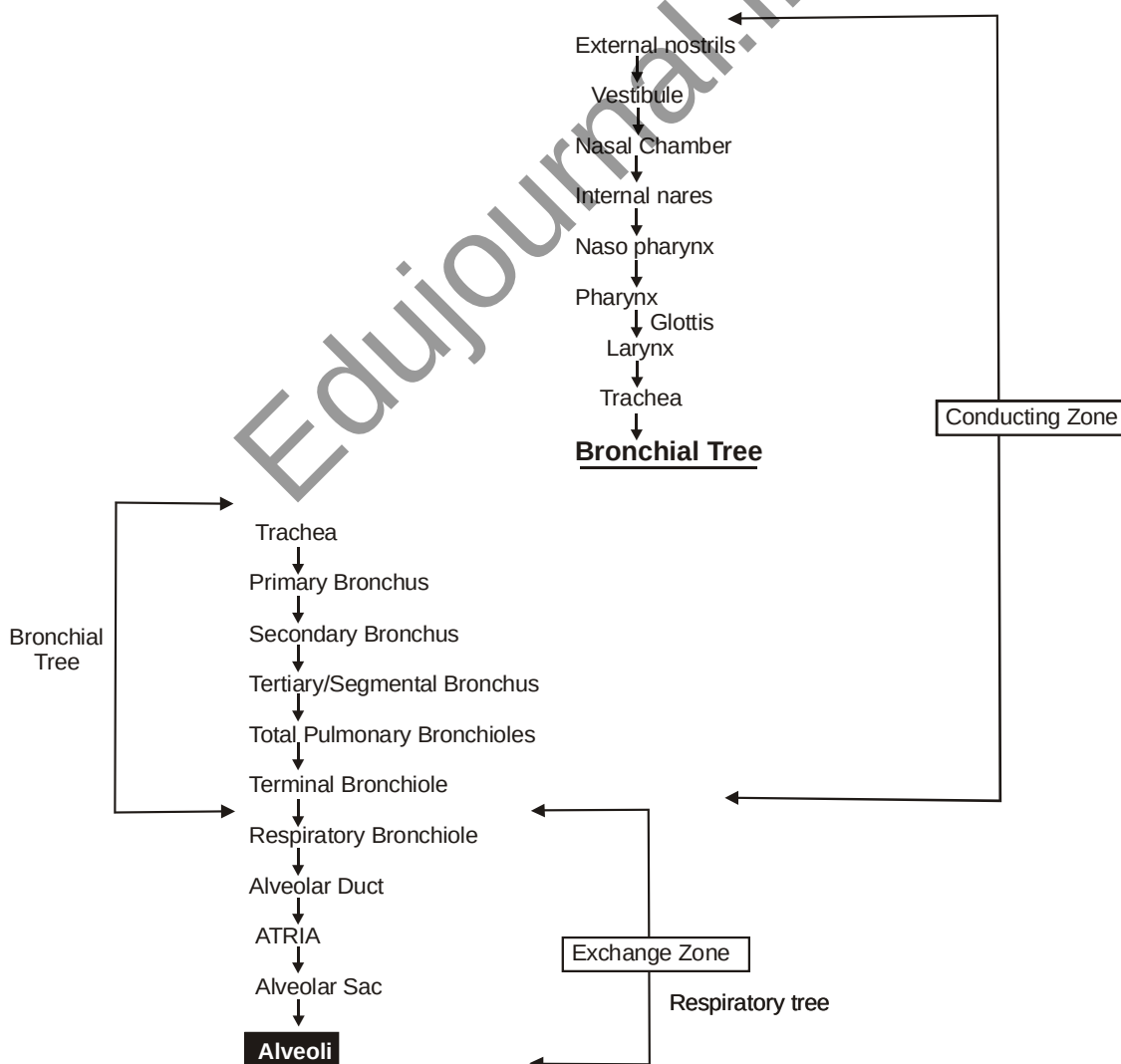
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

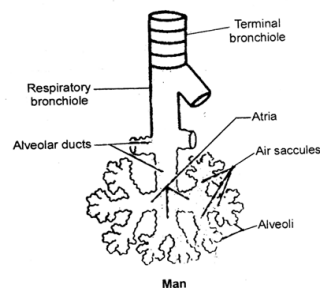
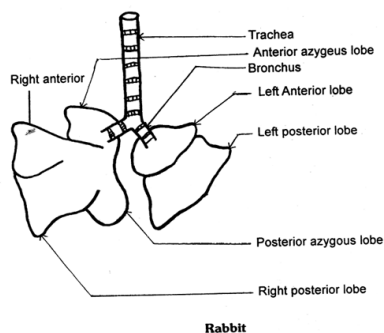
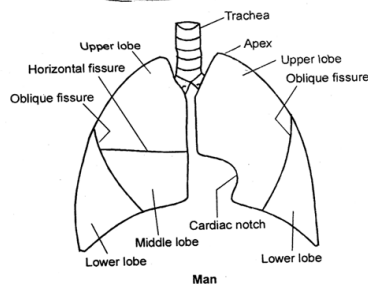
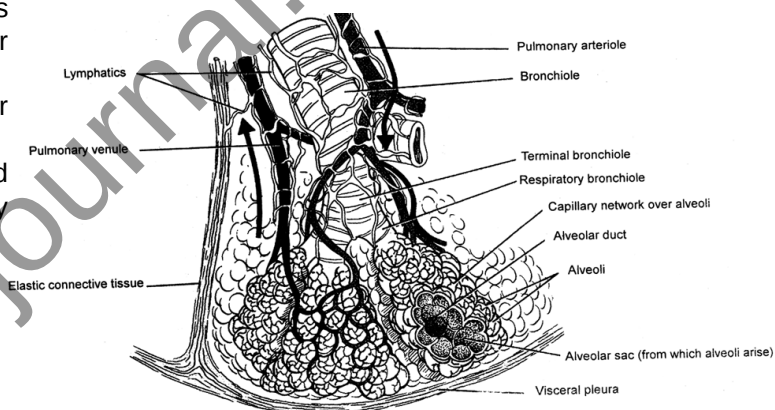
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

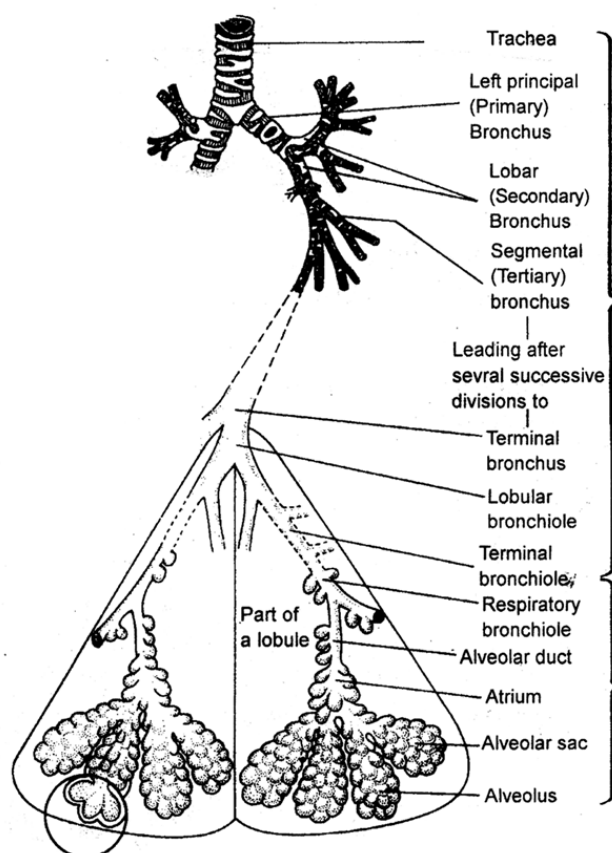
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

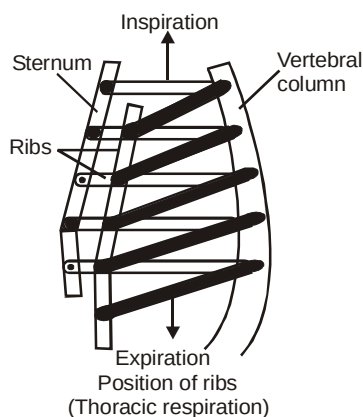
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

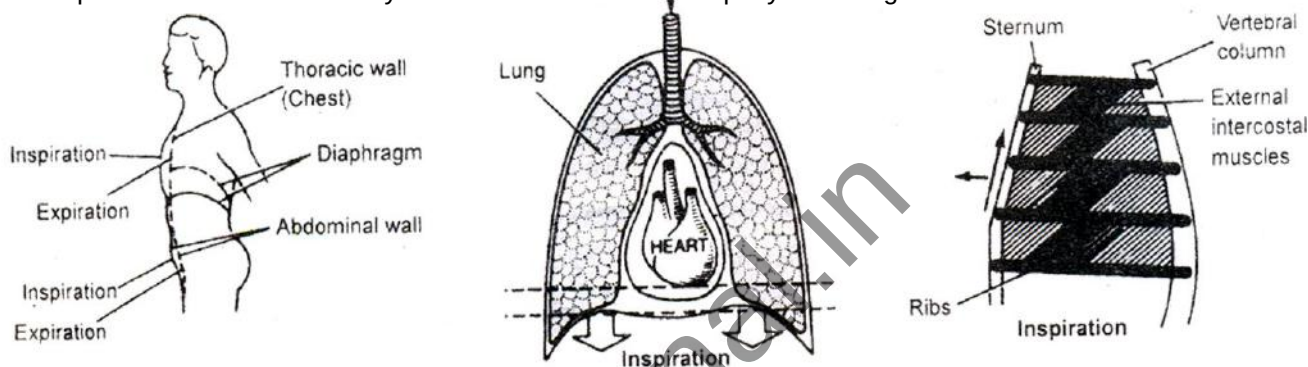
Inspiration

Expiration



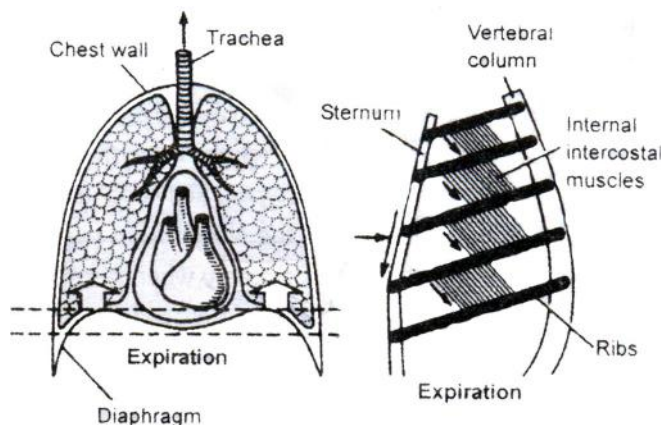
INSPIRATION ::

- (i) It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- (ii) During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- (iii) Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- (iv) Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- (i) It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- (ii) It is passive process
- (iii) During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- (iv) Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- (v) Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strenuous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been identified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group. During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

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Hering breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The Hering Breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Hering Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

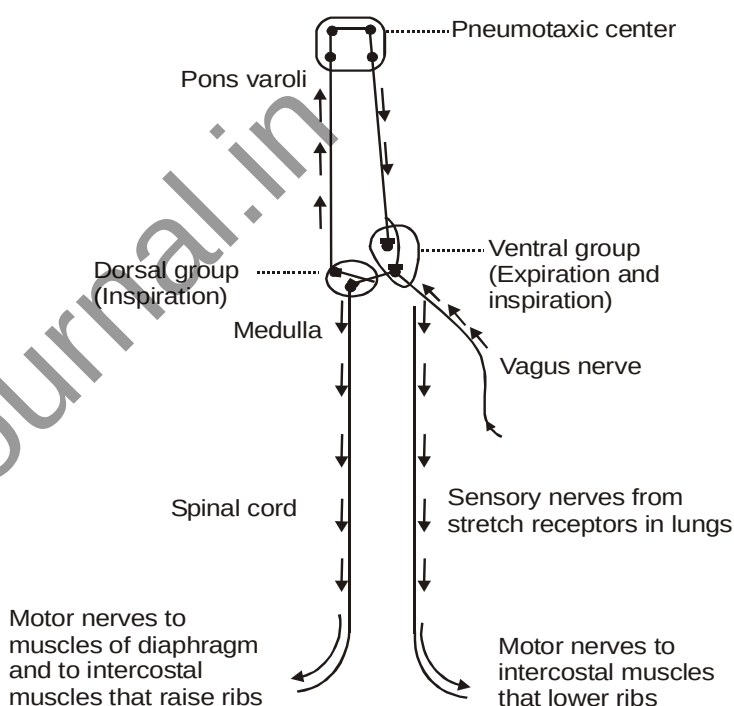


Diagram showing nervous control of breathing

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CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

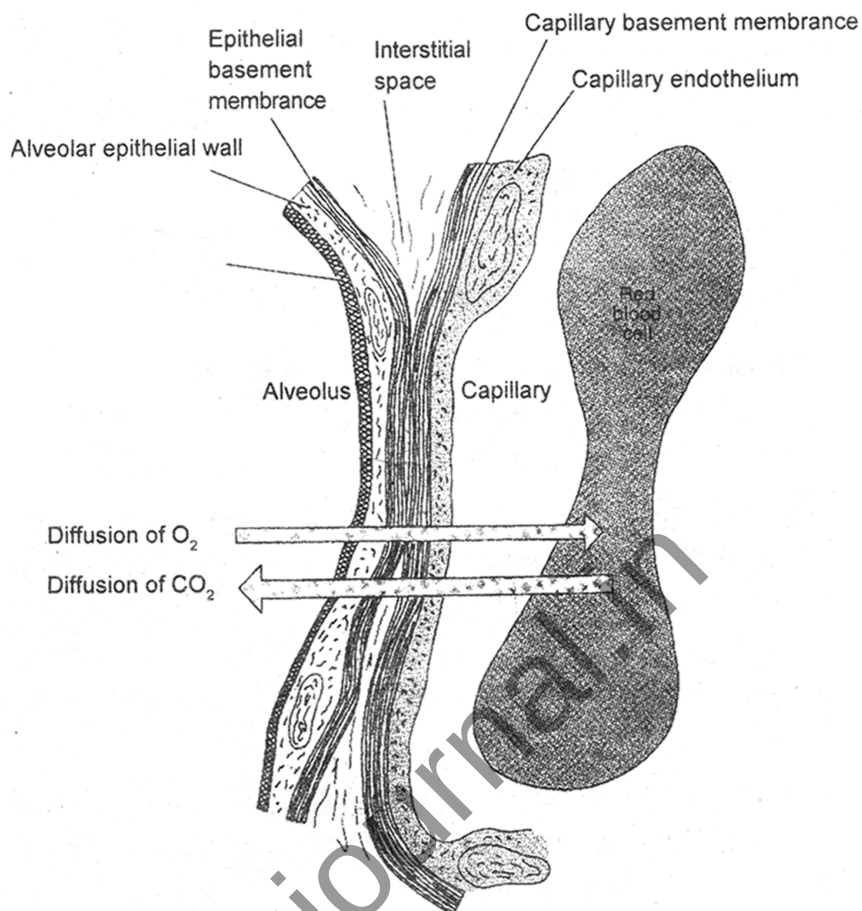
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

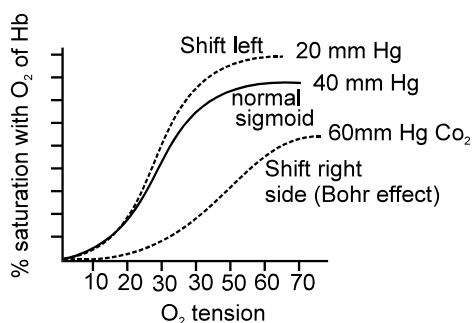
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25% O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

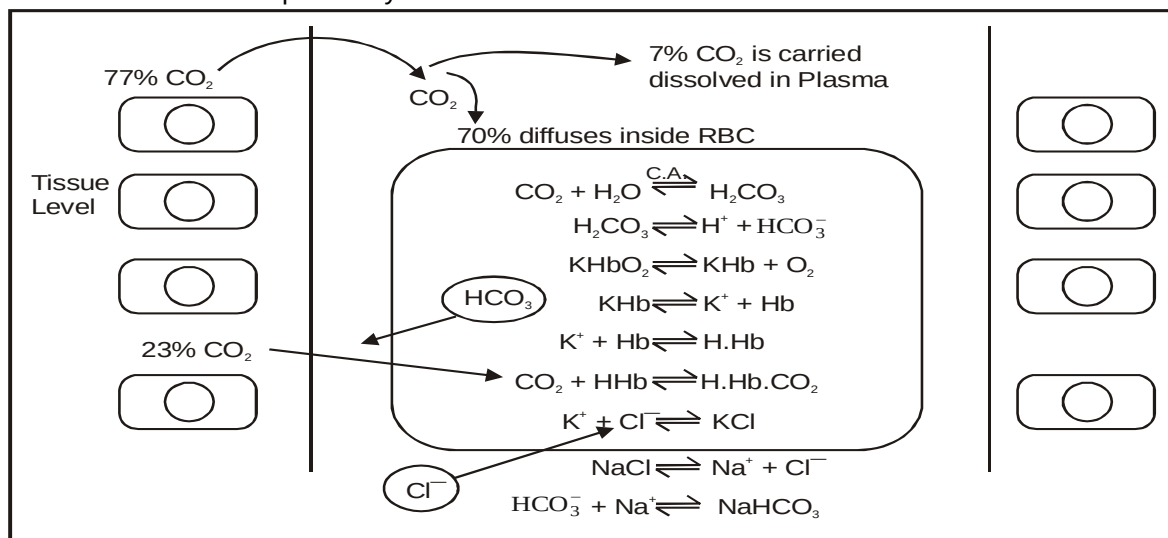
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

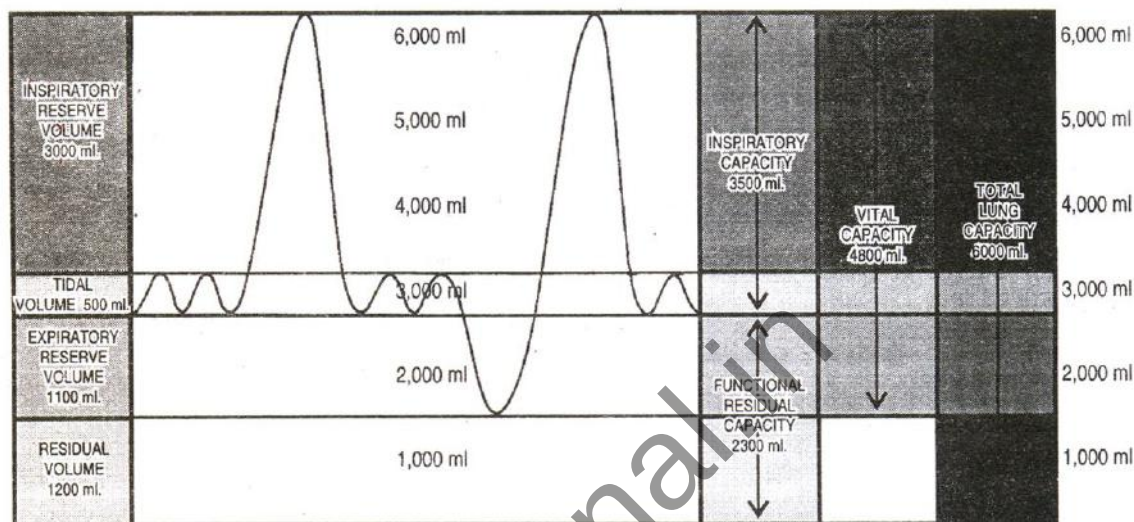
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humidified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO₂ in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO₂ (pCO₂) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO₂ concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO₂
 - (2) High pCO₂
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P₅₀ of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O₂

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box (2) Vocal cord
 - (3) Trachea (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue (2) Larynx
 - (3) Trachea (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million (2) 450 million
 - (3) 750 million (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney (2) Envelop the lung
 - (3) Envelop the liver (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi (2) Tracheae
 - (3) Alveoli (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis (2) Tracheal valves
 - (3) Syrinx (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three (2) Four
 - (3) Two (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid (2) Larynx
 - (3) Trachea (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries (2) Alveoli
 - (3) Turbinates (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

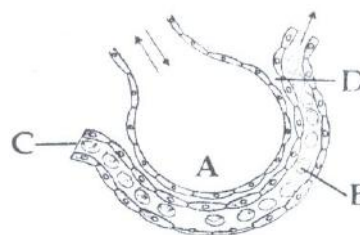
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1
Ques.	20	21	22	23	24														
Ans.	2	2	3	2	4														

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- (i) In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- (ii) Exchange of gases occurs on the principle of diffusion, through moist body surface.
- (iii) Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- (i) In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- (ii) Indirect respiration is found in complex and higher form of organism.
- (iii) Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- (i) Respiration which occurs in presence of oxygen is called aerobic respiration.
- (ii) The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- (iii) Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- (i) External respiration is also called **breathing** or **ventilation**.

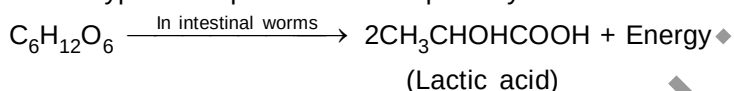
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

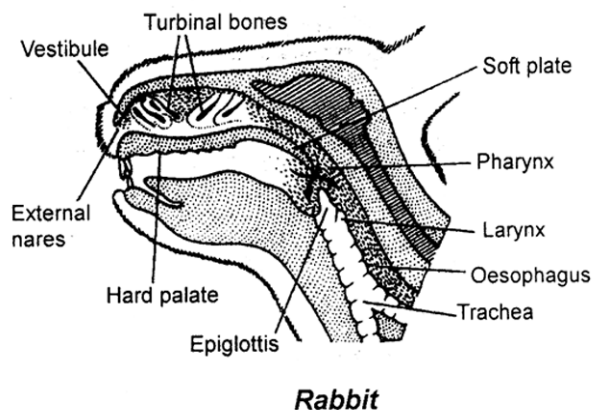
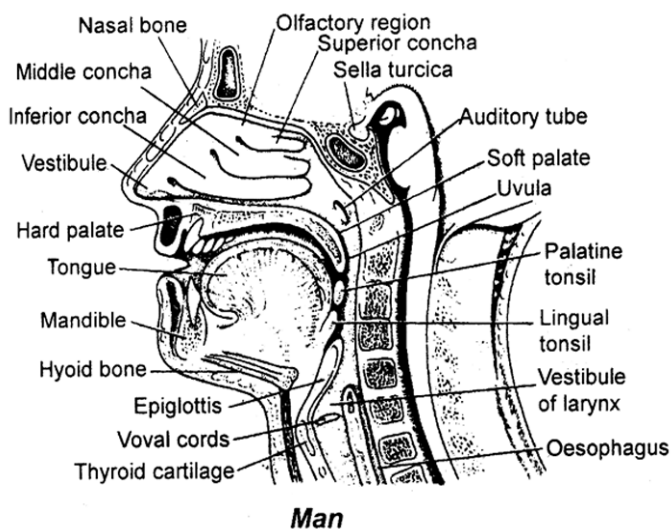
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

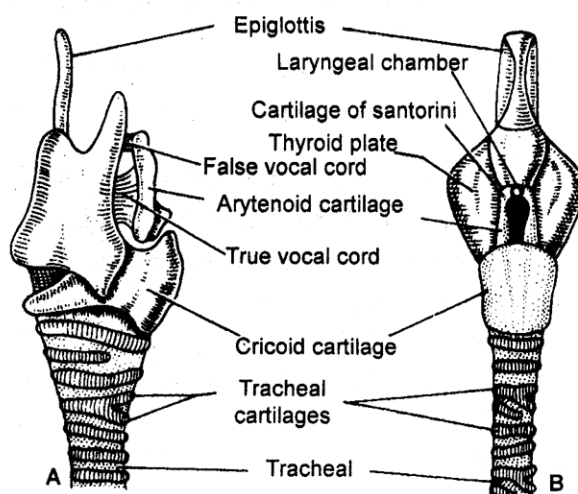
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

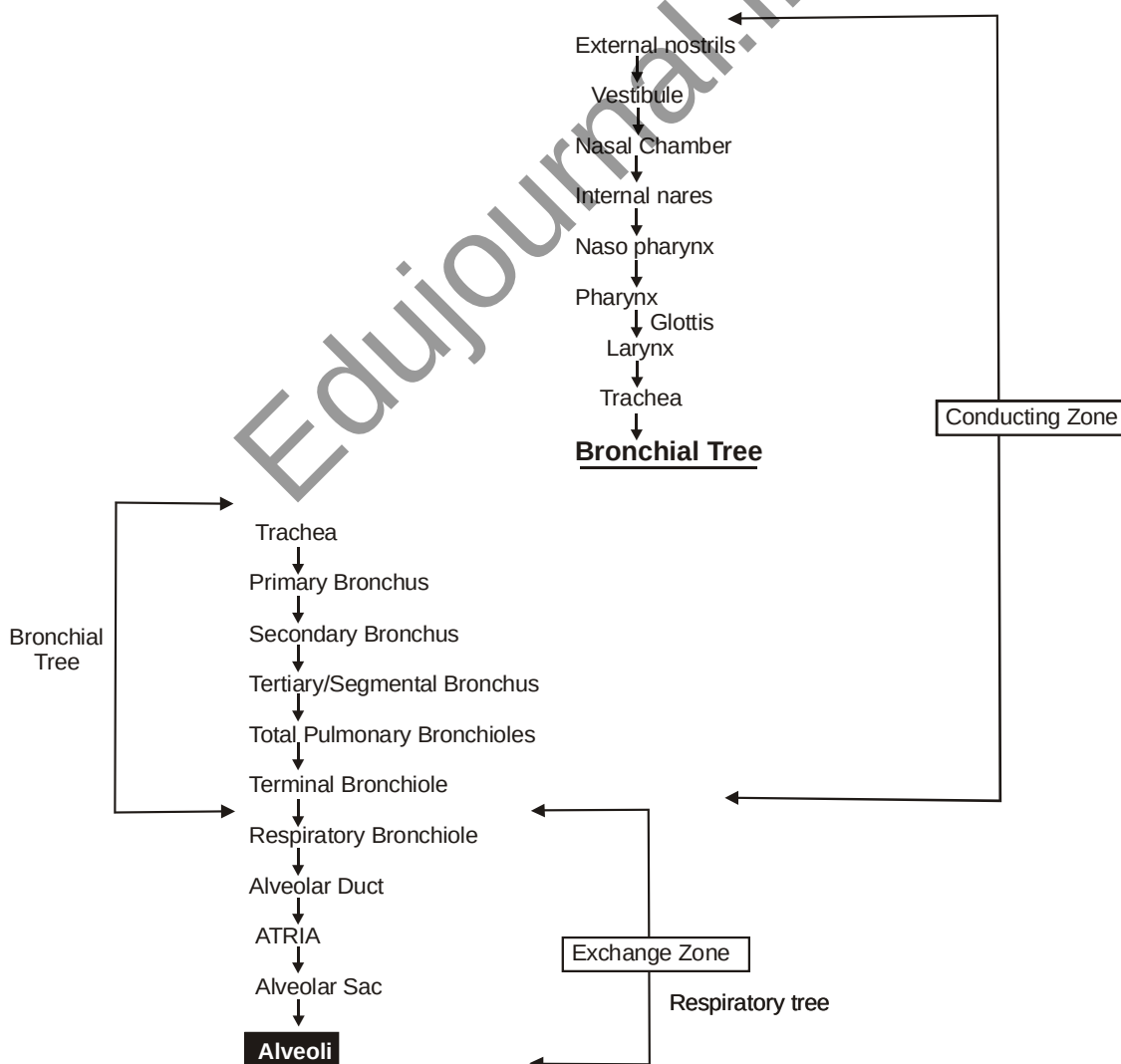
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

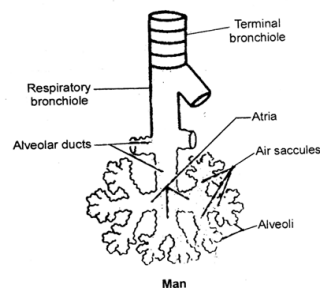
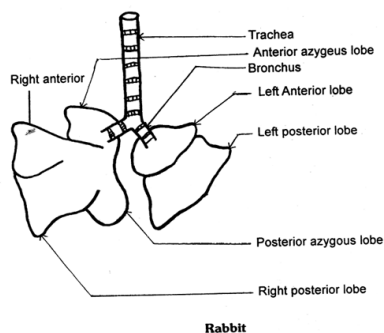
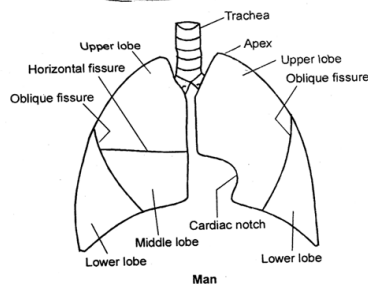
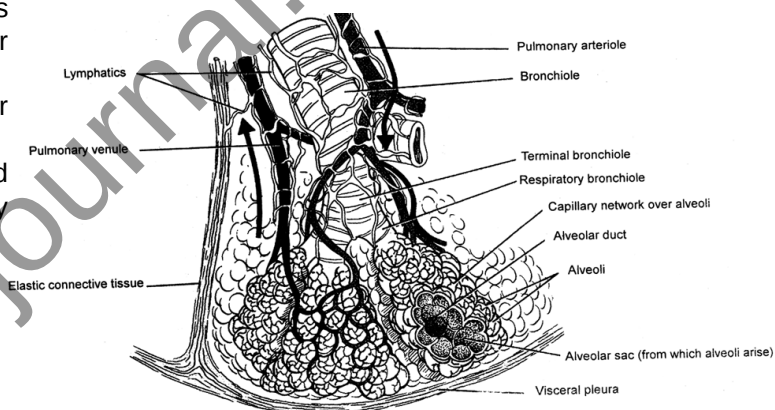
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveoli ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

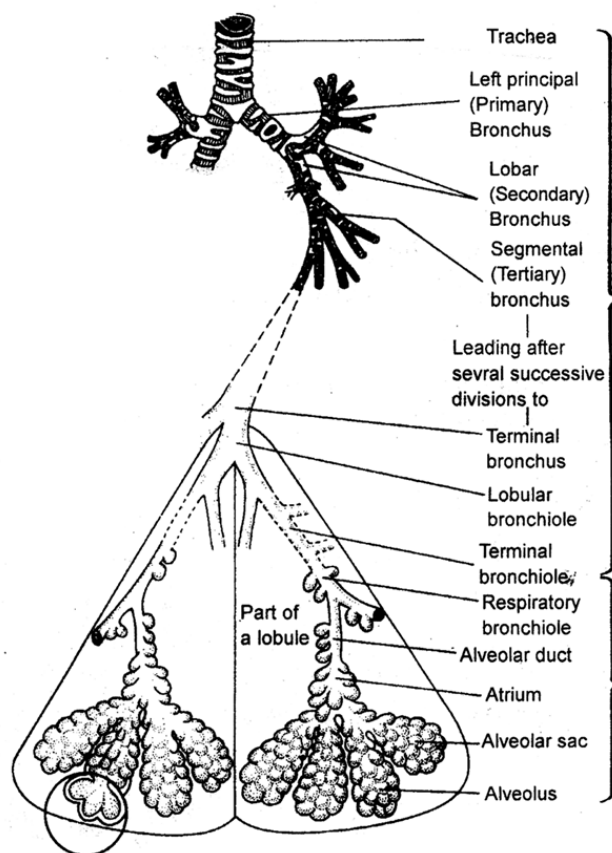
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

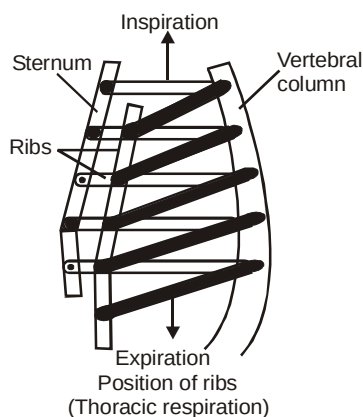
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

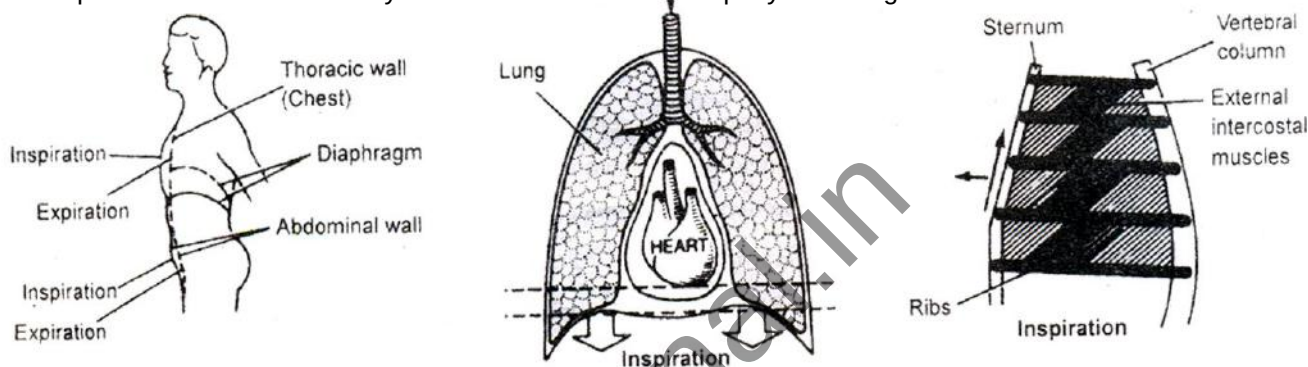
Inspiration

Expiration



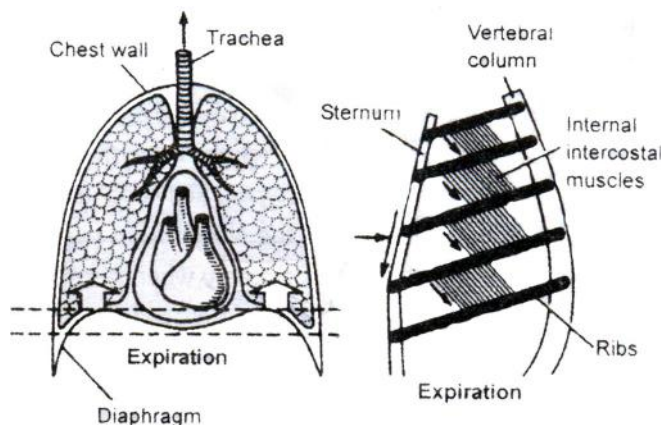
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

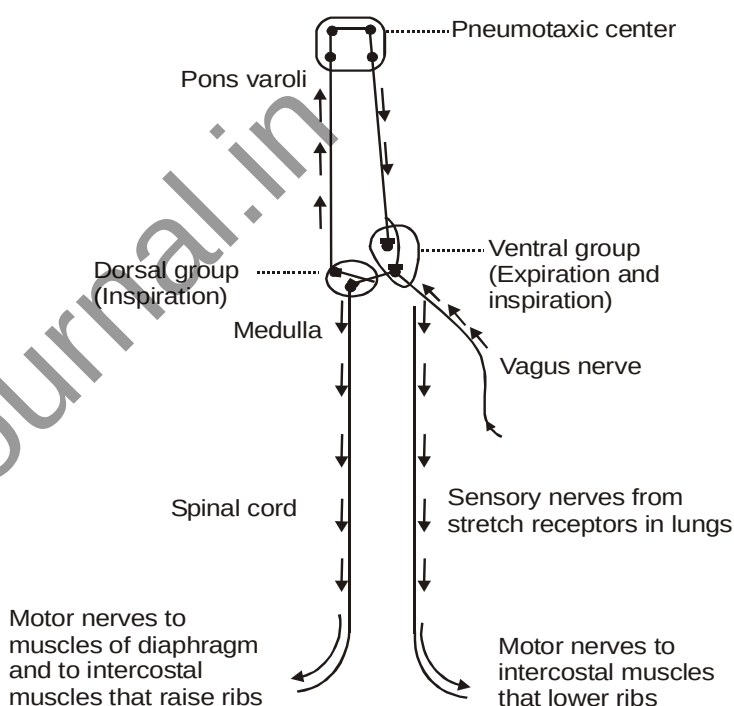


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

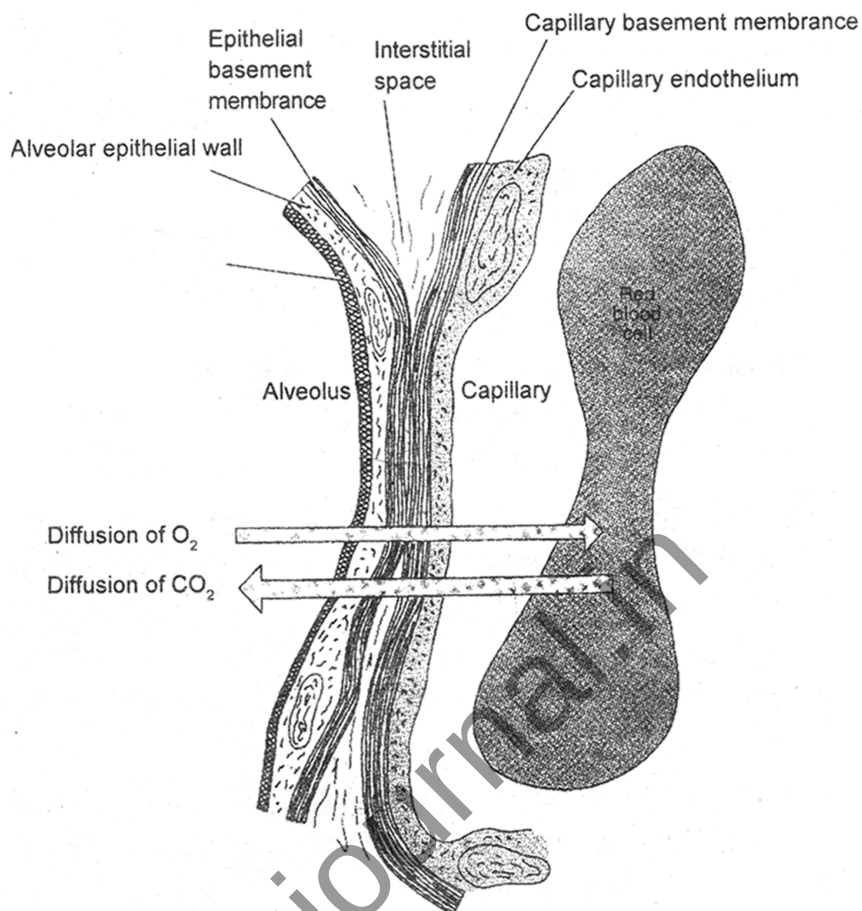
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

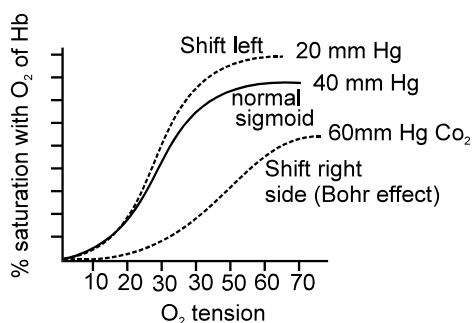
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

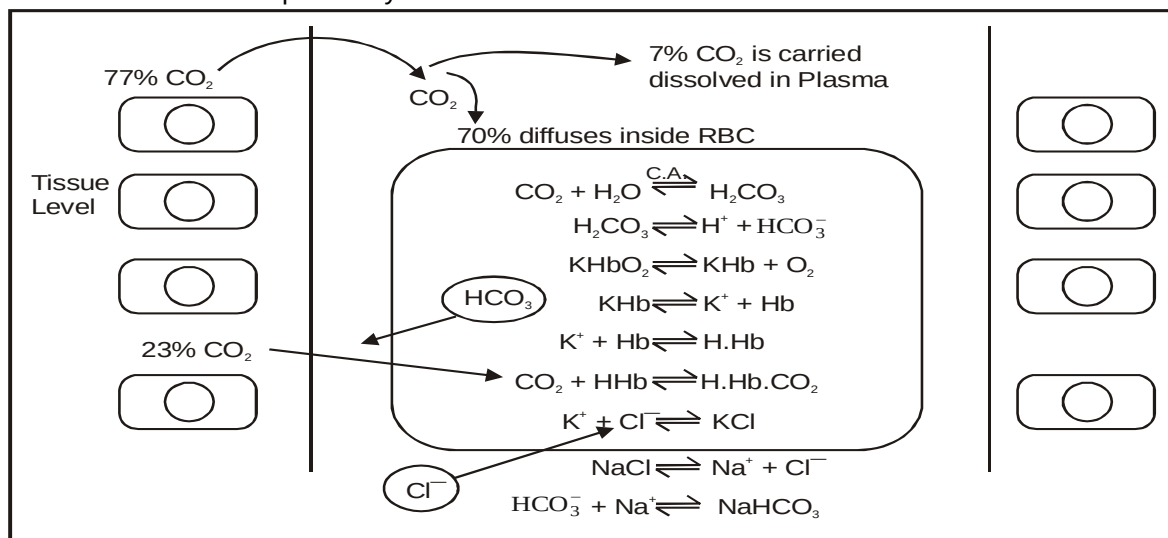
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

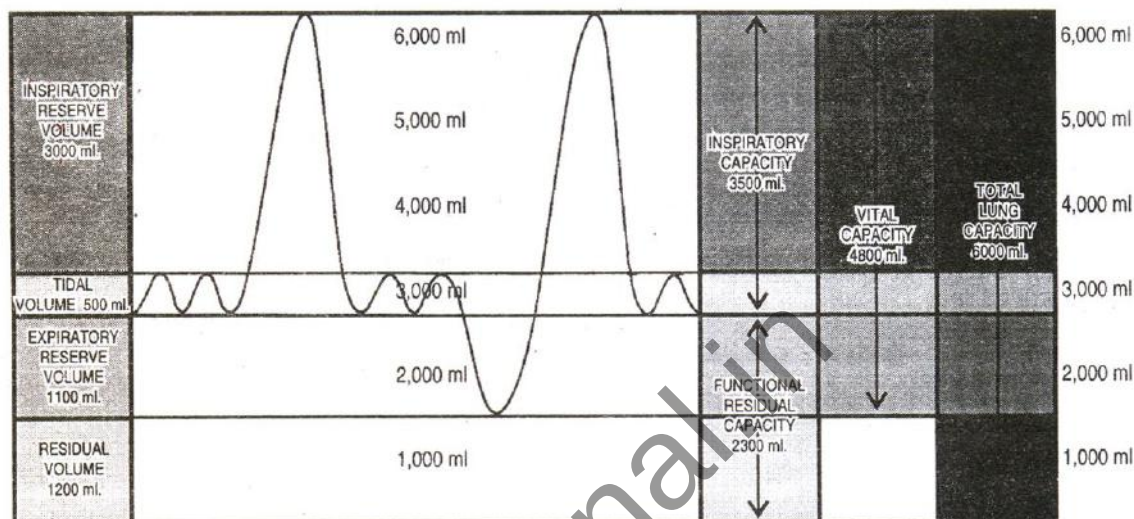
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO₂ is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO₂ with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned}
 IC &= TV + IRV \\
 &= 500 + 3000 \\
 &= 3500 \text{ mL.}
 \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$E.R.V. + R.V. = FRC$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- Dead volume
 - Dead space
 - Both A and B
 - Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- Omosis
 - Diffusion
 - Active transport
 - None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- Spherometer
 - Spirometer
 - Sphygmomanometer
 - Barometer
- Q.28** Air moves into the lungs when-
- Atmospheric pressure is less than pressure within the lungs
 - Atmospheric pressure is equal to the pressure within the lungs
 - Atmospheric pressure is greater than pressure within the lungs
 - None of these
- Q.29** Normal rate of breathing in man is-
- 20-30 times per minute
 - 12-14 times per minute
 - 5-10 times per minute
 - 40-50 times per minute
- Q.30** Choose the correct equation-
- Total capacity of lungs = Vital capacity + Residual air
 - Vital capacity of lungs = Tidal air + Complemental air
 - Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- Hypothalamus
 - Medulla oblongata
 - Cerebellum
 - Thalamus
- Q.32** Which of the following statements is correct-
- Inspiration is an active process
 - Expiration is an active process
 - Inspiration is a passive process
 - Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- Oxygen in trachea
 - Concentration of O_2
 - Diaphragm expansion
 - Concentration of CO_2
- Q.34** The breathing rate in a child is-
- Same as in an adult man
 - Less than in an adult man
 - More than in an adult man
 - None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- Inspiration
 - Normal respiration
 - Aspiration
 - Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- Backward and upward
 - Forward and upward
 - Backward and downward
 - Forward and downward
- Q.37** Tidal air in mammals is-
- Total air that can be drawn into lungs
 - Air that normally goes in and comes out of lungs during breathing
 - Air that is left in the lungs after normal expiration
 - Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
(1) Voice box (2) Vocal cord
(3) Trachea (4) None of these
- Q.119** Sound get converted into speech by-
(1) Tongue (2) Larynx
(3) Trachea (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
(1) 300 million (2) 450 million
(3) 750 million (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
(1) Envelop the kidney (2) Envelop the lung
(3) Envelop the liver (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
(1) Bronchi (2) Tracheae
(3) Alveoli (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
(1) Epiglottis (2) Tracheal valves
(3) Syrinx (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
(1) Three (2) Four
(3) Two (4) Five
- Q.125** Adams' apple corresponds to -
(1) Thyroid (2) Larynx
(3) Trachea (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
(1) Thickness
(2) Moistness
(3) Large respiratory surface
(4) Rich blood supply
- Q.127** The process of respiration is concerned with-
(1) Intake of O_2
(2) Liberation of O_2
(3) Liberation of energy
(4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
(1) Tributaries (2) Alveoli
(3) Turbinates (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
(1) Ribs
(2) Abdominal muscles
(3) Larynx
(4) Diaphragm
- Q.130** Inspiration would not occur if the -
(1) Diaphragm is lowered
(2) Diaphragm is elevated
(3) Ribs are elevated
(4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
(1) Internal respiration
(2) Cellular respiration
(3) External respiration
(4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
(1) Mainly in the erythrocytes
(2) Mainly in the blood plasma
(3) Mainly in the interstitial fluid
(4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
(1) Terminal tracheoles
(2) Tracheoles
(3) Alveoli
(4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

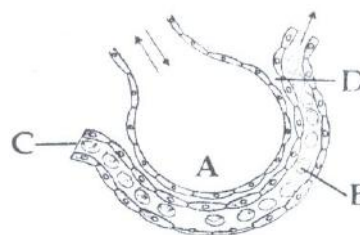
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

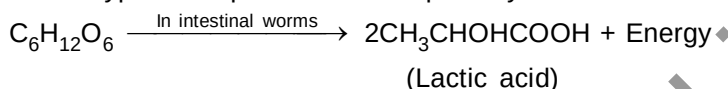
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

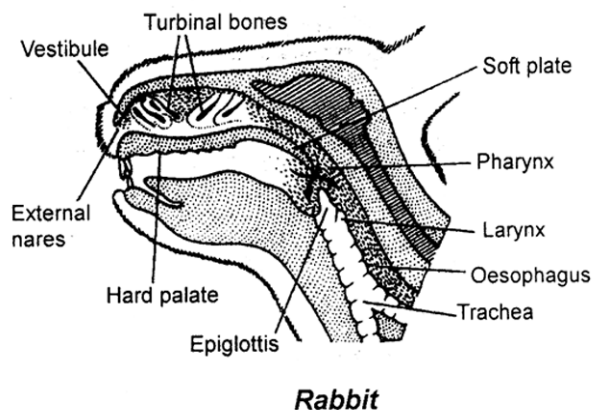
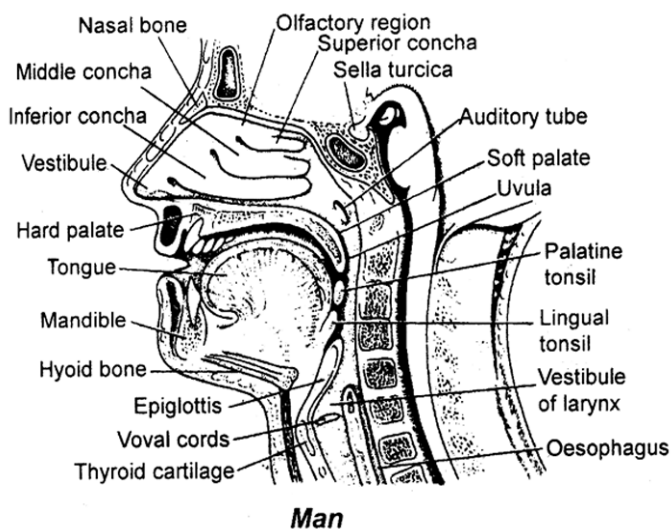
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

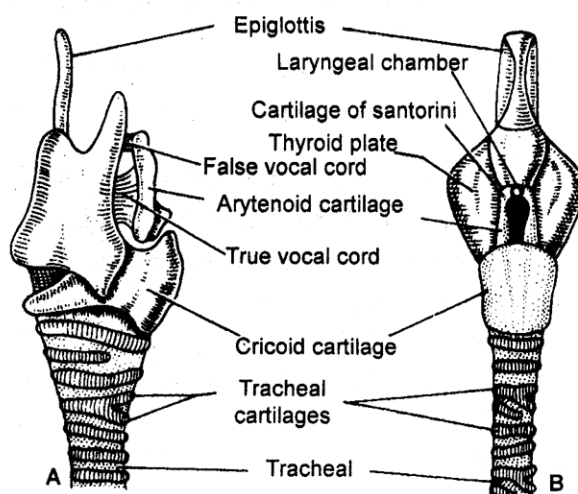
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

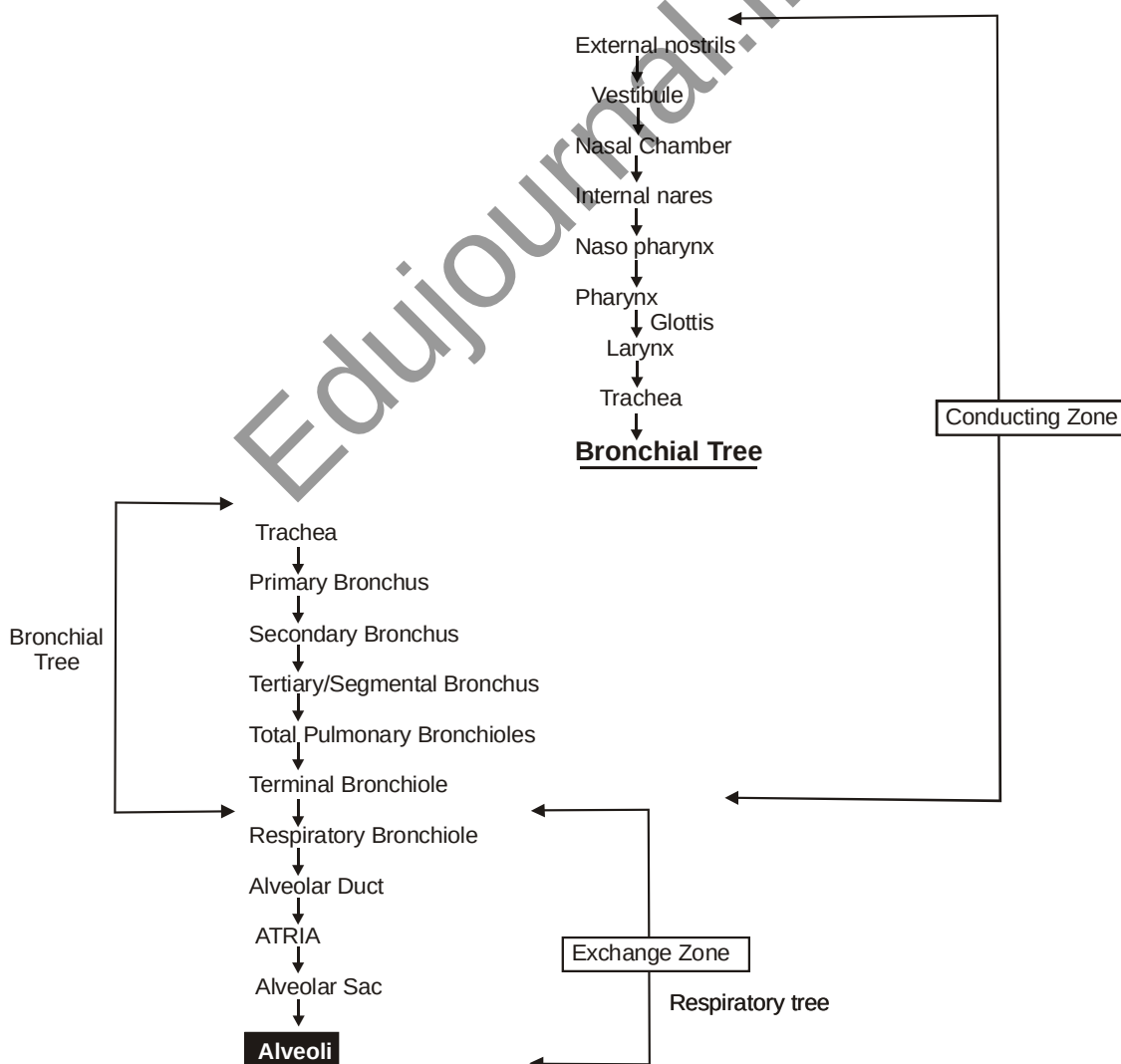
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

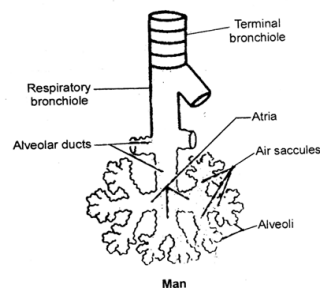
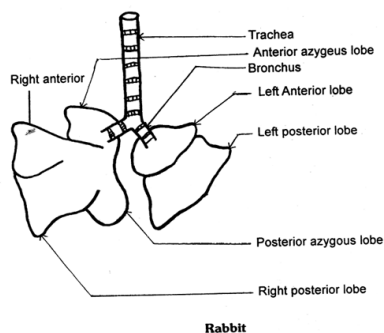
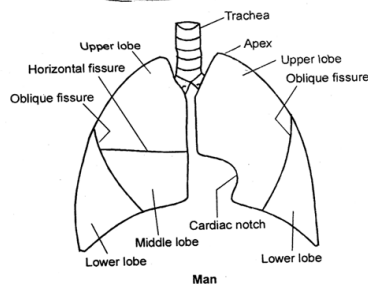
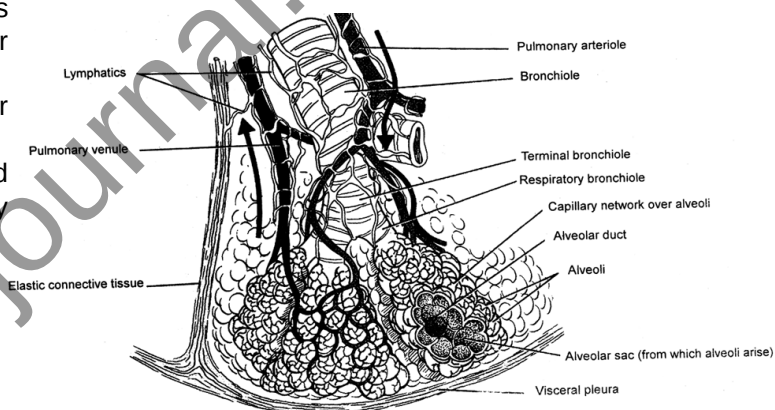
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several airsacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

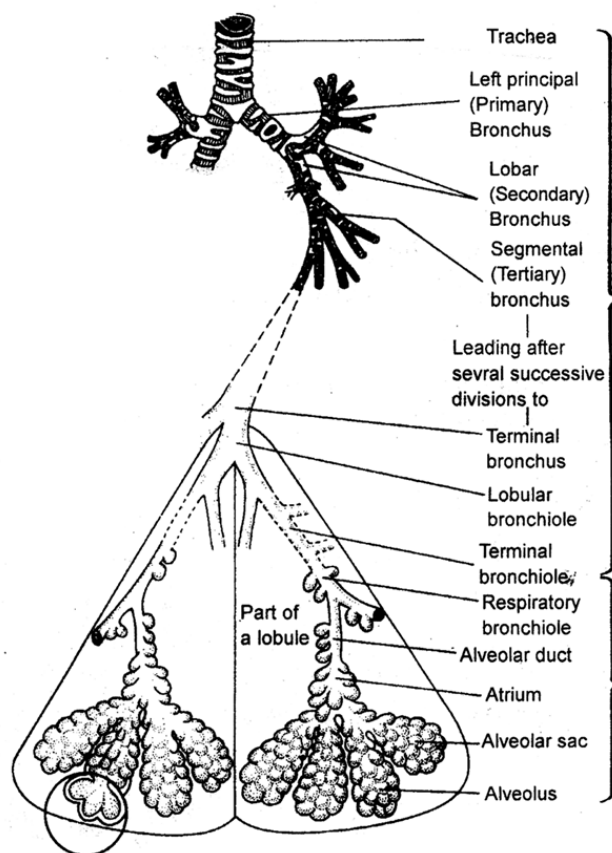
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

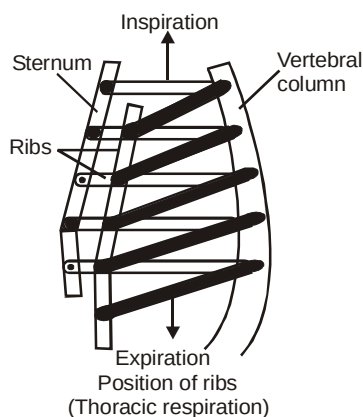
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

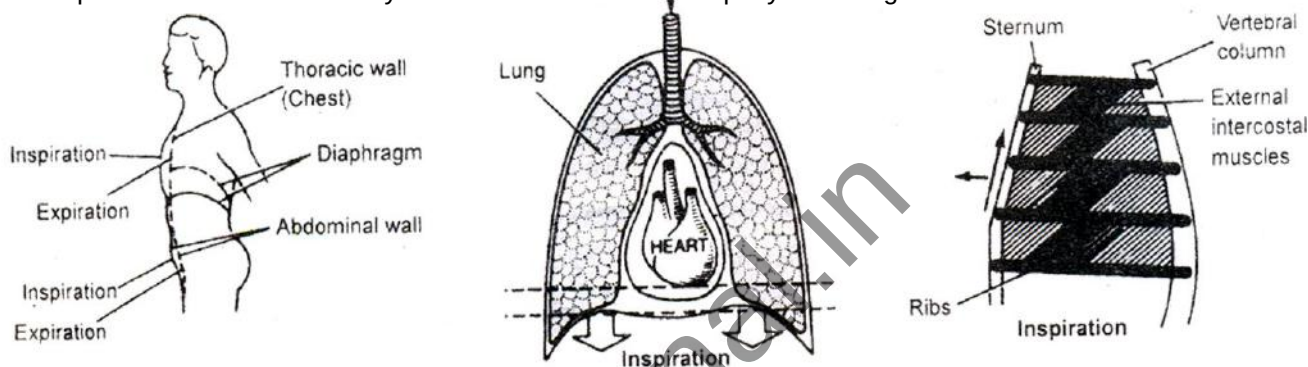
Inspiration

Expiration



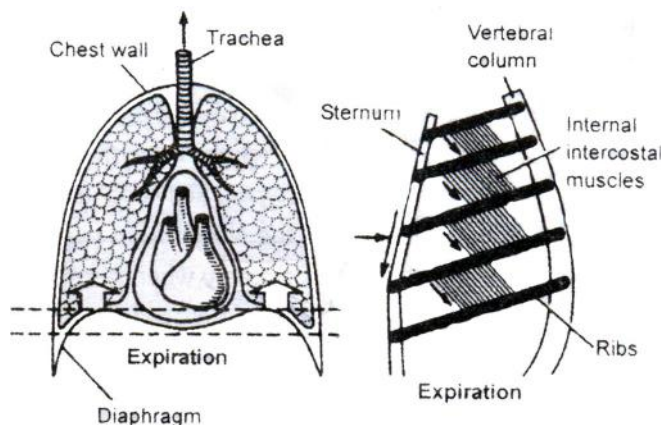
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

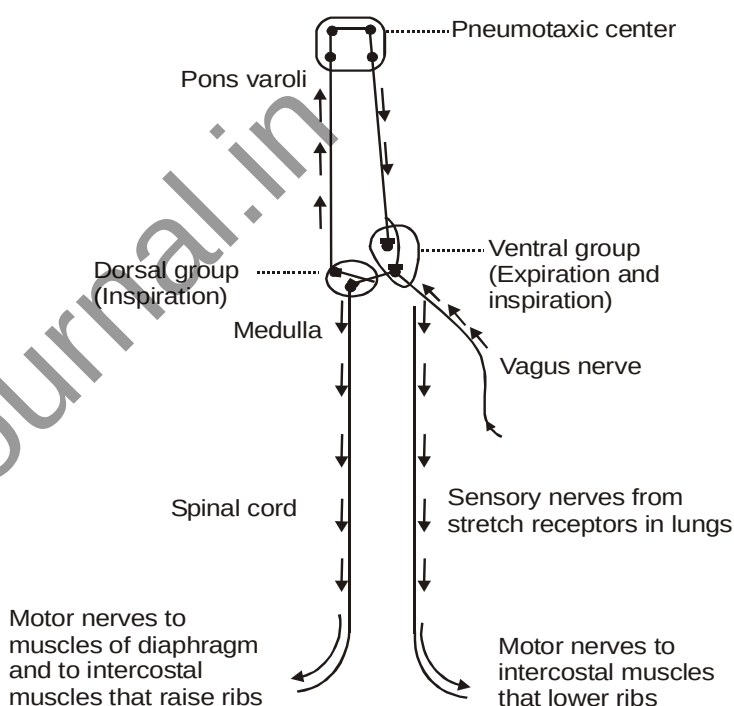


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

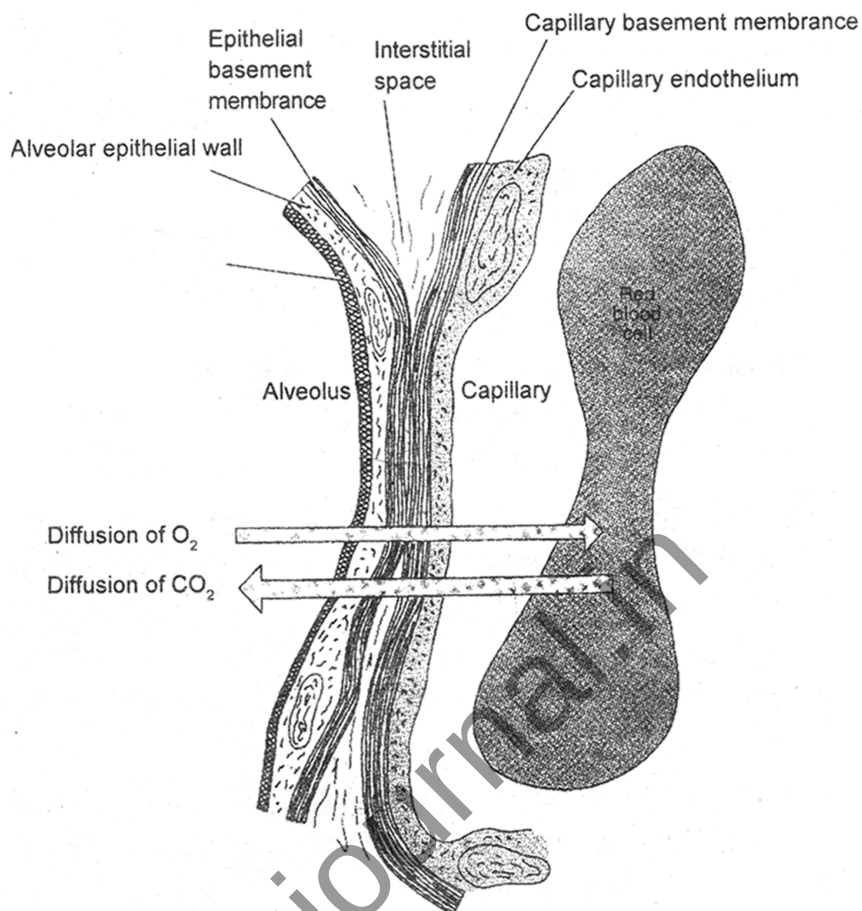
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

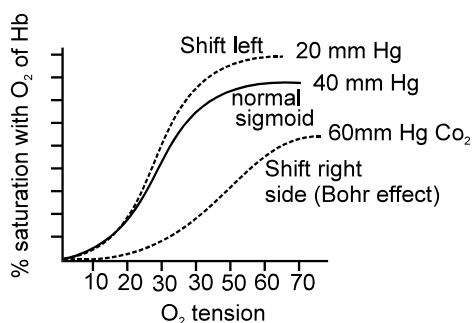
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

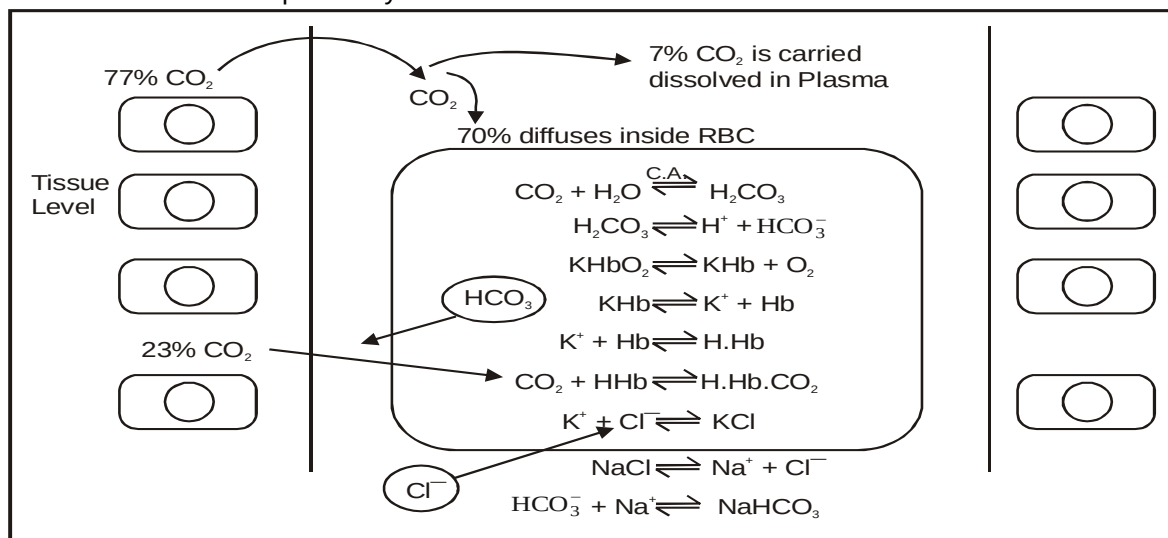
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

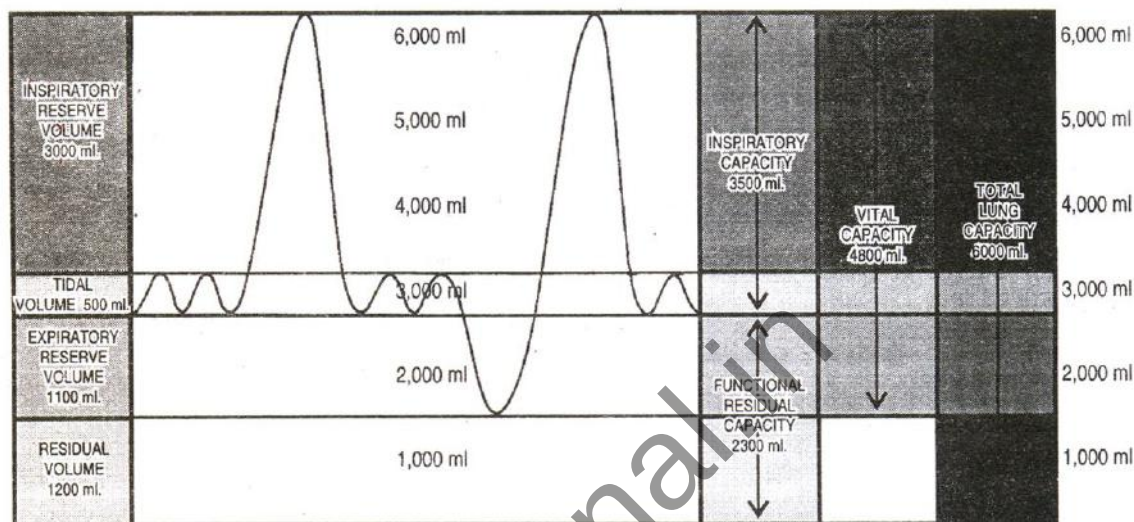
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned}
 \text{IC} &= \text{TV} + \text{IRV} \\
 &= 500 + 3000 \\
 &= 3500 \text{ mL}
 \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humidified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
(1) Voice box (2) Vocal cord
(3) Trachea (4) None of these
- Q.119** Sound get converted into speech by-
(1) Tongue (2) Larynx
(3) Trachea (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
(1) 300 million (2) 450 million
(3) 750 million (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
(1) Envelop the kidney (2) Envelop the lung
(3) Envelop the liver (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
(1) Bronchi (2) Tracheae
(3) Alveoli (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
(1) Epiglottis (2) Tracheal valves
(3) Syrinx (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
(1) Three (2) Four
(3) Two (4) Five
- Q.125** Adams' apple corresponds to -
(1) Thyroid (2) Larynx
(3) Trachea (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
(1) Thickness
(2) Moistness
(3) Large respiratory surface
(4) Rich blood supply
- Q.127** The process of respiration is concerned with-
(1) Intake of O_2
(2) Liberation of O_2
(3) Liberation of energy
(4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
(1) Tributaries (2) Alveoli
(3) Turbinates (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
(1) Ribs
(2) Abdominal muscles
(3) Larynx
(4) Diaphragm
- Q.130** Inspiration would not occur if the -
(1) Diaphragm is lowered
(2) Diaphragm is elevated
(3) Ribs are elevated
(4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
(1) Internal respiration
(2) Cellular respiration
(3) External respiration
(4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
(1) Mainly in the erythrocytes
(2) Mainly in the blood plasma
(3) Mainly in the interstitial fluid
(4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
(1) Terminal tracheoles
(2) Tracheoles
(3) Alveoli
(4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc (2) About 2000 cc
 - (3) About 4500 cc (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease (2) Stop
 - (3) Increase (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia (2) Anoxia
 - (3) Suffocation (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis (2) Asphyxia
 - (3) Hypoxia (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis (2) Hypoxia
 - (3) Pneumonia (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia (2) Bronchitis
 - (3) Asthma (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration (2) breathing
 - (3) inspiration (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2 (2) fall in level of CO_2
 - (3) rise of O_2 level (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Hering breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rings in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Laterally incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

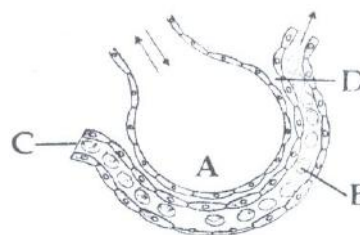
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:

- (1) Tongue
- (2) Epiglottis
- (3) Diaphragm
- (4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

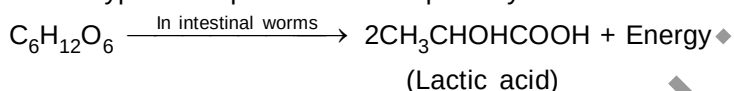
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

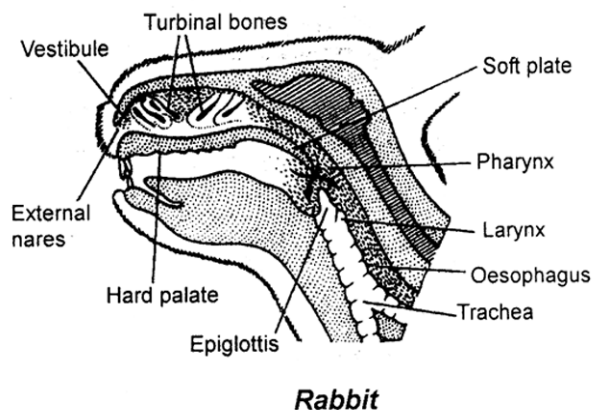
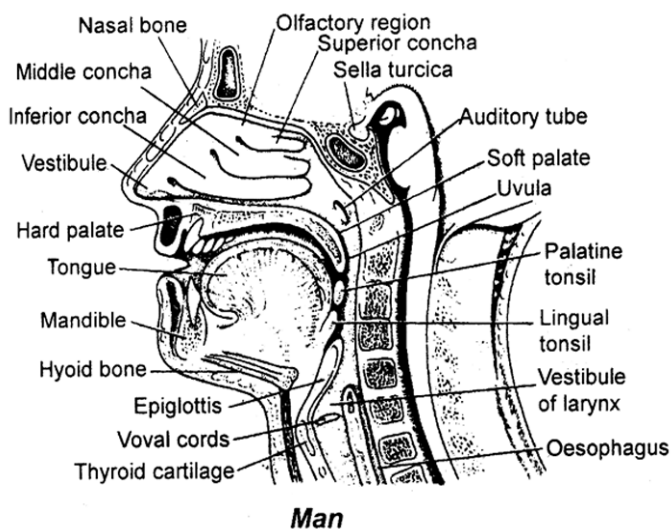
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

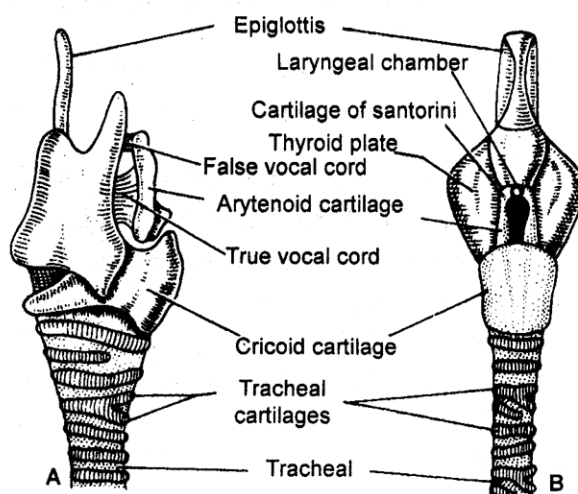
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

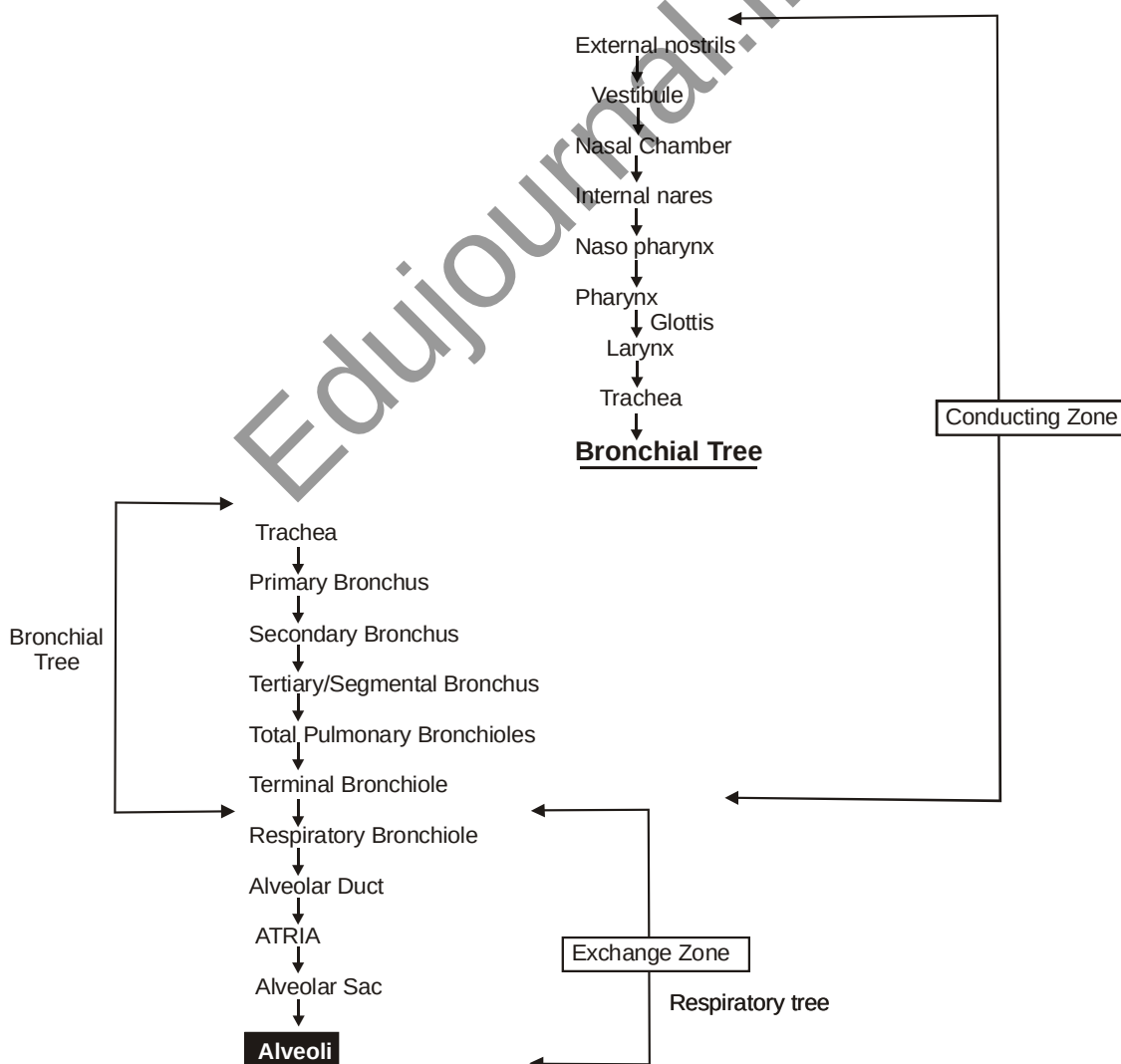
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enter into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

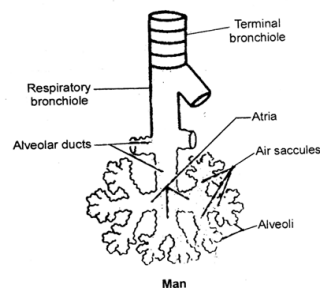
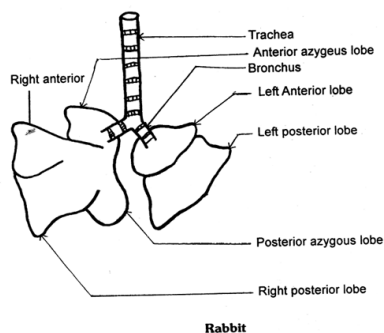
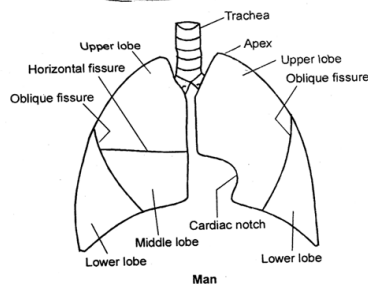
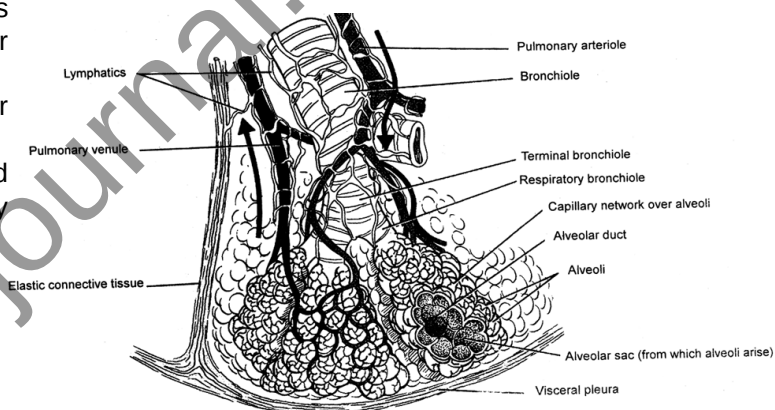
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveoli ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

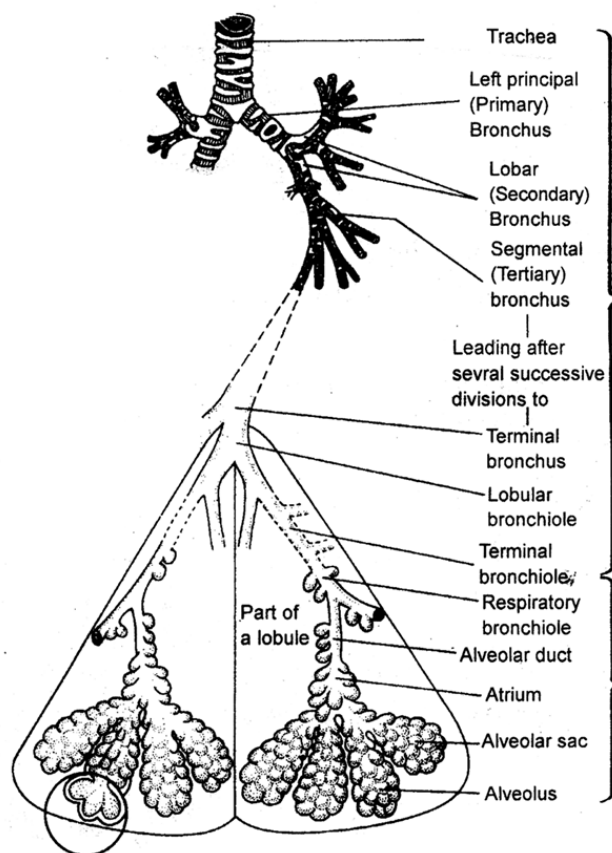
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

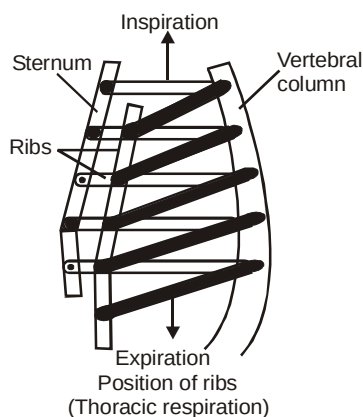
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

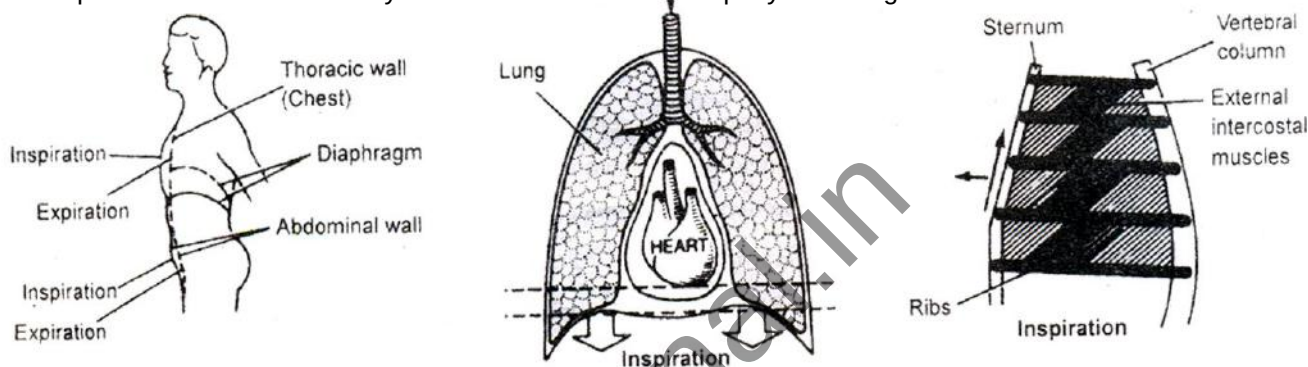
Inspiration

Expiration



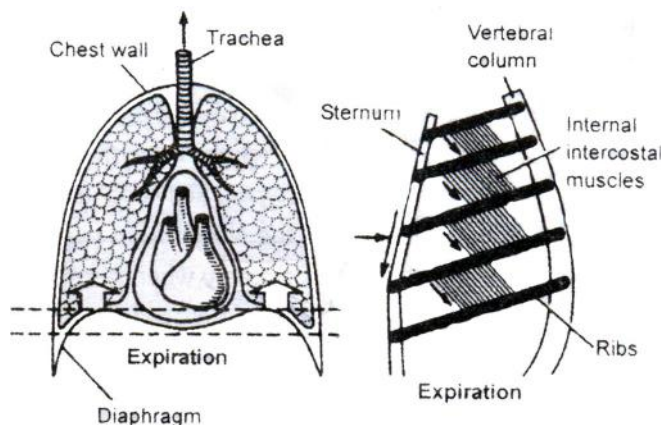
INSPIRATION ::

- (i) It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- (ii) During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- (iii) Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- (iv) Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- (i) It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- (ii) It is passive process
- (iii) During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- (iv) Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- (v) Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

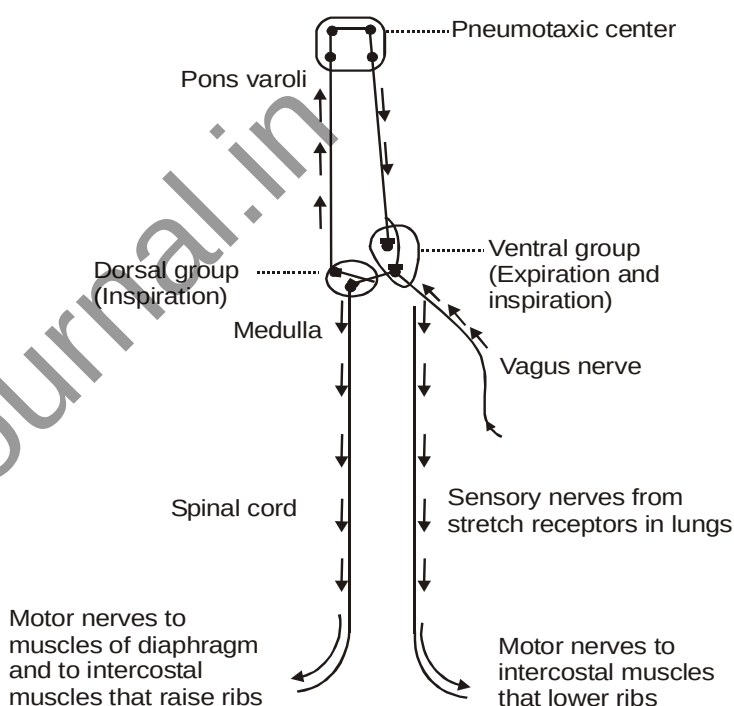


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

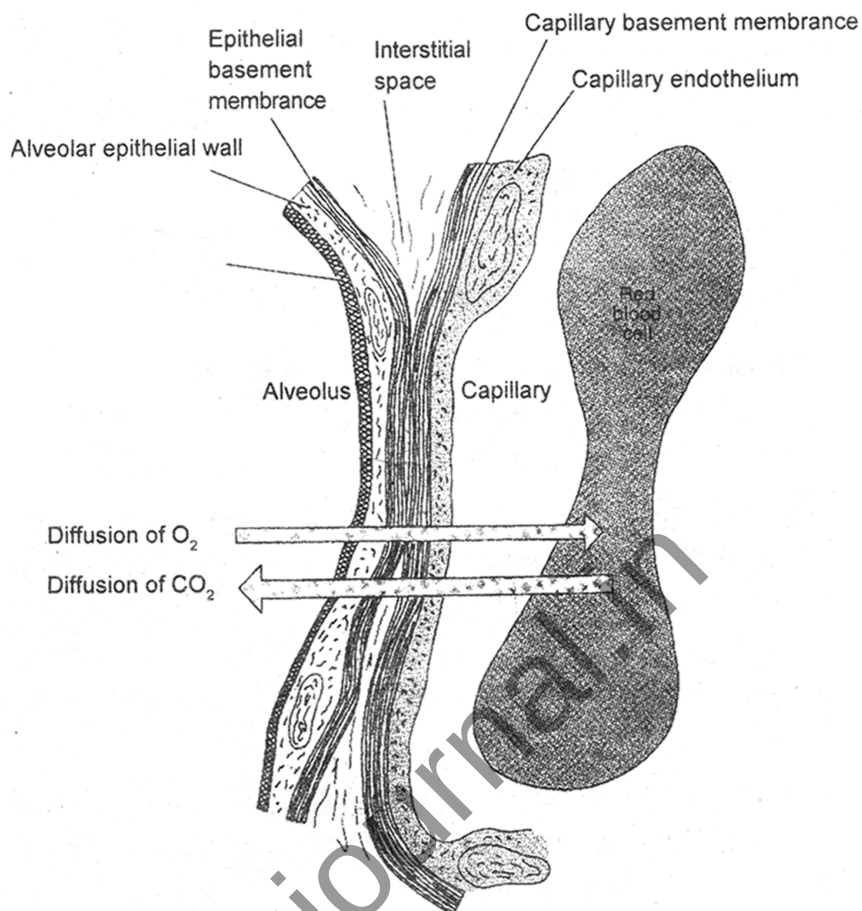
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

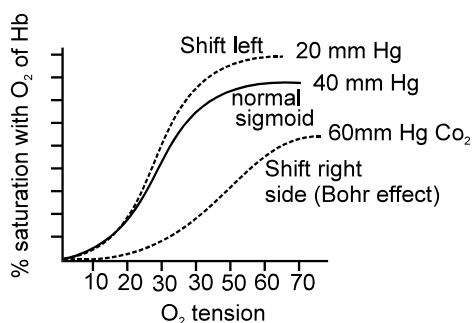
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25% O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

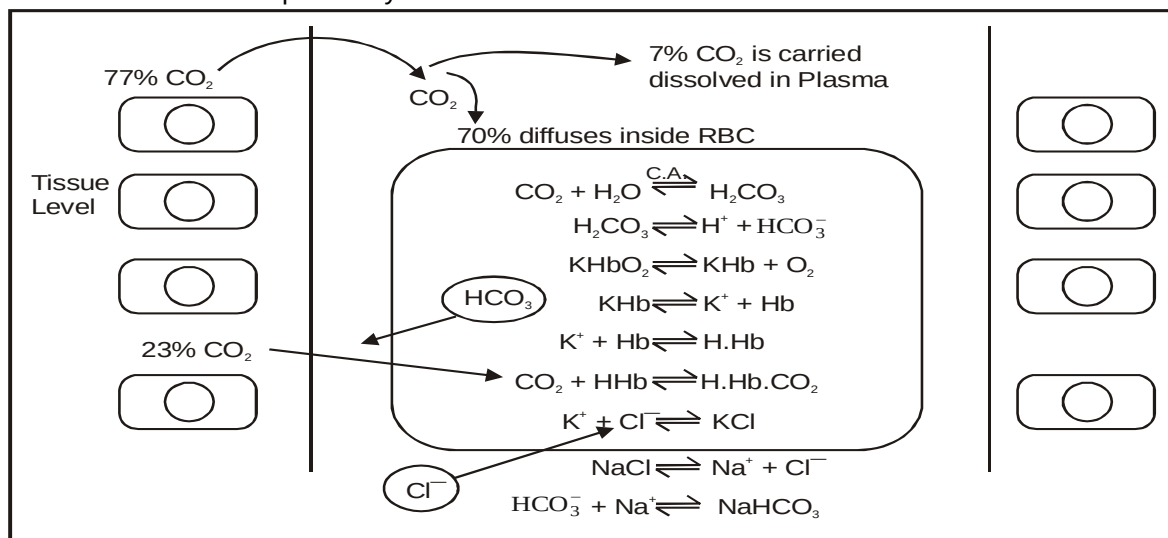
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

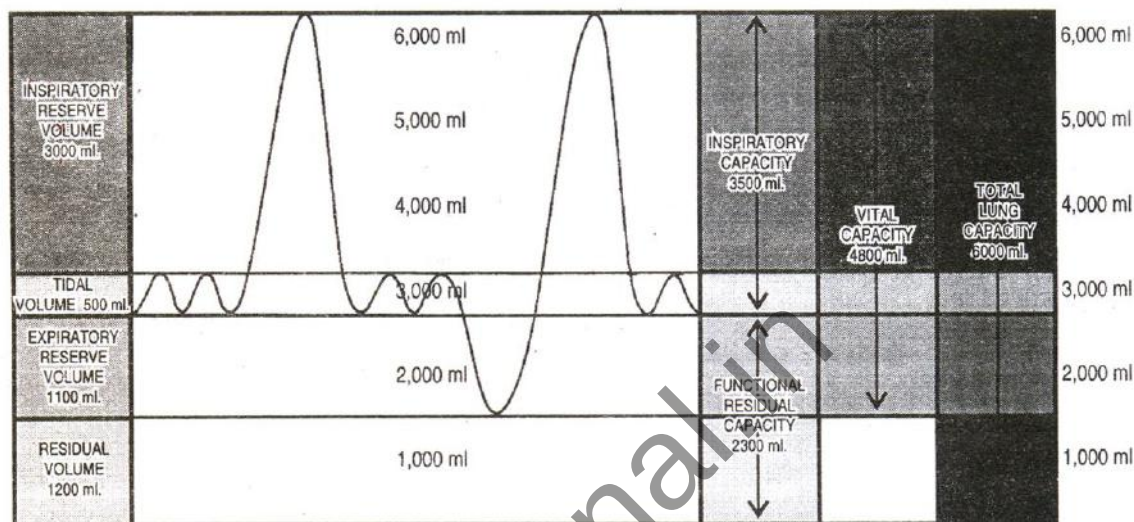
- About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box
 - (2) Vocal cord
 - (3) Trachea
 - (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue
 - (2) Larynx
 - (3) Trachea
 - (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million
 - (2) 450 million
 - (3) 750 million
 - (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney
 - (2) Envelop the lung
 - (3) Envelop the liver
 - (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi
 - (2) Tracheae
 - (3) Alveoli
 - (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis
 - (2) Tracheal valves
 - (3) Syrinx
 - (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three
 - (2) Four
 - (3) Two
 - (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid
 - (2) Larynx
 - (3) Trachea
 - (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries
 - (2) Alveoli
 - (3) Turbinates
 - (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

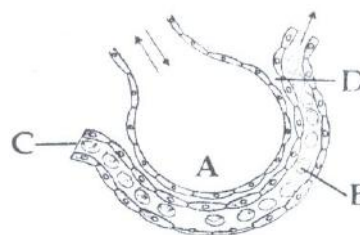
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing , by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventillation**.

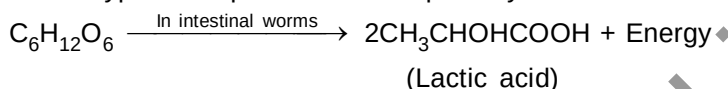
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

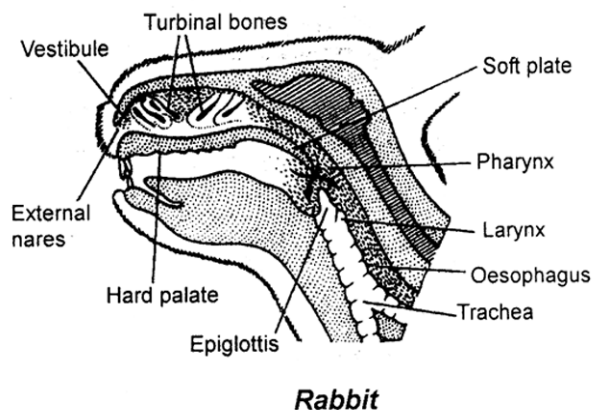
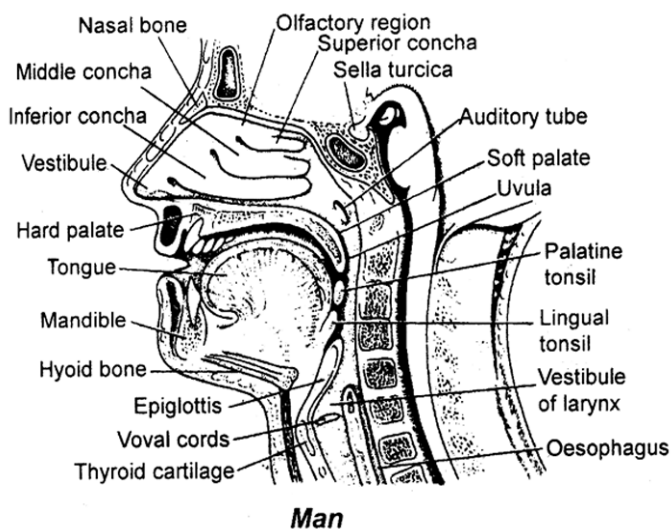
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

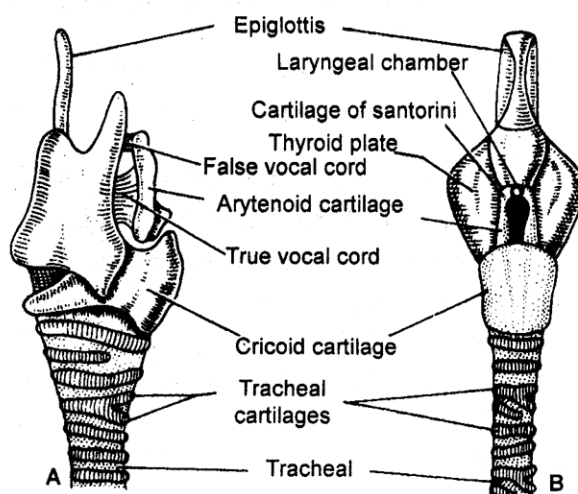
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

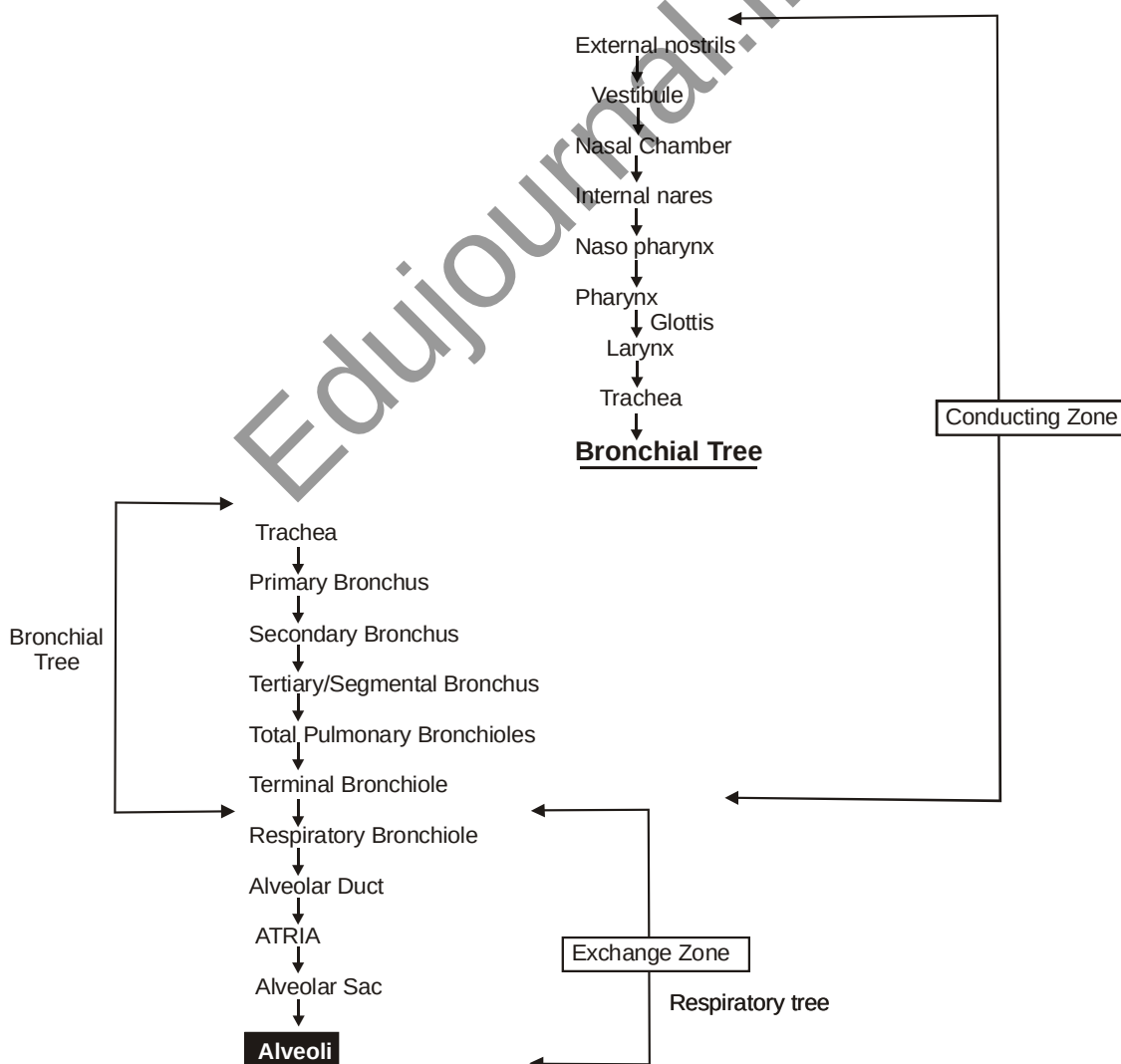
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

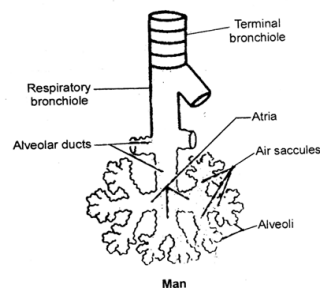
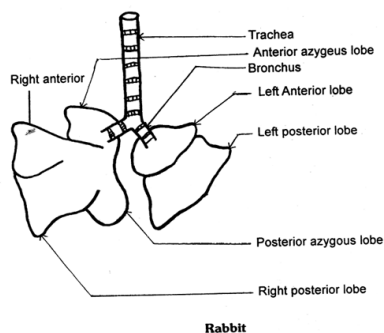
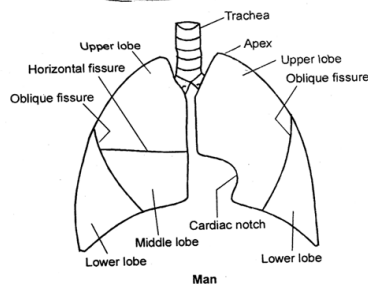
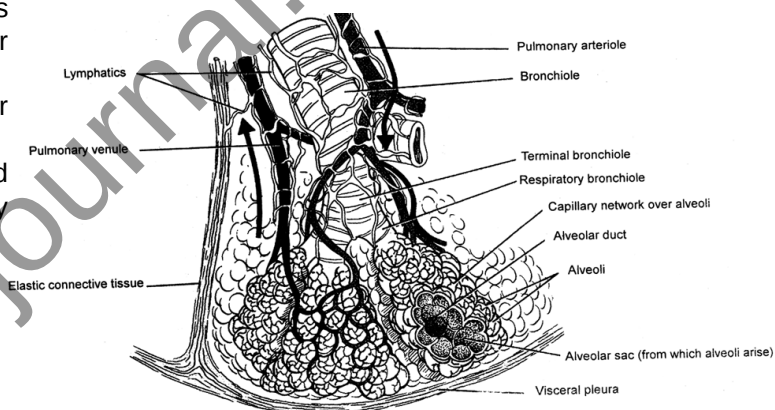
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

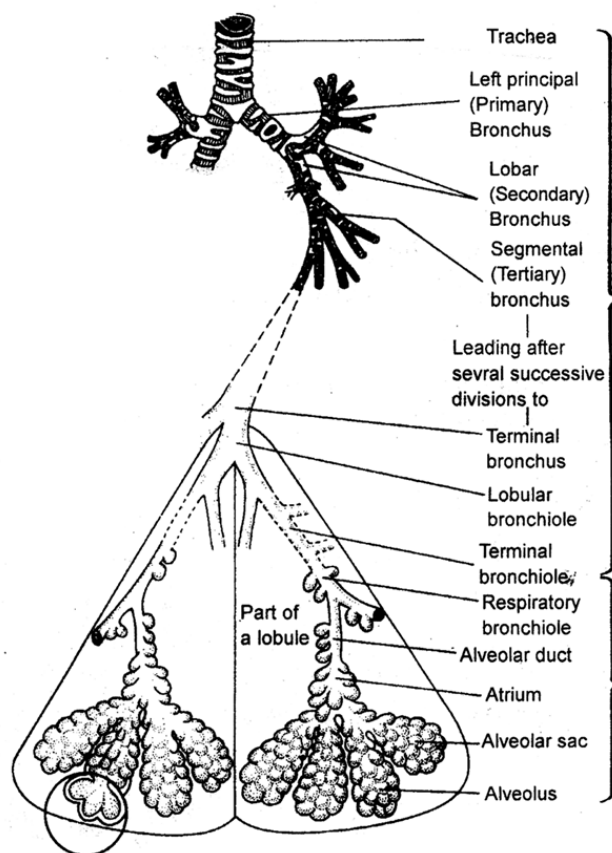
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

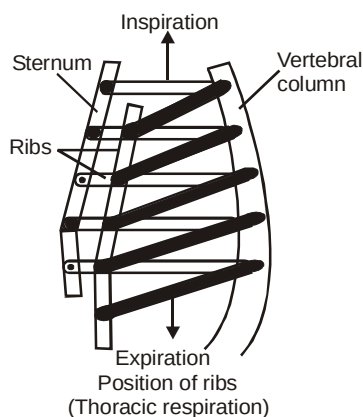
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

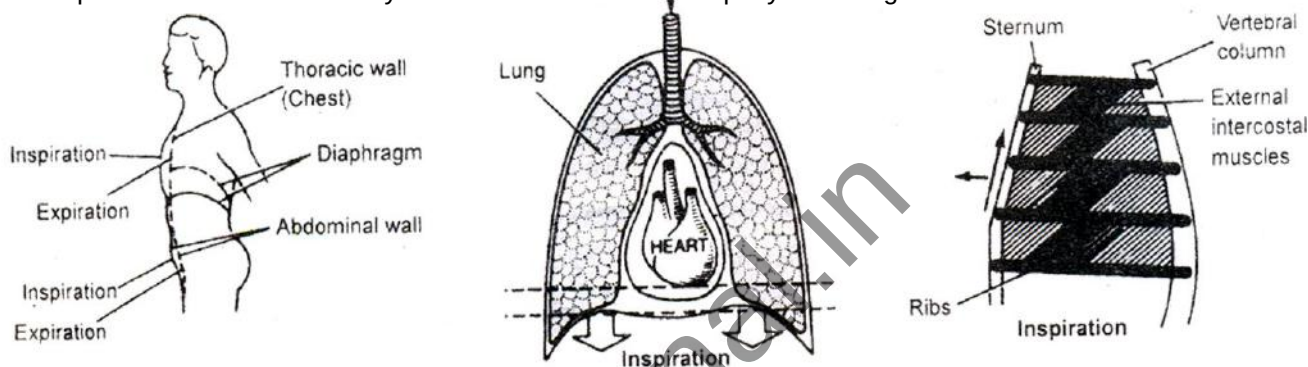
Inspiration

Expiration



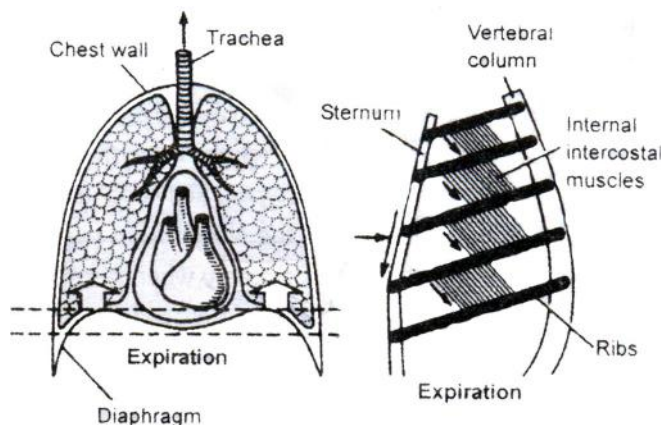
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

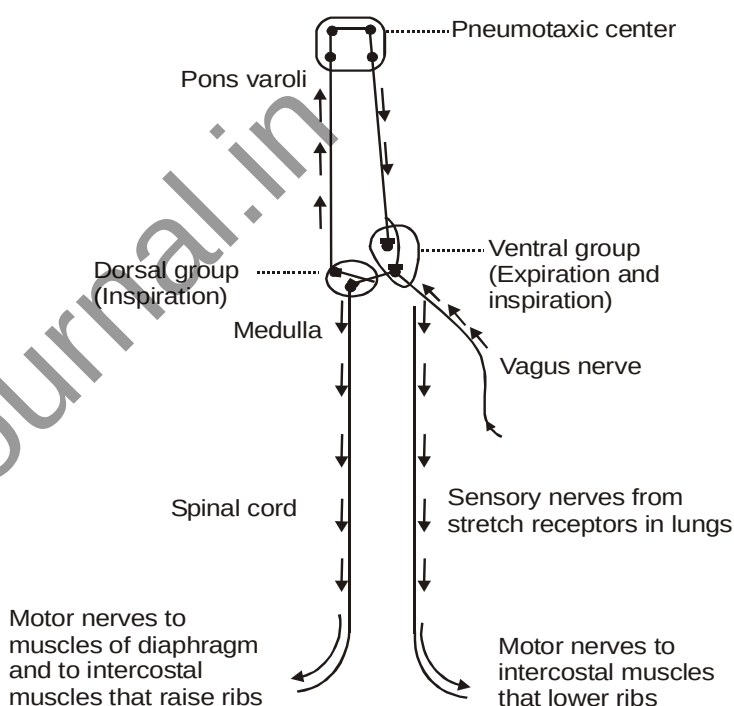


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

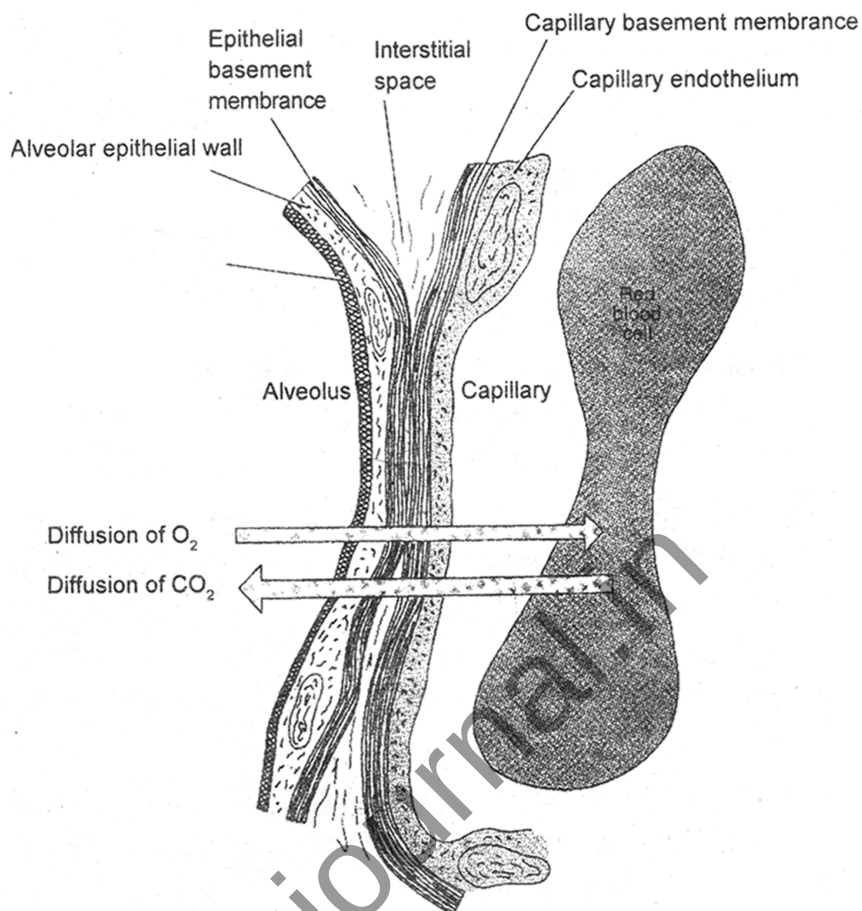
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

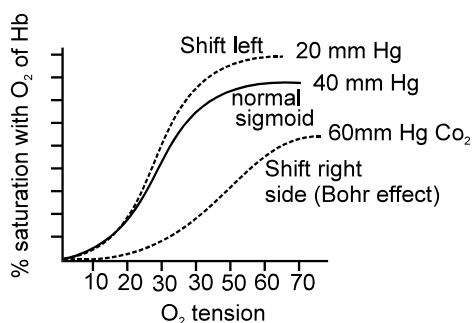
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

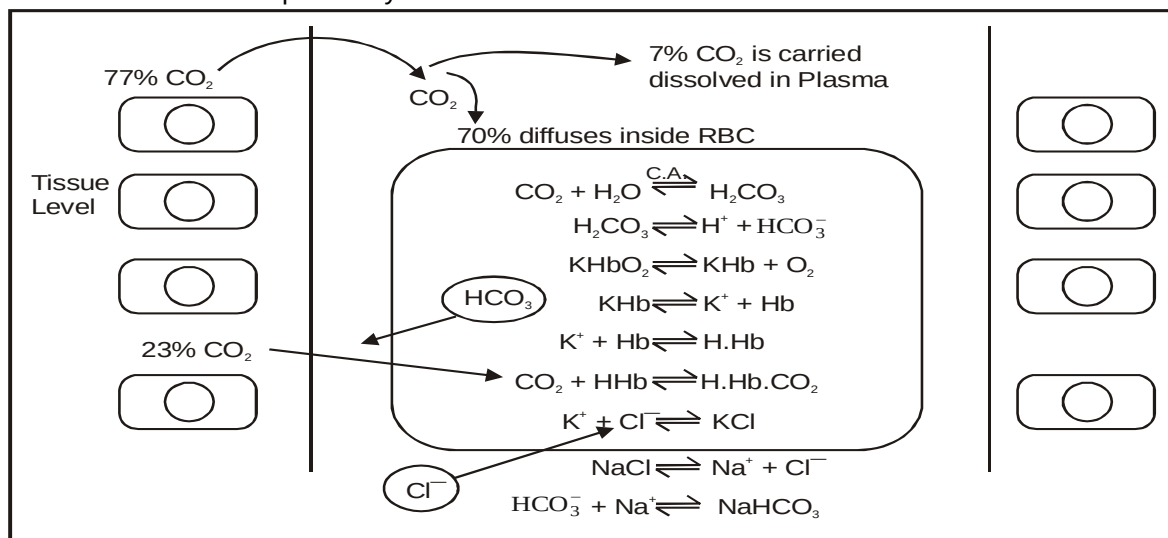
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

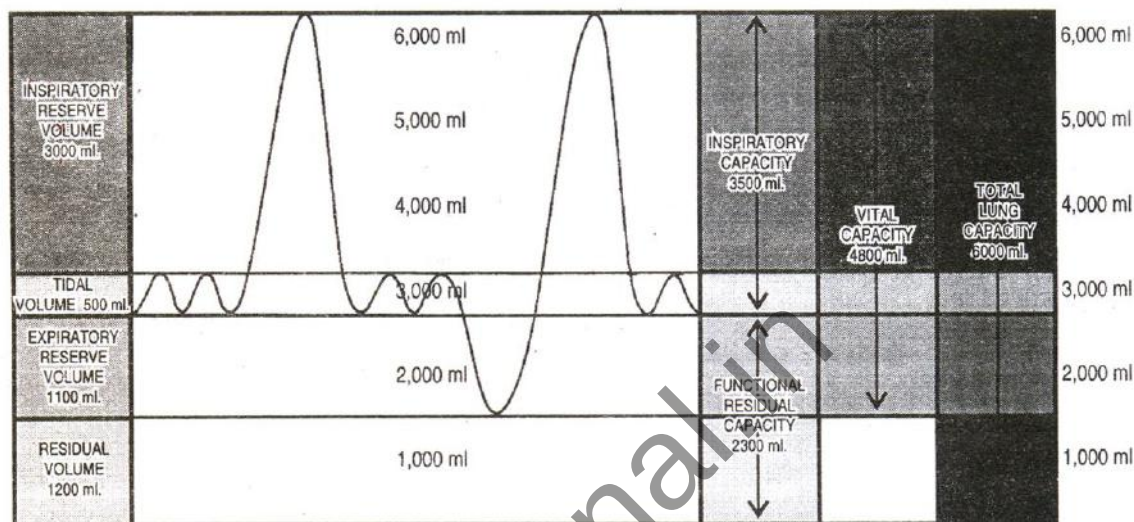
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbamino haemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box (2) Vocal cord
 - (3) Trachea (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue (2) Larynx
 - (3) Trachea (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million (2) 450 million
 - (3) 750 million (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney (2) Envelop the lung
 - (3) Envelop the liver (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi (2) Tracheae
 - (3) Alveoli (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis (2) Tracheal valves
 - (3) Syrinx (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three (2) Four
 - (3) Two (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid (2) Larynx
 - (3) Trachea (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries (2) Alveoli
 - (3) Turbinates (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

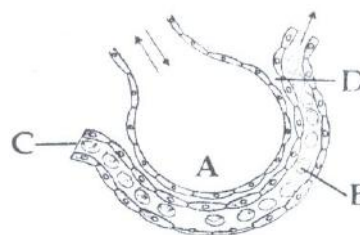
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1
Ques.	20	21	22	23	24														
Ans.	2	2	3	2	4														

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- (i) In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- (ii) Exchange of gases occurs on the principle of diffusion, through moist body surface.
- (iii) Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- (i) In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- (ii) Indirect respiration is found in complex and higher form of organism.
- (iii) Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- (i) Respiration which occurs in presence of oxygen is called aerobic respiration.
- (ii) The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- (iii) Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- (i) External respiration is also called **breathing** or **ventillation**.

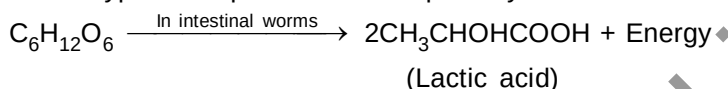
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

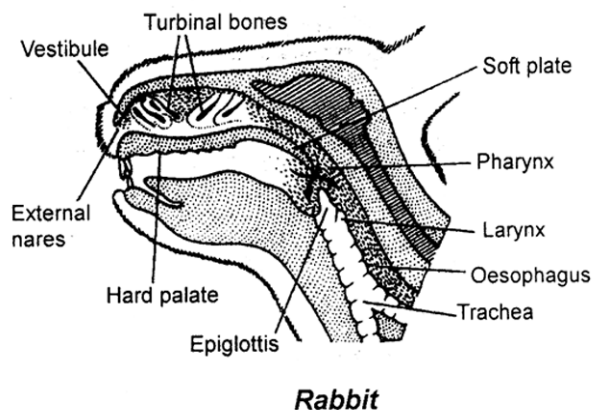
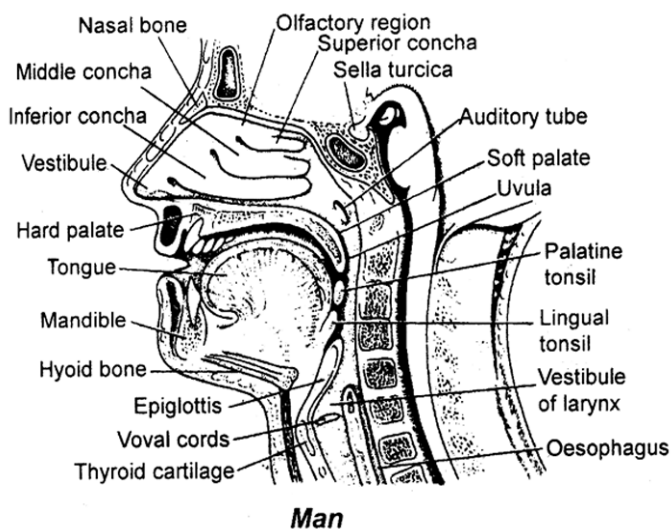
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

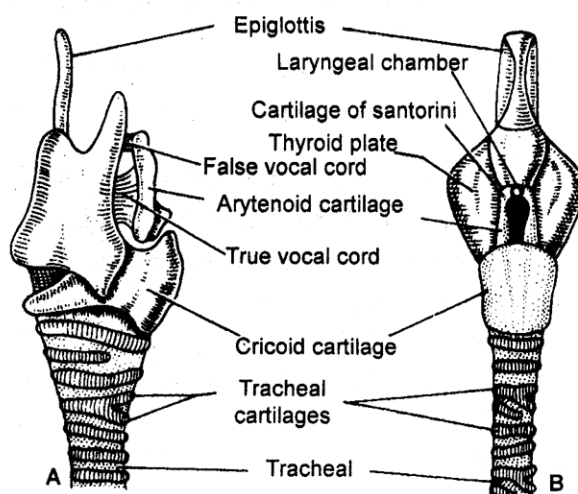
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

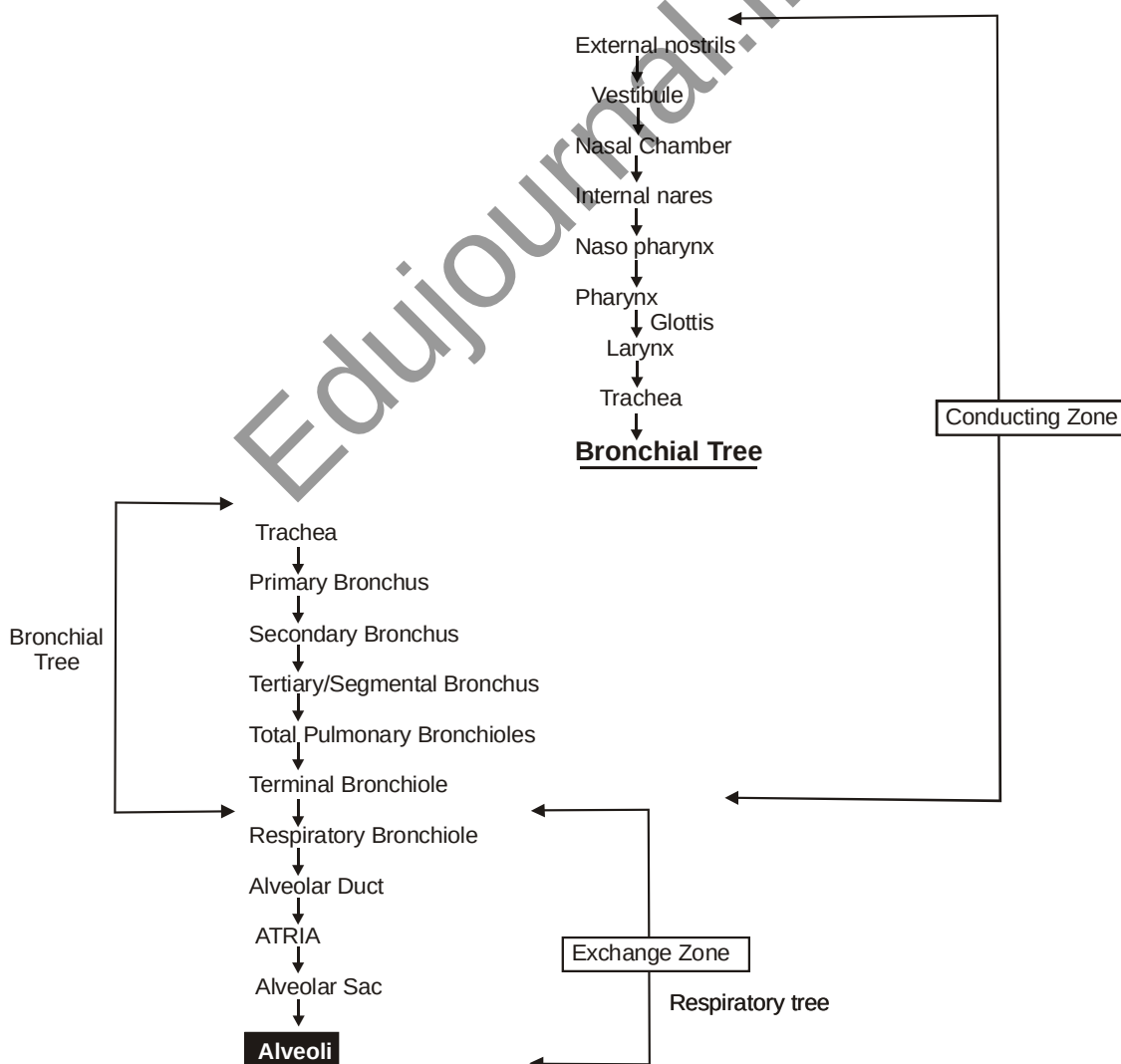
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enter into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

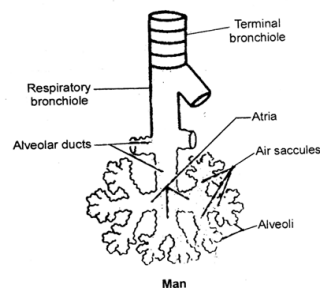
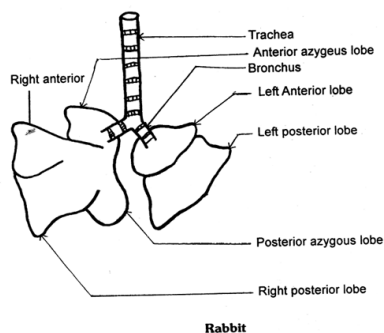
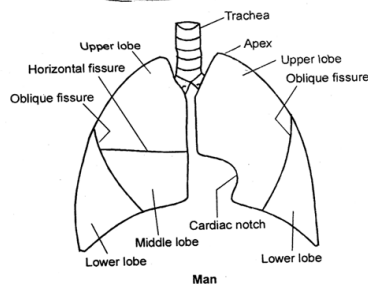
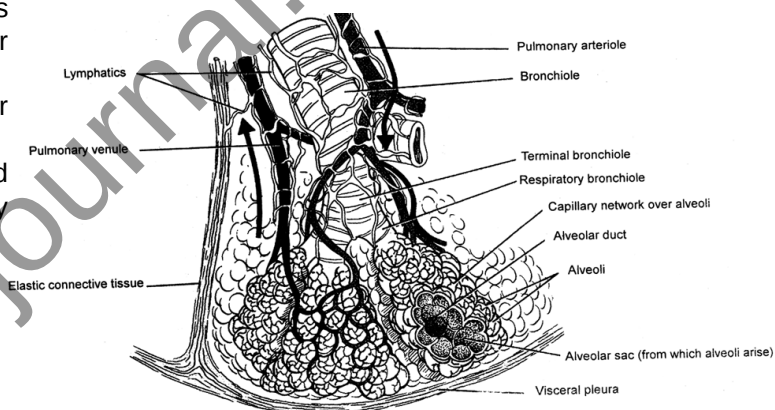
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

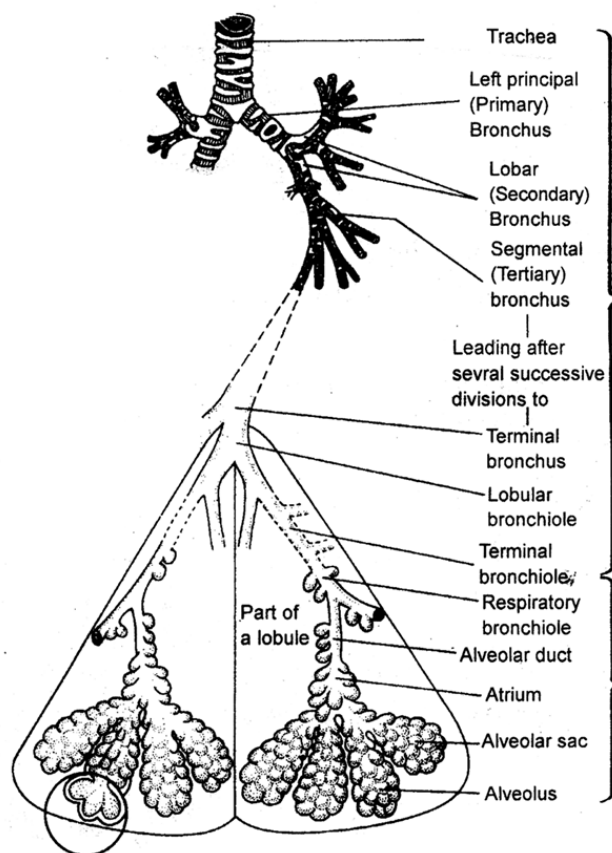
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

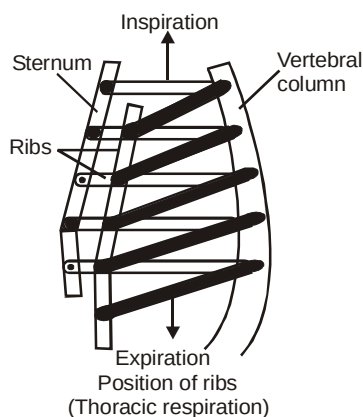
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

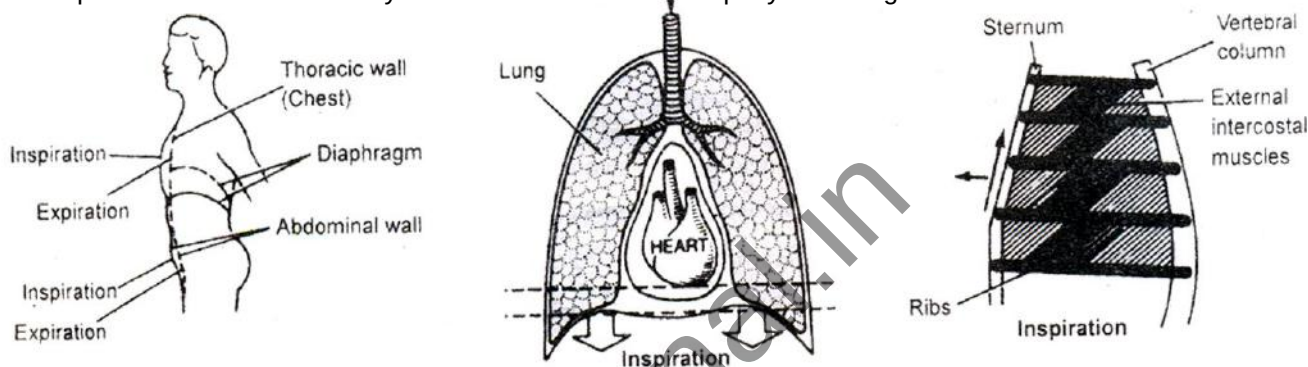
Inspiration

Expiration



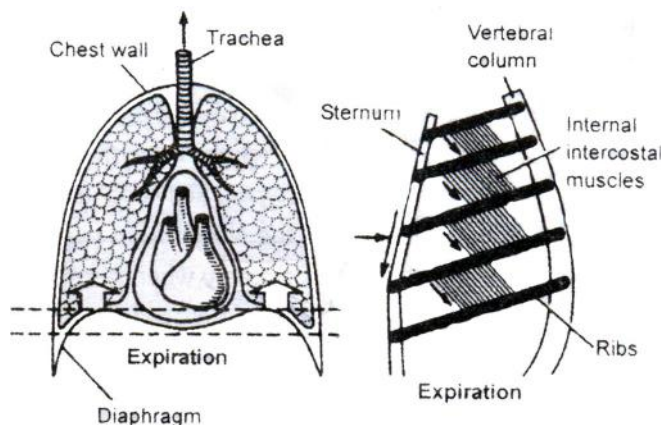
INSPIRATION ::

- (i) It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- (ii) During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- (iii) Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- (iv) Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- (i) It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- (ii) It is passive process
- (iii) During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- (iv) Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- (v) Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strenuous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been identified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group. During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

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Hering breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The Hering Breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Hering Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

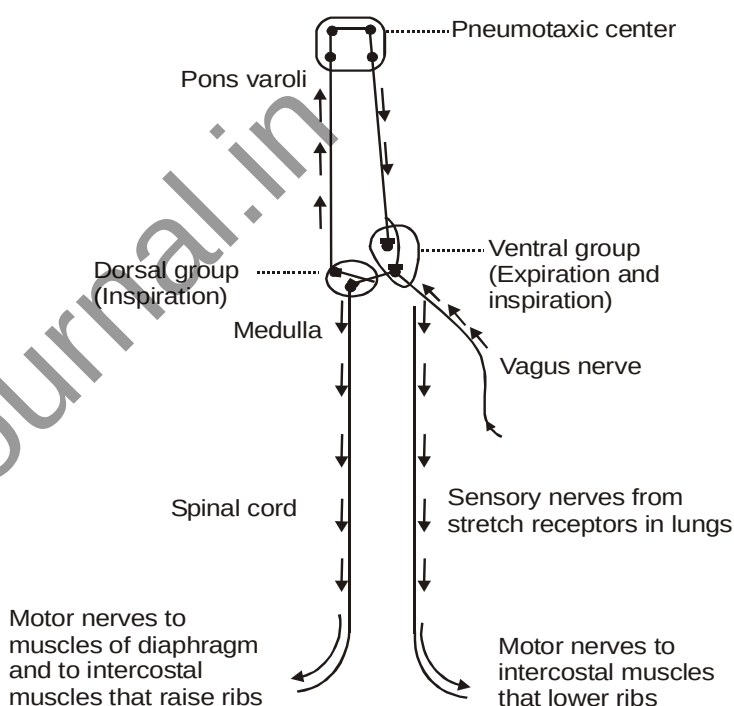


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

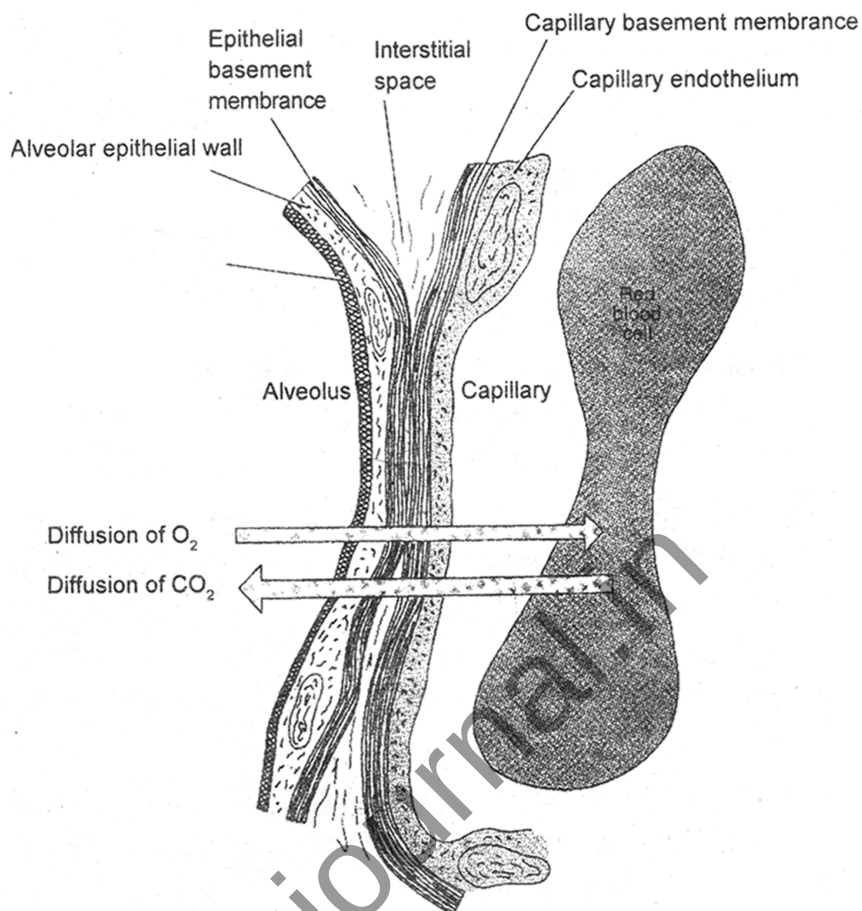
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

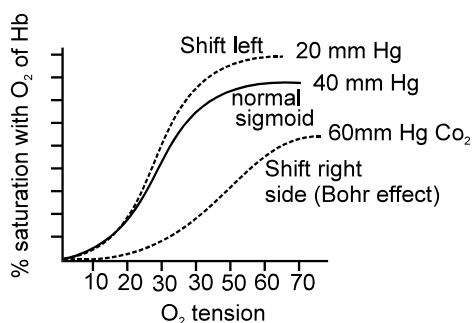
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

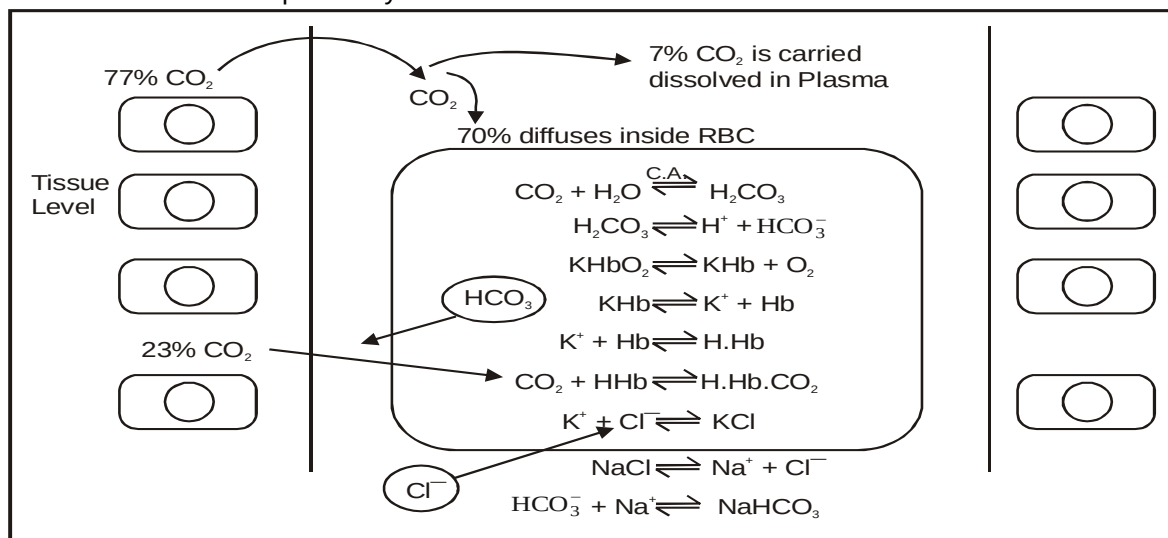
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

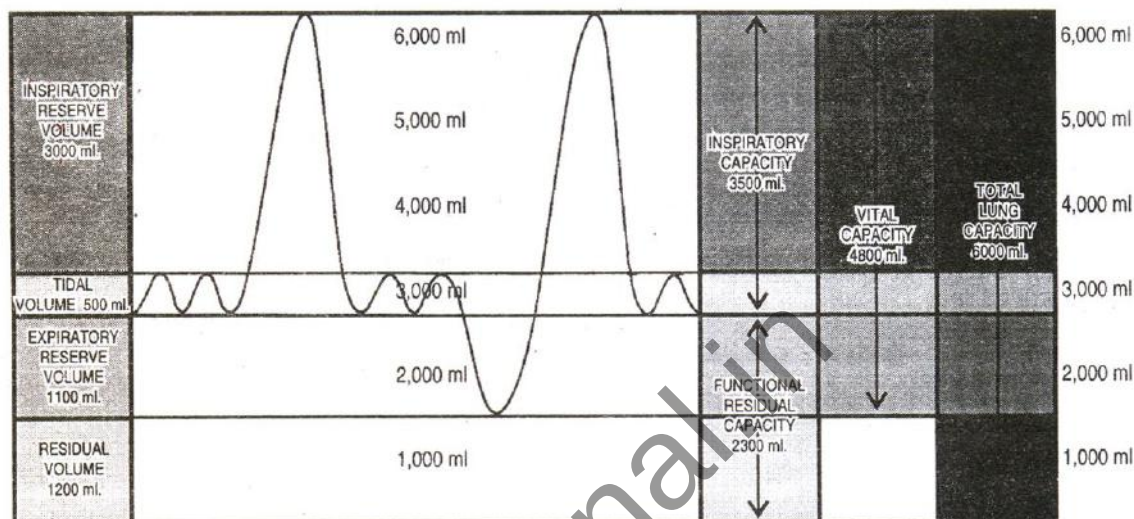
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO₂ is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO₂ with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned}
 IC &= TV + IRV \\
 &= 500 + 3000 \\
 &= 3500 \text{ mL.}
 \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$E.R.V. + R.V. = FRC$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- Dead volume
 - Dead space
 - Both A and B
 - Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- Omosis
 - Diffusion
 - Active transport
 - None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- Spherometer
 - Spirometer
 - Sphygmomanometer
 - Barometer
- Q.28** Air moves into the lungs when-
- Atmospheric pressure is less than pressure within the lungs
 - Atmospheric pressure is equal to the pressure within the lungs
 - Atmospheric pressure is greater than pressure within the lungs
 - None of these
- Q.29** Normal rate of breathing in man is-
- 20-30 times per minute
 - 12-14 times per minute
 - 5-10 times per minute
 - 40-50 times per minute
- Q.30** Choose the correct equation-
- Total capacity of lungs = Vital capacity + Residual air
 - Vital capacity of lungs = Tidal air + Complemental air
 - Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- Hypothalamus
 - Medulla oblongata
 - Cerebellum
 - Thalamus
- Q.32** Which of the following statements is correct-
- Inspiration is an active process
 - Expiration is an active process
 - Inspiration is a passive process
 - Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- Oxygen in trachea
 - Concentration of O_2
 - Diaphragm expansion
 - Concentration of CO_2
- Q.34** The breathing rate in a child is-
- Same as in an adult man
 - Less than in an adult man
 - More than in an adult man
 - None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- Inspiration
 - Normal respiration
 - Aspiration
 - Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- Backward and upward
 - Forward and upward
 - Backward and downward
 - Forward and downward
- Q.37** Tidal air in mammals is-
- Total air that can be drawn into lungs
 - Air that normally goes in and comes out of lungs during breathing
 - Air that is left in the lungs after normal expiration
 - Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO₂ in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO₂ (pCO₂) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO₂ concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO₂
 - (2) High pCO₂
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P₅₀ of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O₂

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
(1) Voice box (2) Vocal cord
(3) Trachea (4) None of these
- Q.119** Sound get converted into speech by-
(1) Tongue (2) Larynx
(3) Trachea (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
(1) 300 million (2) 450 million
(3) 750 million (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
(1) Envelop the kidney (2) Envelop the lung
(3) Envelop the liver (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
(1) Bronchi (2) Tracheae
(3) Alveoli (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
(1) Epiglottis (2) Tracheal valves
(3) Syrinx (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
(1) Three (2) Four
(3) Two (4) Five
- Q.125** Adams' apple corresponds to -
(1) Thyroid (2) Larynx
(3) Trachea (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
(1) Thickness
(2) Moistness
(3) Large respiratory surface
(4) Rich blood supply
- Q.127** The process of respiration is concerned with-
(1) Intake of O_2
(2) Liberation of O_2
(3) Liberation of energy
(4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
(1) Tributaries (2) Alveoli
(3) Turbinates (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
(1) Ribs
(2) Abdominal muscles
(3) Larynx
(4) Diaphragm
- Q.130** Inspiration would not occur if the -
(1) Diaphragm is lowered
(2) Diaphragm is elevated
(3) Ribs are elevated
(4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
(1) Internal respiration
(2) Cellular respiration
(3) External respiration
(4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
(1) Mainly in the erythrocytes
(2) Mainly in the blood plasma
(3) Mainly in the interstitial fluid
(4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
(1) Terminal tracheoles
(2) Tracheoles
(3) Alveoli
(4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc (2) About 2000 cc
 - (3) About 4500 cc (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease (2) Stop
 - (3) Increase (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia (2) Anoxia
 - (3) Suffocation (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis (2) Asphyxia
 - (3) Hypoxia (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis (2) Hypoxia
 - (3) Pneumonia (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia (2) Bronchitis
 - (3) Asthma (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration (2) breathing
 - (3) inspiration (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2 (2) fall in level of CO_2
 - (3) rise of O_2 level (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

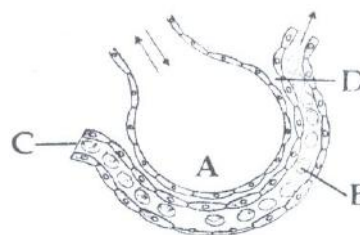
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

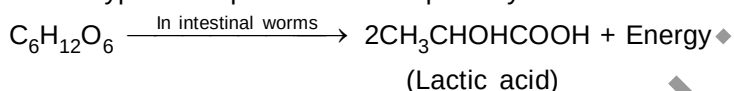
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

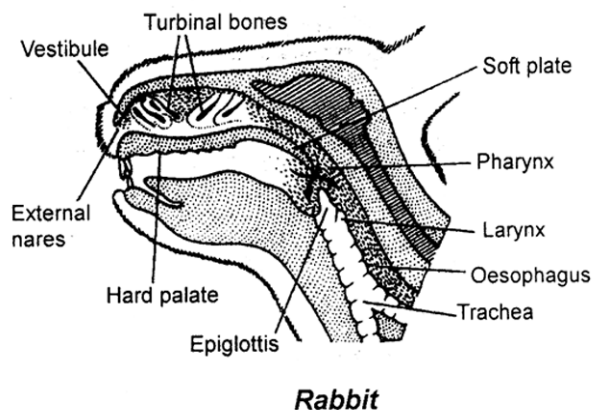
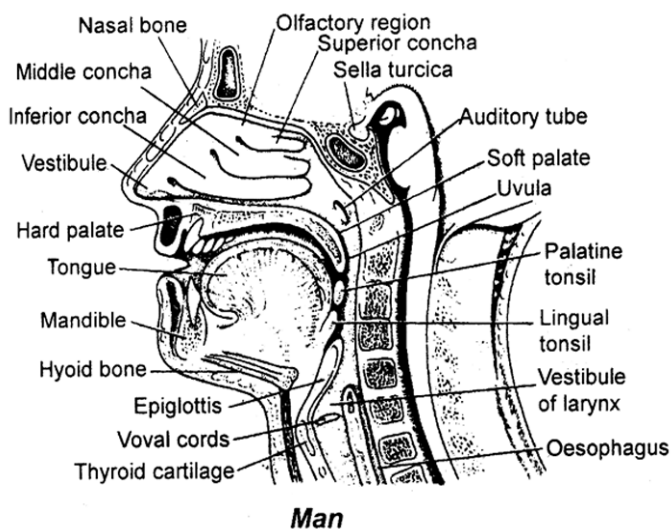
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

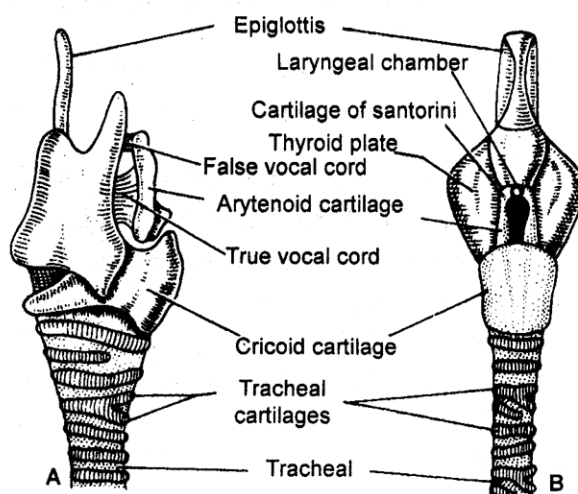
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

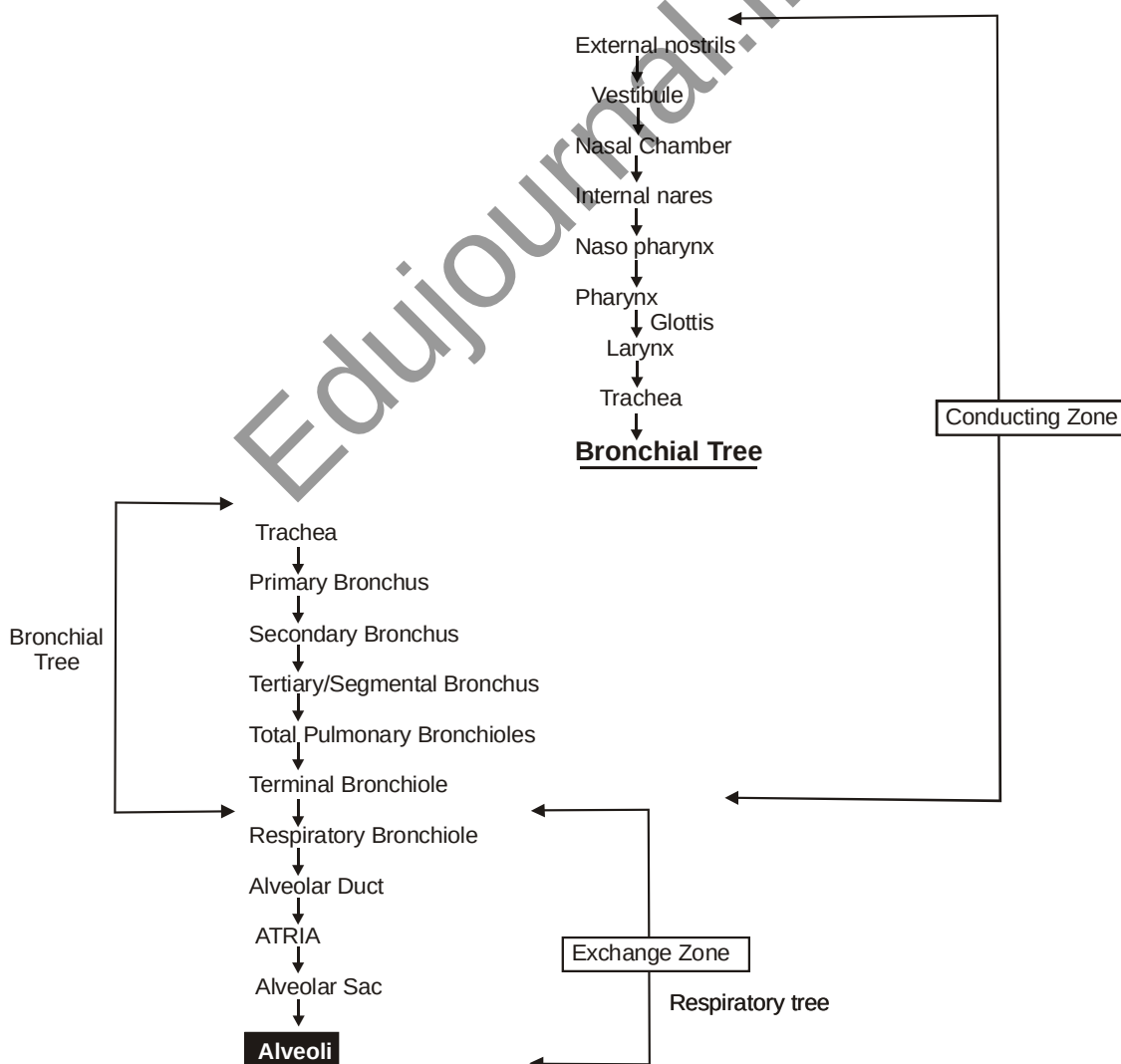
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters thoracic cavity, it divides into two branches called primary bronchus. Branches of primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

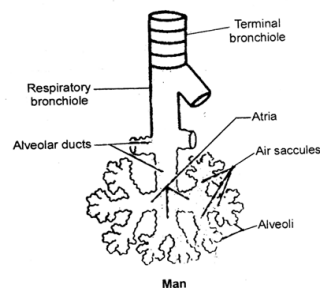
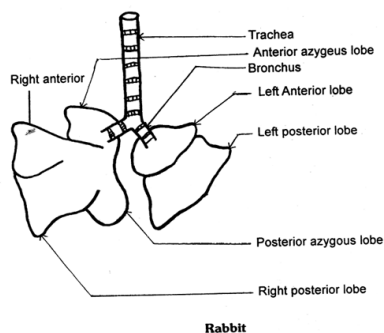
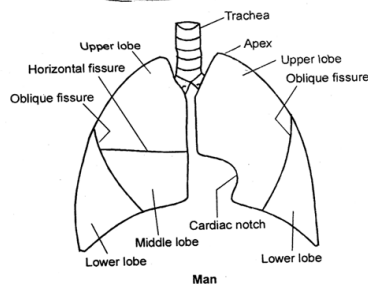
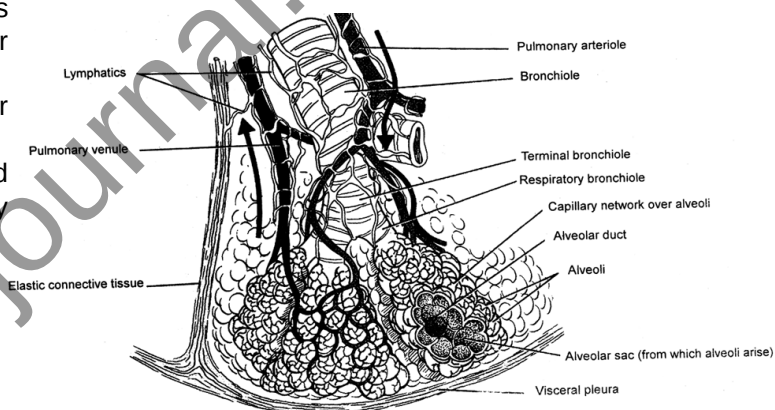
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

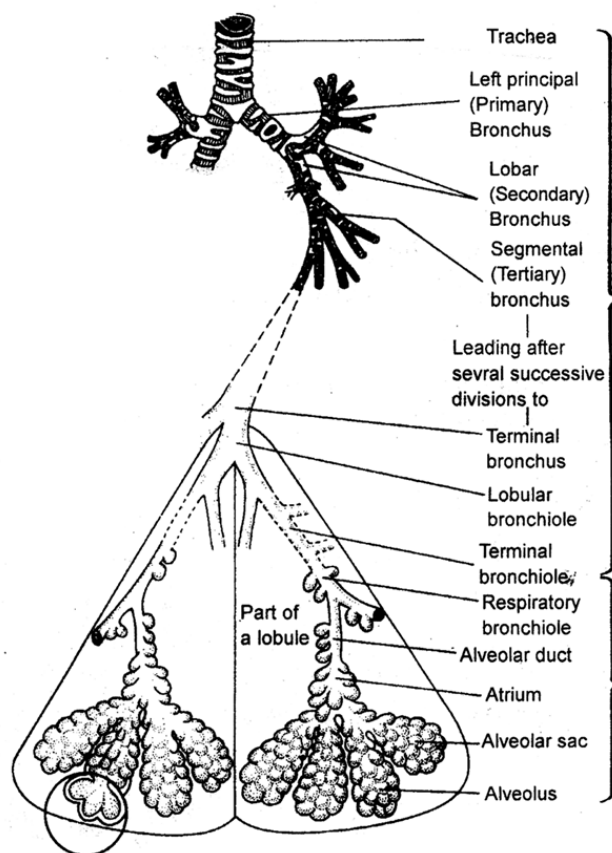
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

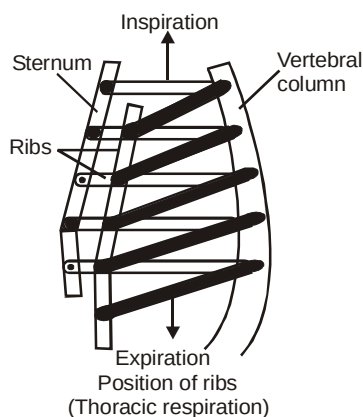
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

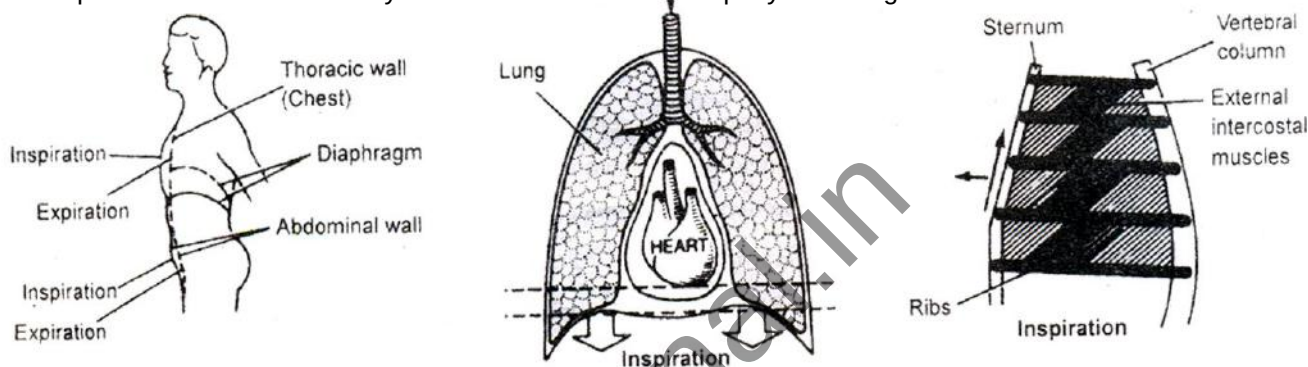
Inspiration

Expiration



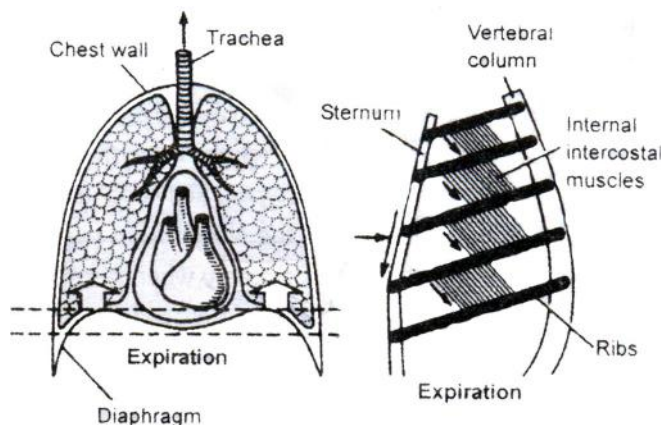
INSPIRATION ::

- (i) It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- (ii) During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- (iii) Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- (iv) Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- (i) It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- (ii) It is passive process
- (iii) During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- (iv) Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- (v) Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

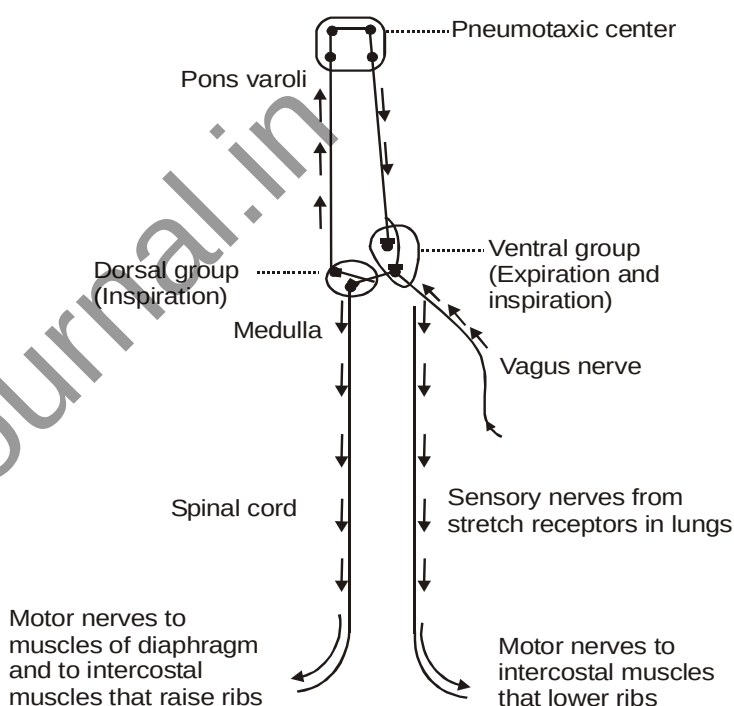


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

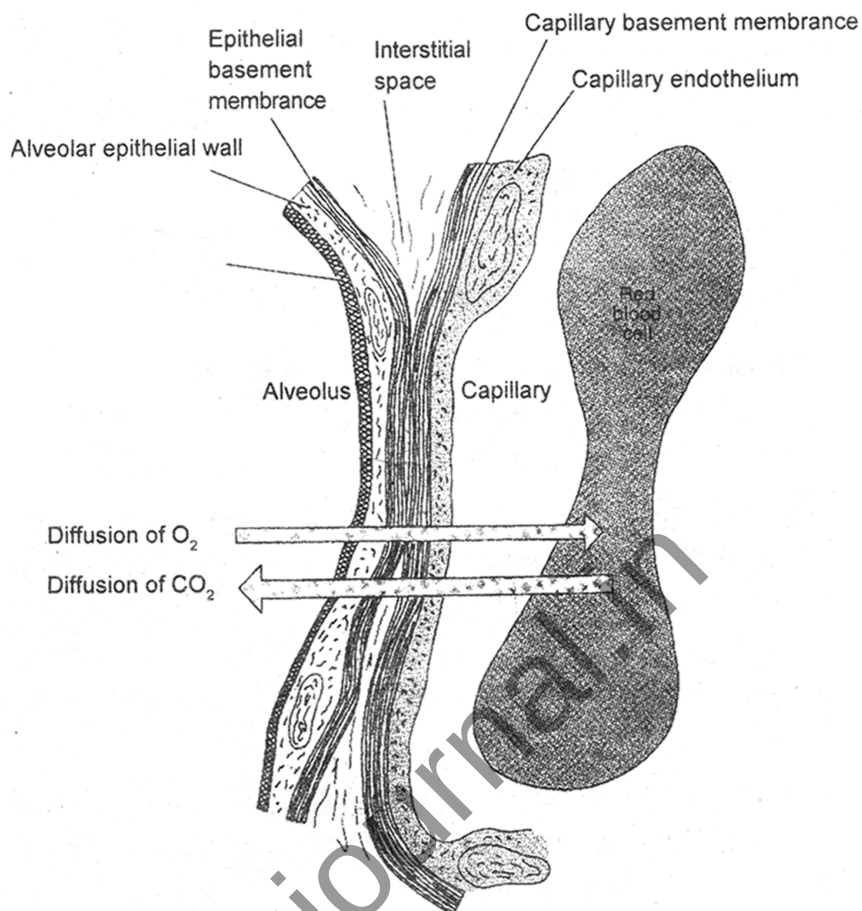
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

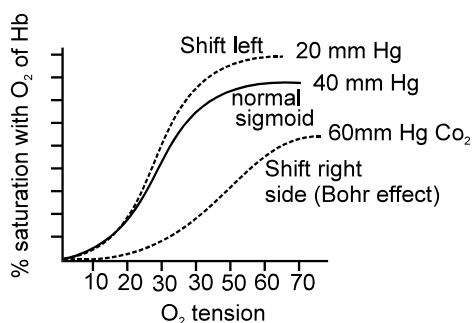
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25% O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

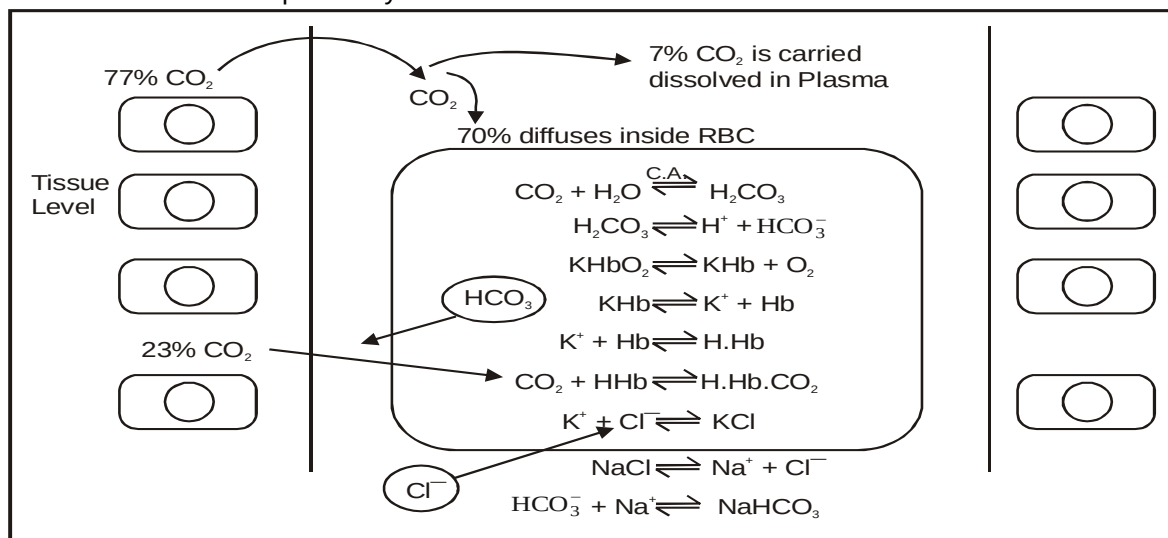
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

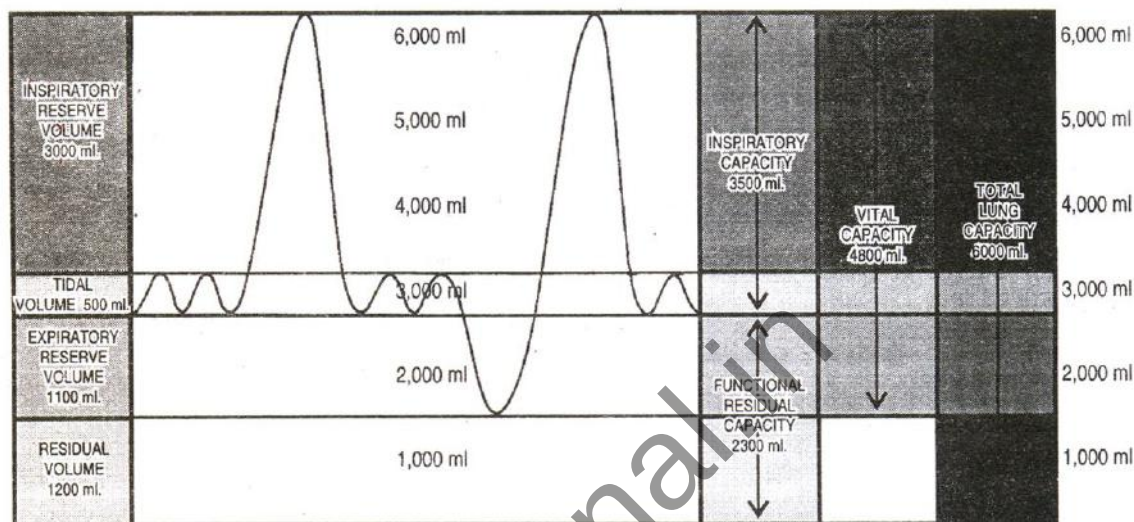
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humidified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box
 - (2) Vocal cord
 - (3) Trachea
 - (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue
 - (2) Larynx
 - (3) Trachea
 - (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million
 - (2) 450 million
 - (3) 750 million
 - (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney
 - (2) Envelop the lung
 - (3) Envelop the liver
 - (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi
 - (2) Tracheae
 - (3) Alveoli
 - (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis
 - (2) Tracheal valves
 - (3) Syrinx
 - (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three
 - (2) Four
 - (3) Two
 - (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid
 - (2) Larynx
 - (3) Trachea
 - (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries
 - (2) Alveoli
 - (3) Turbinates
 - (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc (2) About 2000 cc
 - (3) About 4500 cc (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease (2) Stop
 - (3) Increase (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia (2) Anoxia
 - (3) Suffocation (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis (2) Asphyxia
 - (3) Hypoxia (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis (2) Hypoxia
 - (3) Pneumonia (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia (2) Bronchitis
 - (3) Asthma (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration (2) breathing
 - (3) inspiration (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2 (2) fall in level of CO_2
 - (3) rise of O_2 level (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by—
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude—
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow—
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it—
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as—
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because—
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

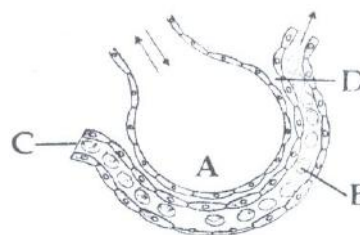
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- (i) In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- (ii) Exchange of gases occurs on the principle of diffusion, through moist body surface.
- (iii) Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- (i) In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- (ii) Indirect respiration is found in complex and higher form of organism.
- (iii) Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- (i) Respiration which occurs in presence of oxygen is called aerobic respiration.
- (ii) The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- (iii) Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- (i) External respiration is also called **breathing** or **ventillation**.

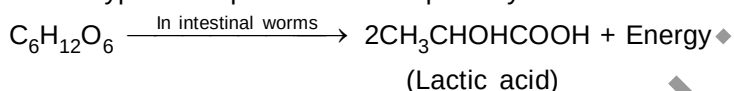
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

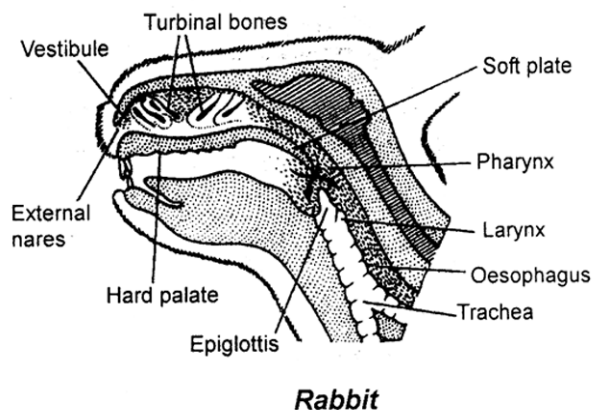
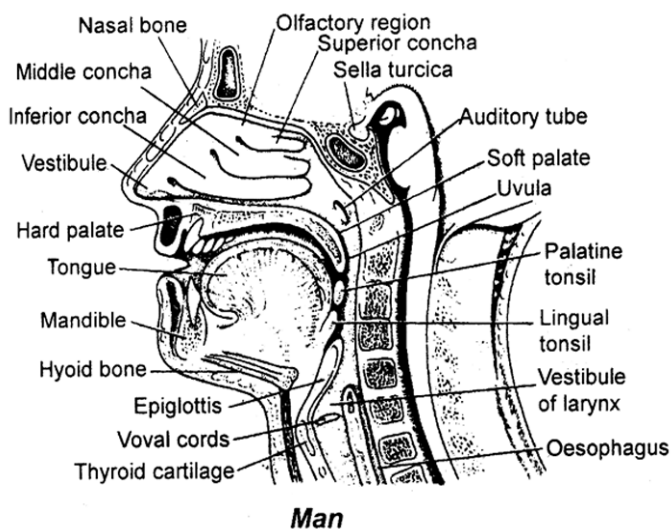
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

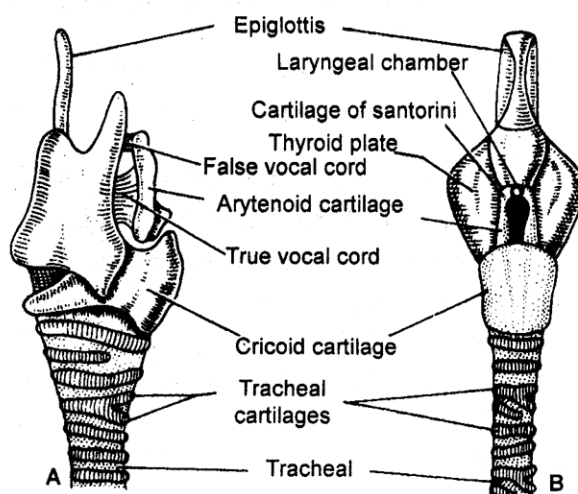
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

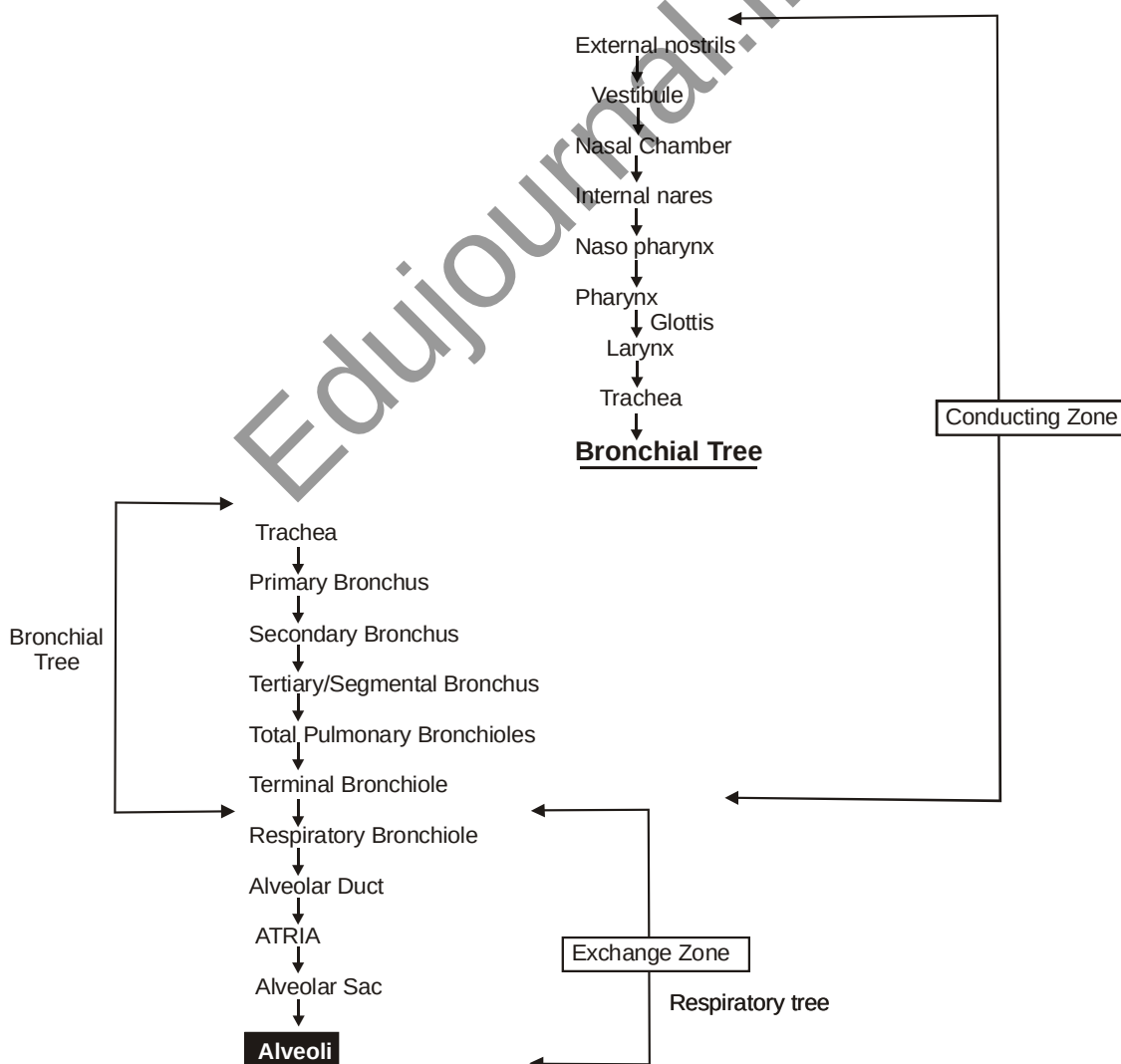
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters thoracic cavity, it divides into two branches called primary bronchus. Branches of primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

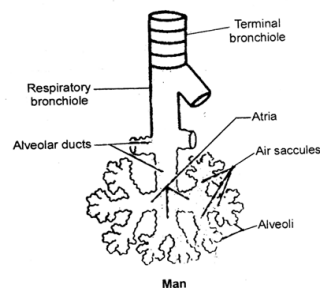
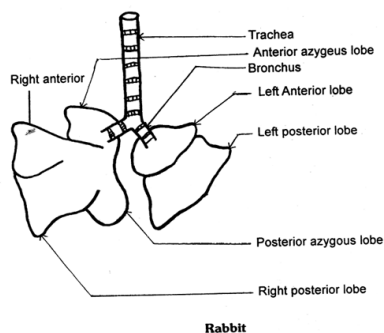
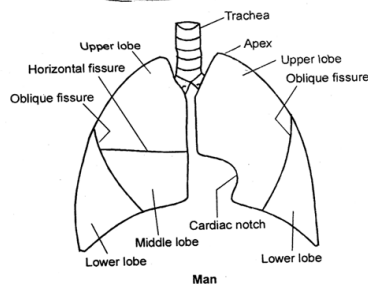
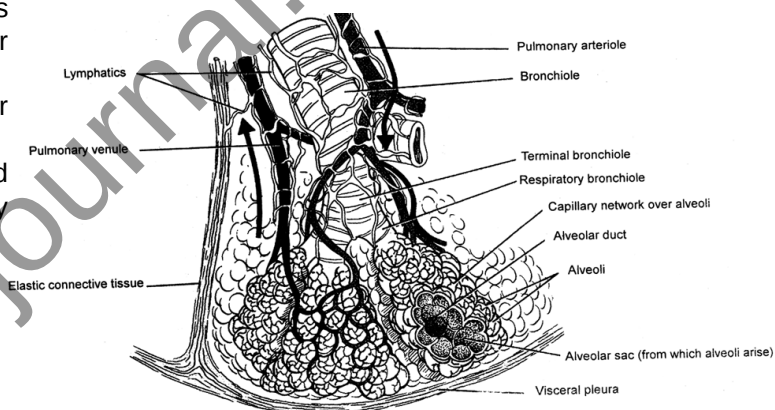
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

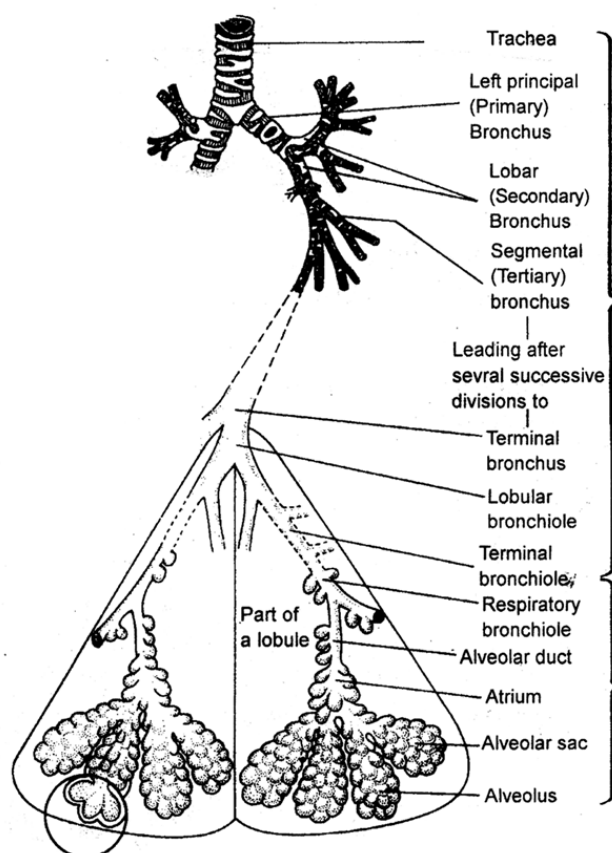
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

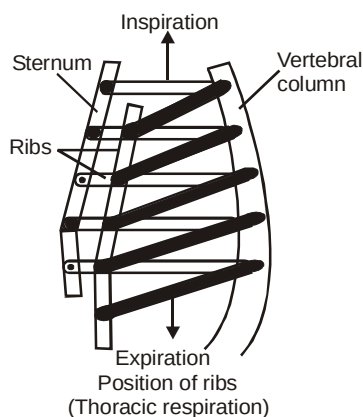
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

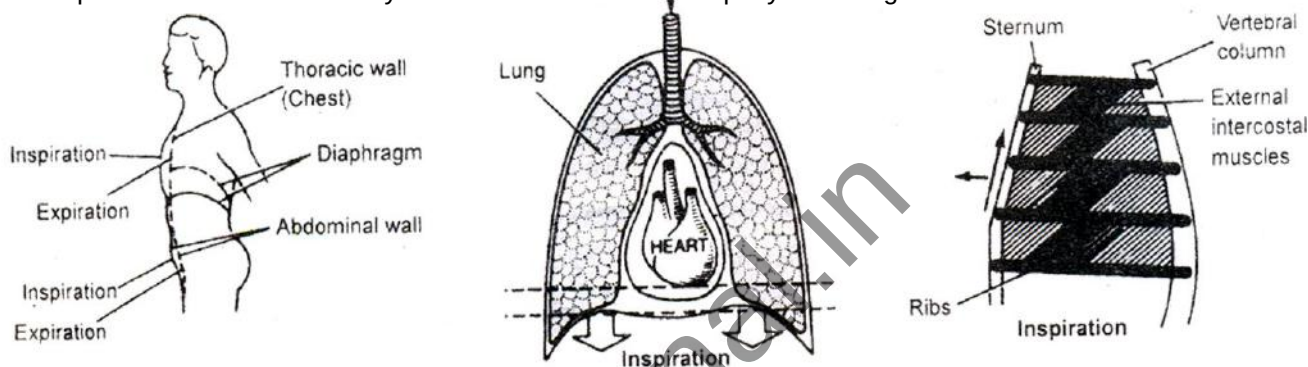
Inspiration

Expiration



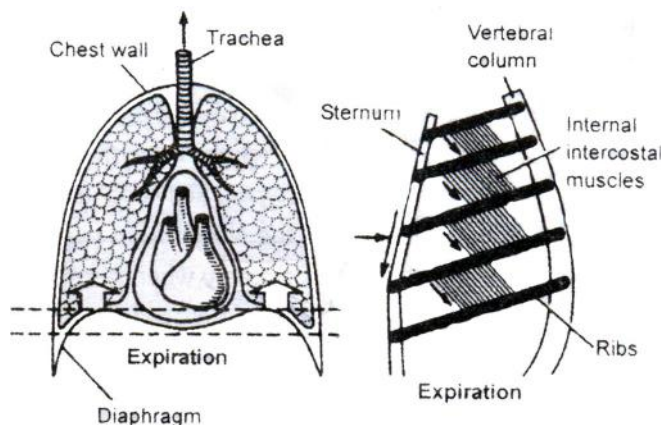
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

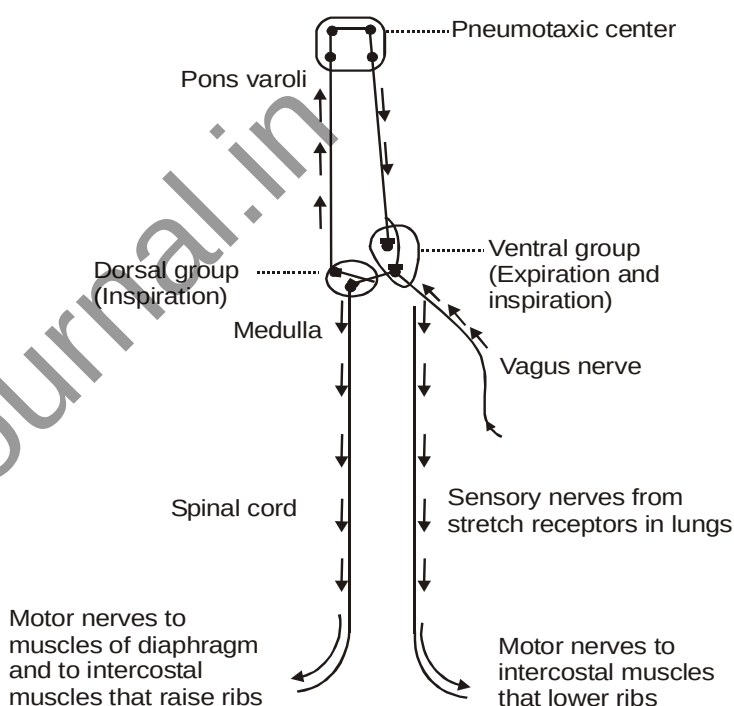


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

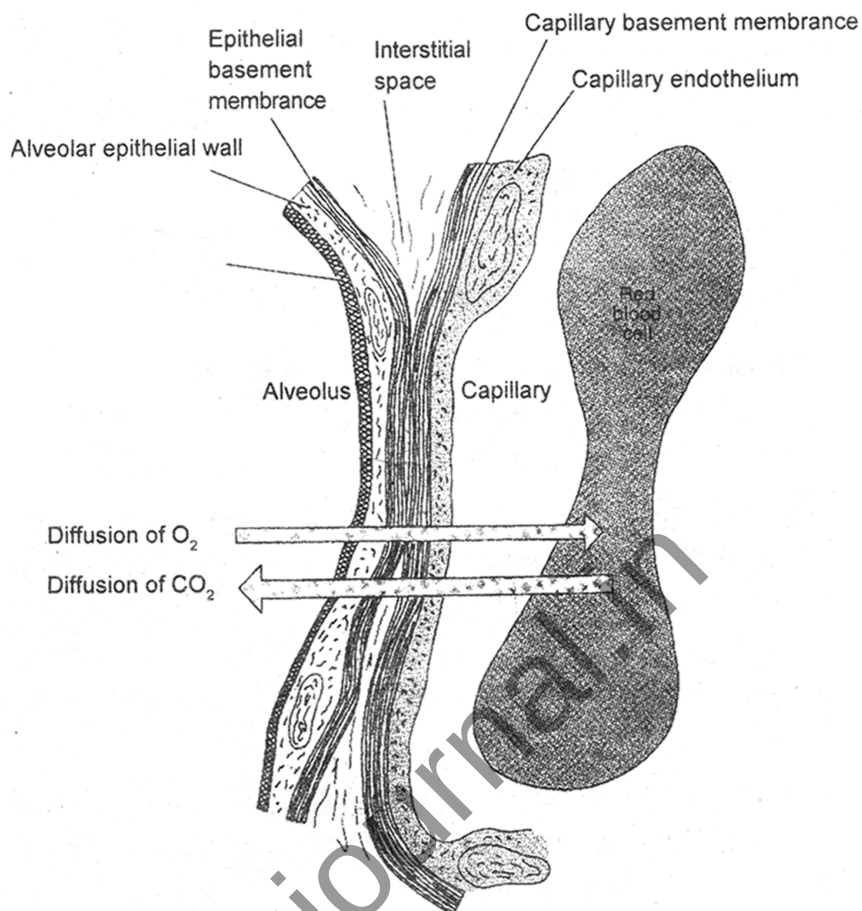
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

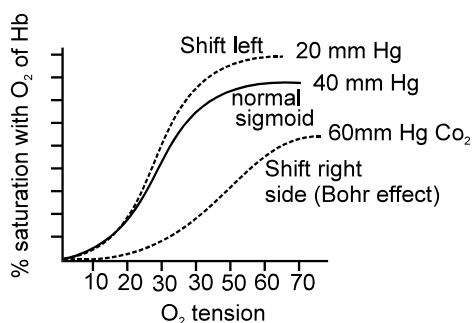
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

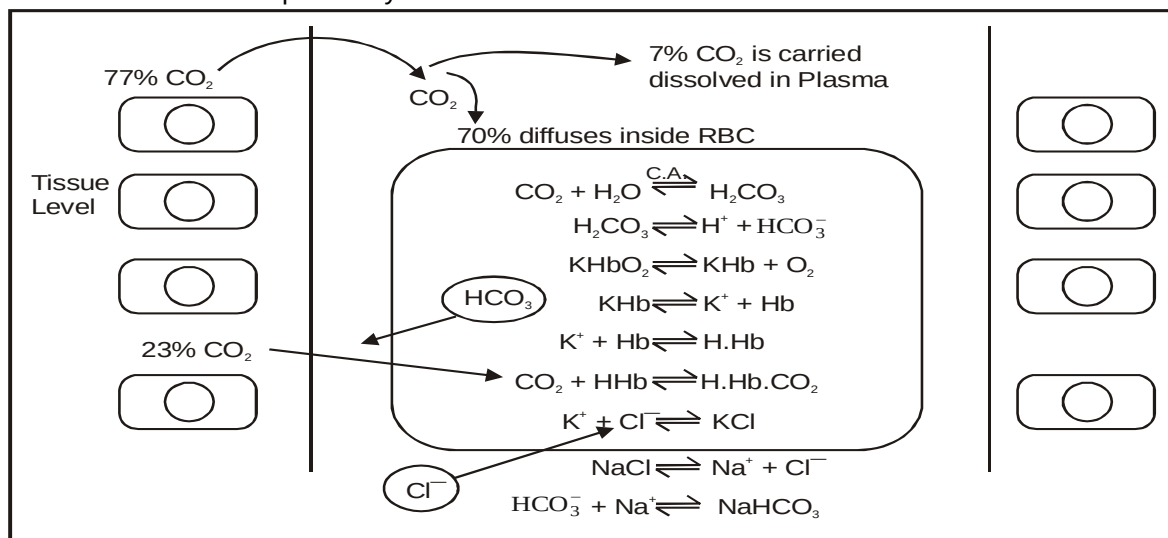
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

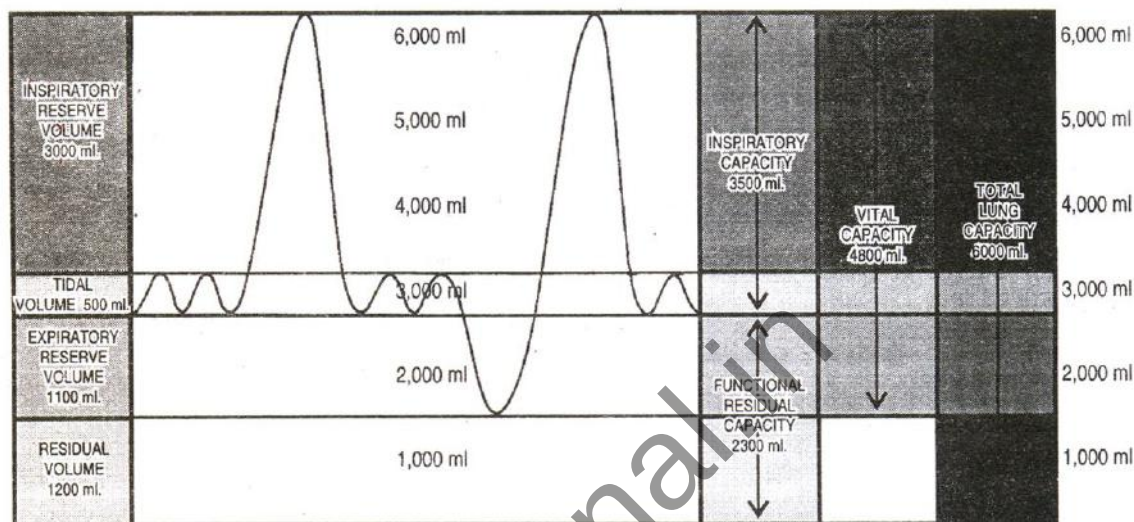
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
- (1) Neck and shoulder
 - (2) Thorax and abdomen
 - (3) Thoracic ribs
 - (4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
- (1) Tidal volume
 - (2) Residual volume
 - (3) Lungs volume
 - (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
- (1) Vital capacity
 - (2) Pulmonary capacity
 - (3) Tidal capacity
 - (4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
- (1) The tissue can absorb O_2 from oxyhaemoglobin
 - (2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
 - (3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
 - (4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
- (1) High body temperature
 - (2) Low pCO_2
 - (3) High blood pH
 - (4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
- (1) $Hb(O_2)_4$
 - (2) $Hb(O_3)_4$
 - (3) $H_2B_2O_4$
 - (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
- (1) Lungs
 - (2) Skin
 - (3) Branchial chamber
 - (4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
- (1) Sympathetic nervous system
 - (2) Central nervous system
 - (3) Autonomic nervous system
 - (4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
- (1) Carboxyhaemoglobin
 - (2) Oxyhaemoglobin
 - (3) Carbaminohaemoglobin
 - (4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
- (1) The arterial pH is decreased
 - (2) The arterial pO_2 is increased
 - (3) The haemoglobin concentration is increased
 - (4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
- (1) HCO_3^-
 - (2) H_2CO_3
 - (3) As free CO_2
 - (4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
- (1) Hippopotamus
 - (2) Man
 - (3) Elephant
 - (4) Monkey
- Q.51** True organ of sound production in birds is-
- (1) Sound box
 - (2) Vocal sac
 - (3) Syrinx
 - (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humidified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box
 - (2) Vocal cord
 - (3) Trachea
 - (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue
 - (2) Larynx
 - (3) Trachea
 - (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million
 - (2) 450 million
 - (3) 750 million
 - (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney
 - (2) Envelop the lung
 - (3) Envelop the liver
 - (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi
 - (2) Tracheae
 - (3) Alveoli
 - (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis
 - (2) Tracheal valves
 - (3) Syrinx
 - (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three
 - (2) Four
 - (3) Two
 - (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid
 - (2) Larynx
 - (3) Trachea
 - (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries
 - (2) Alveoli
 - (3) Turbinates
 - (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

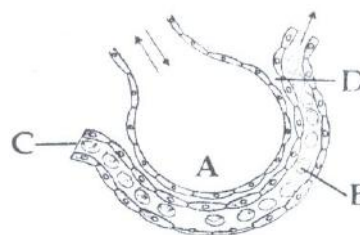
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1
Ques.	20	21	22	23	24														
Ans.	2	2	3	2	4														

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

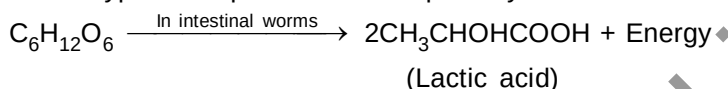
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

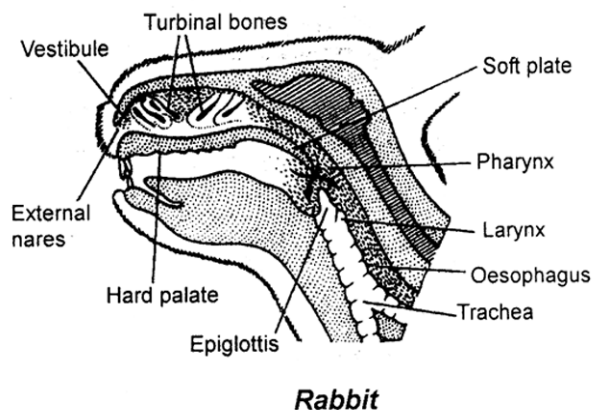
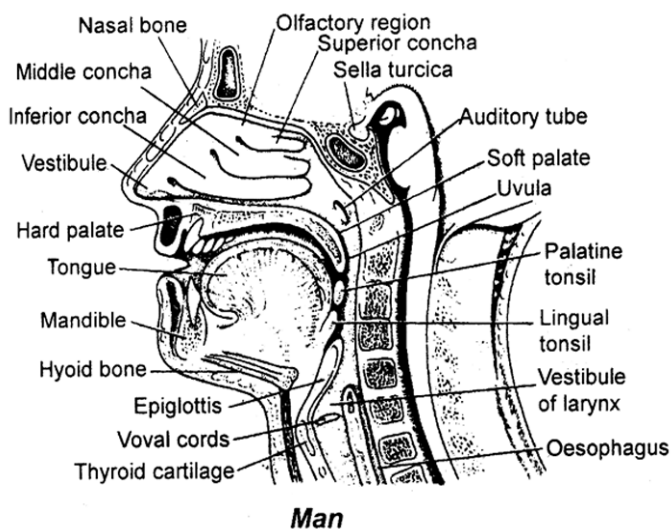
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

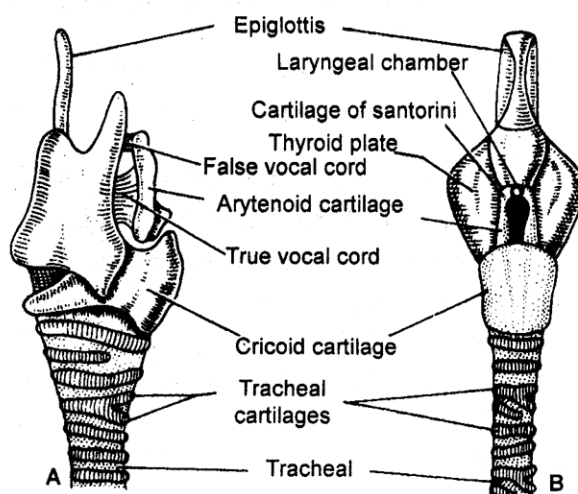
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

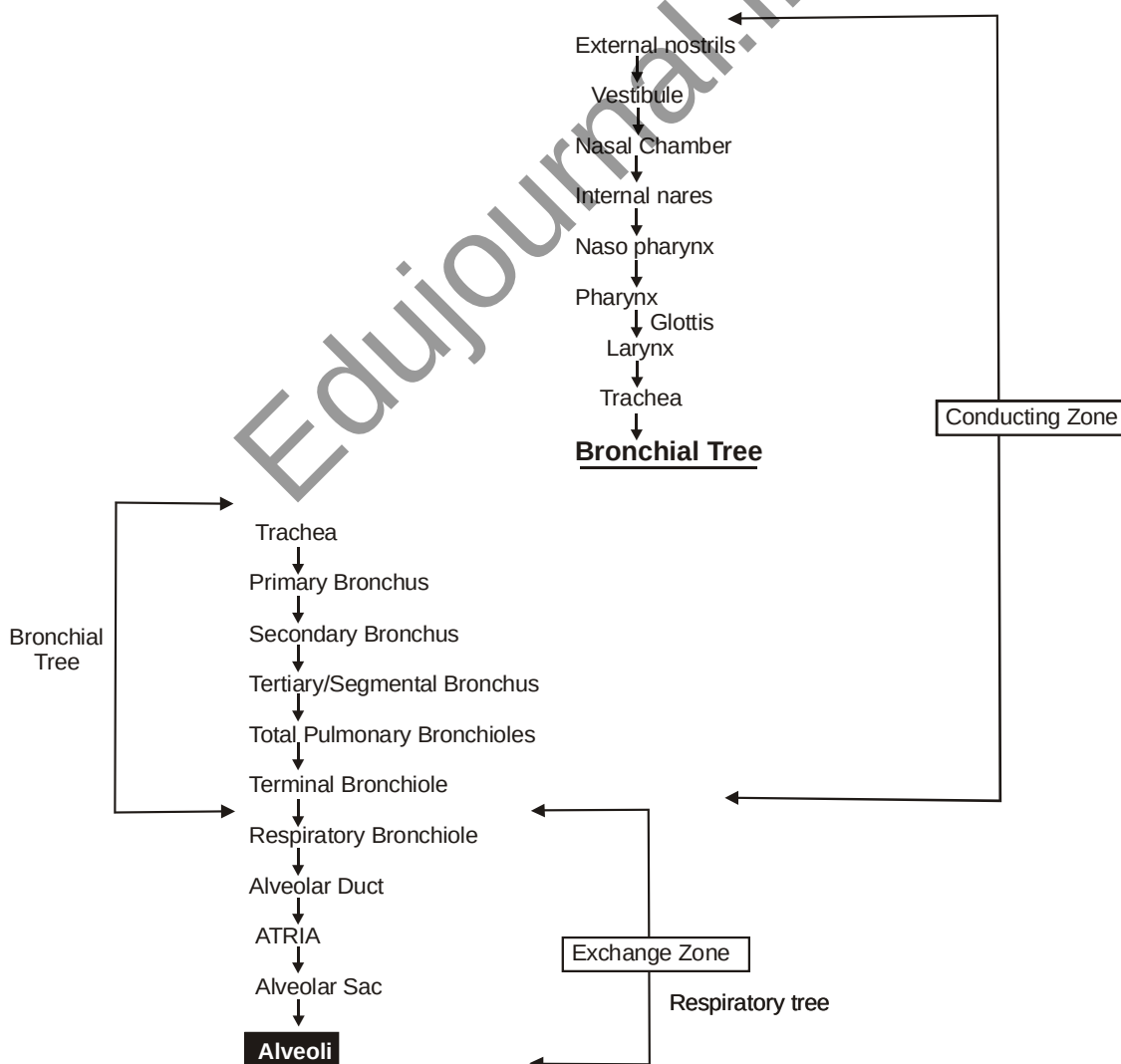
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

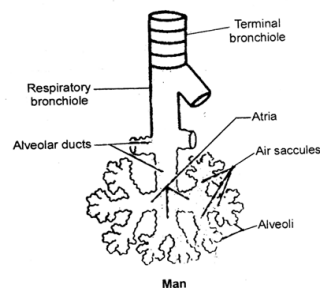
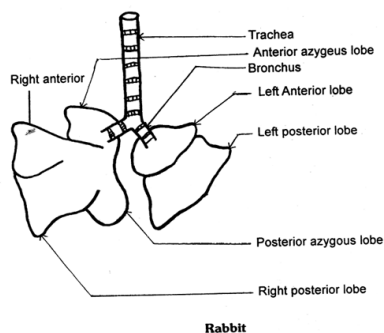
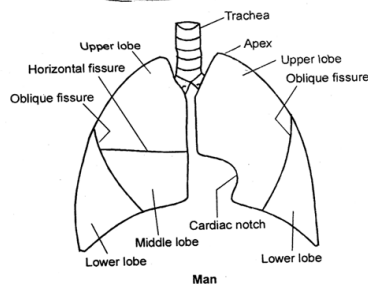
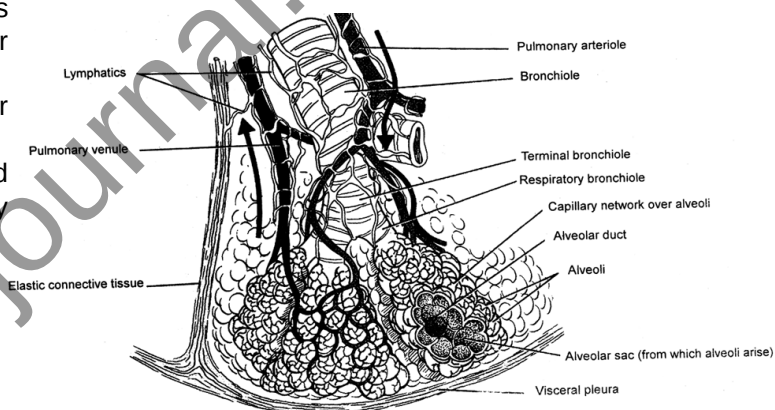
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

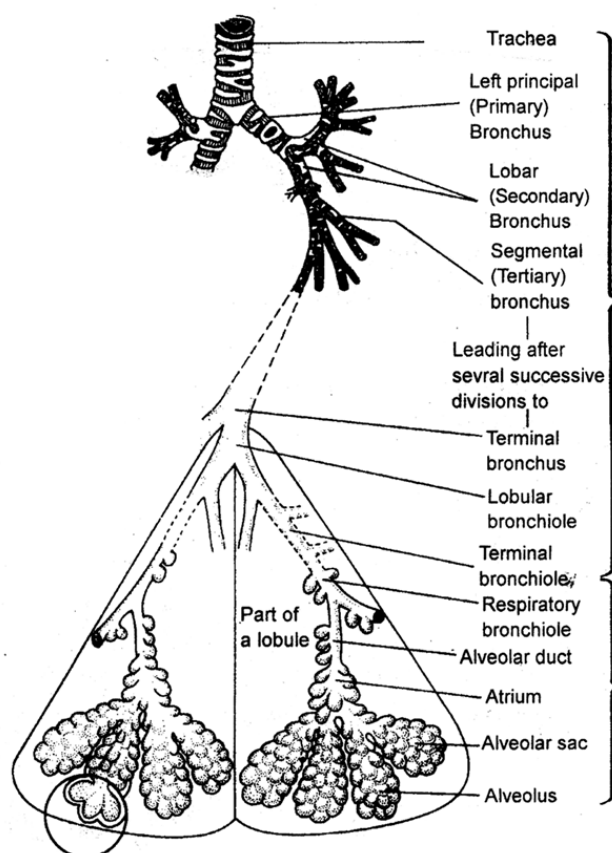
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m². Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

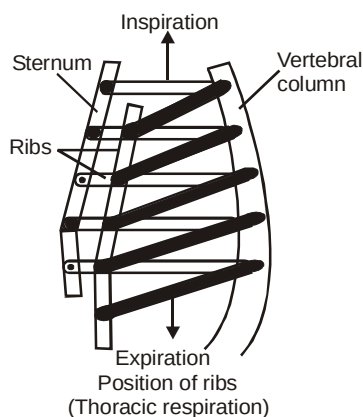
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

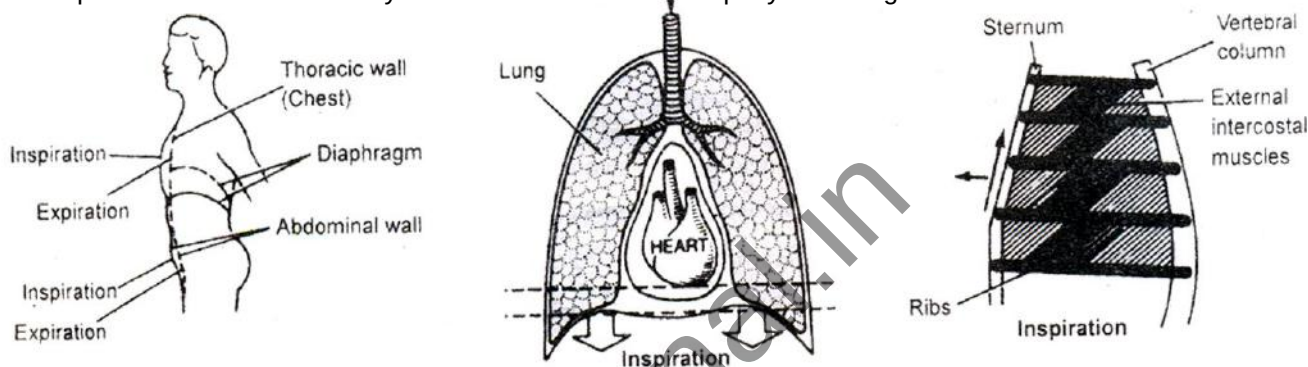
Inspiration

Expiration



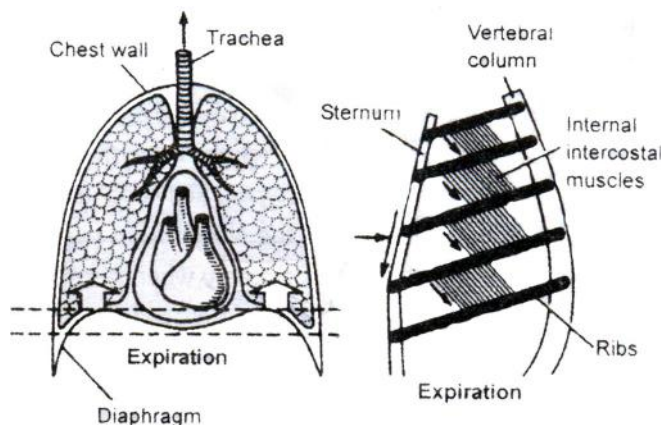
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

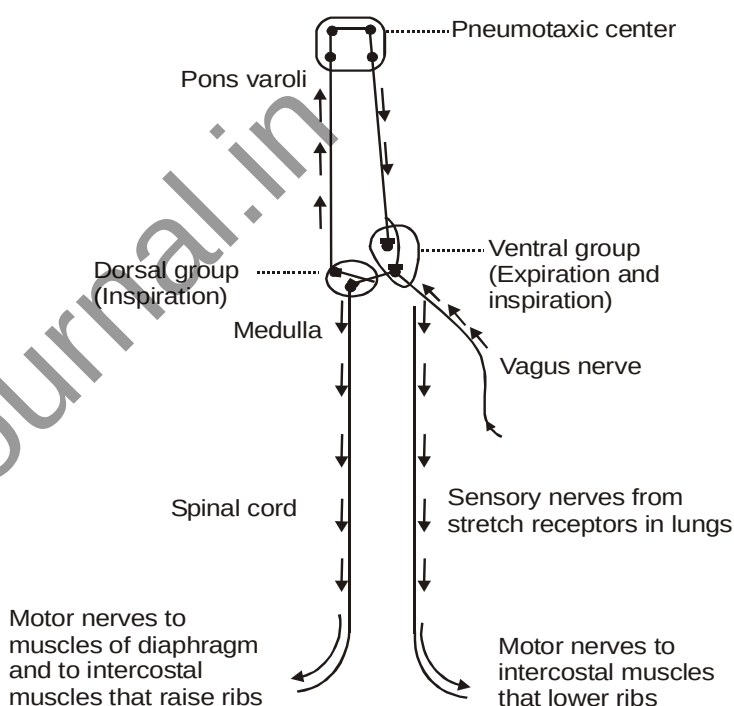


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

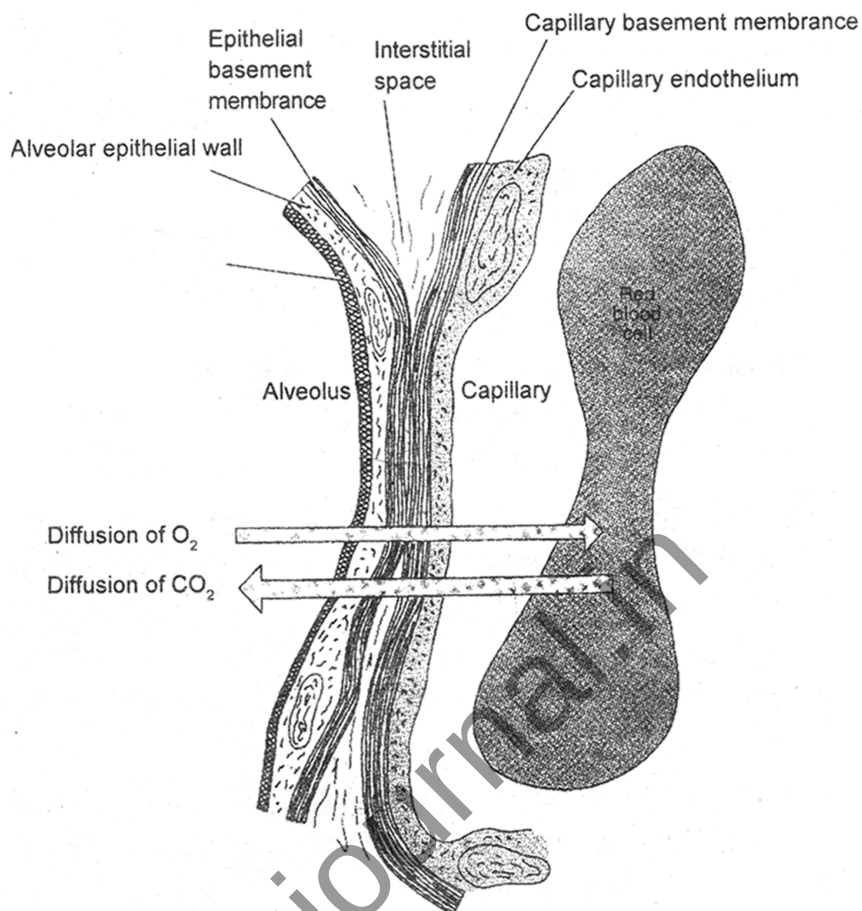
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

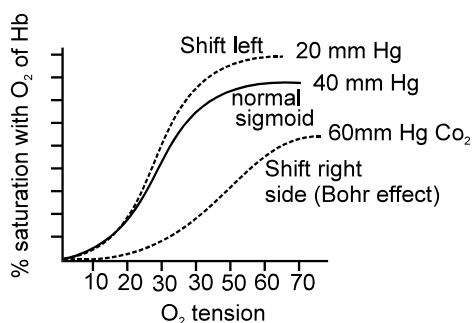
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25% O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

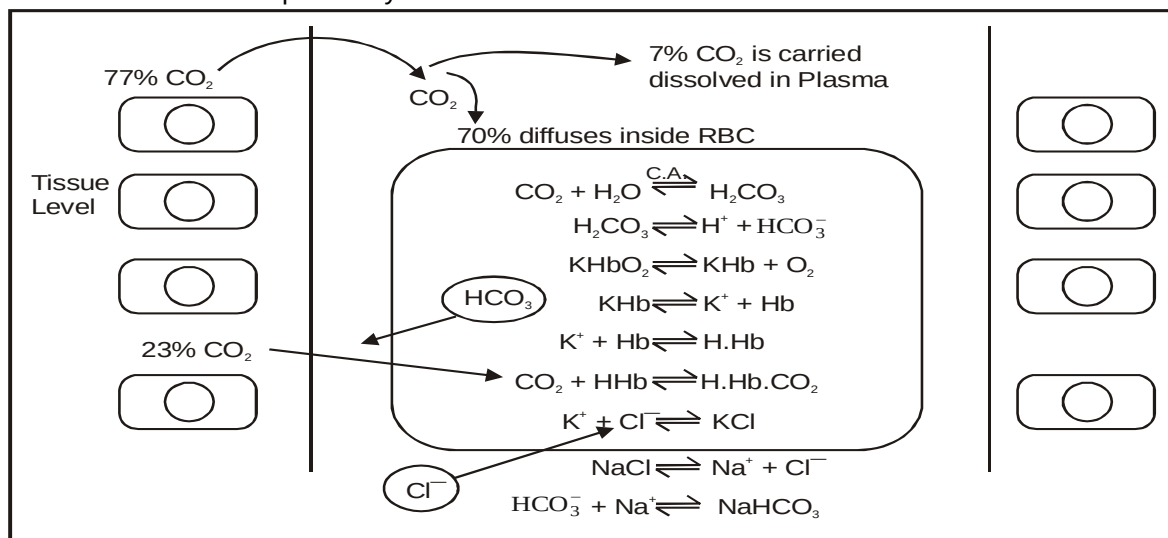
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

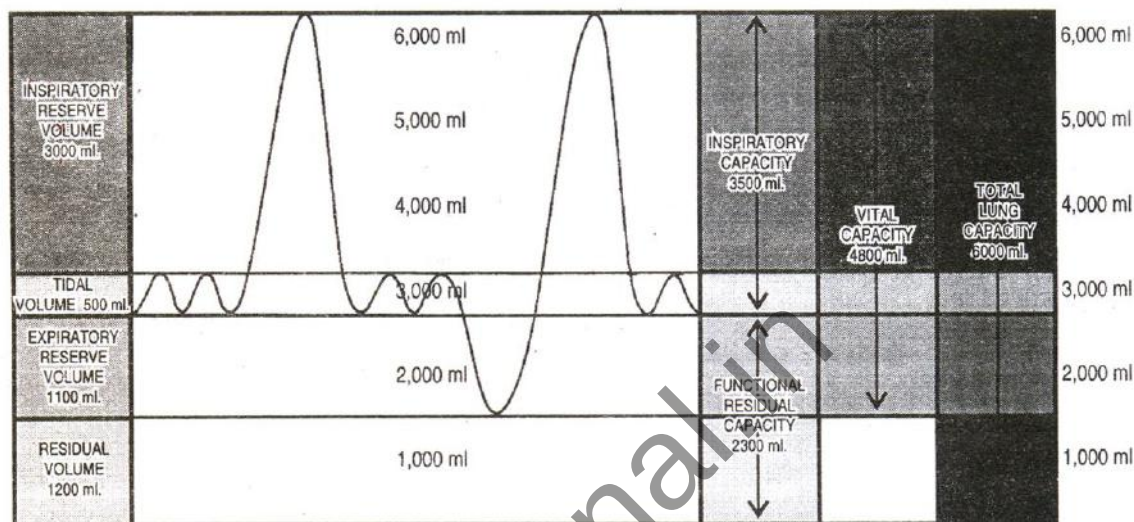
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
(1) Voice box (2) Vocal cord
(3) Trachea (4) None of these
- Q.119** Sound get converted into speech by-
(1) Tongue (2) Larynx
(3) Trachea (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
(1) 300 million (2) 450 million
(3) 750 million (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
(1) Envelop the kidney (2) Envelop the lung
(3) Envelop the liver (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
(1) Bronchi (2) Tracheae
(3) Alveoli (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
(1) Epiglottis (2) Tracheal valves
(3) Syrinx (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
(1) Three (2) Four
(3) Two (4) Five
- Q.125** Adams' apple corresponds to -
(1) Thyroid (2) Larynx
(3) Trachea (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
(1) Thickness
(2) Moistness
(3) Large respiratory surface
(4) Rich blood supply
- Q.127** The process of respiration is concerned with-
(1) Intake of O_2
(2) Liberation of O_2
(3) Liberation of energy
(4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
(1) Tributaries (2) Alveoli
(3) Turbinates (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
(1) Ribs
(2) Abdominal muscles
(3) Larynx
(4) Diaphragm
- Q.130** Inspiration would not occur if the -
(1) Diaphragm is lowered
(2) Diaphragm is elevated
(3) Ribs are elevated
(4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
(1) Internal respiration
(2) Cellular respiration
(3) External respiration
(4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
(1) Mainly in the erythrocytes
(2) Mainly in the blood plasma
(3) Mainly in the interstitial fluid
(4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
(1) Terminal tracheoles
(2) Tracheoles
(3) Alveoli
(4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

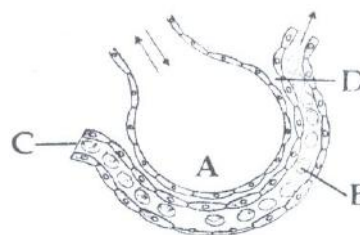
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing , by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1
Ques.	20	21	22	23	24														
Ans.	2	2	3	2	4														

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

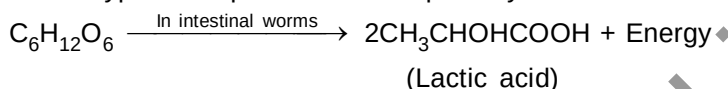
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

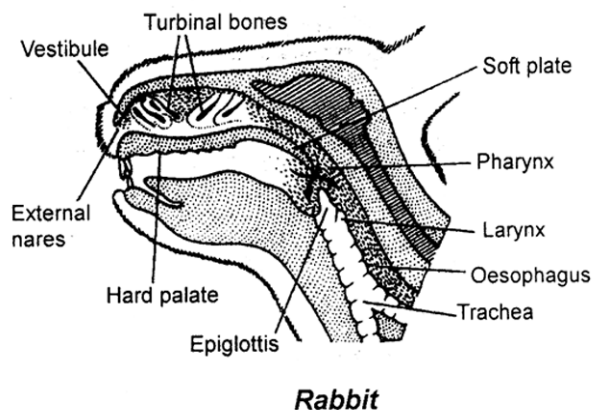
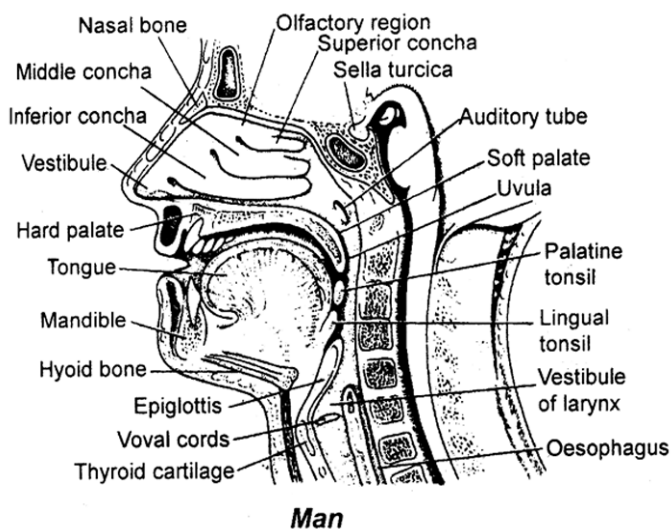
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

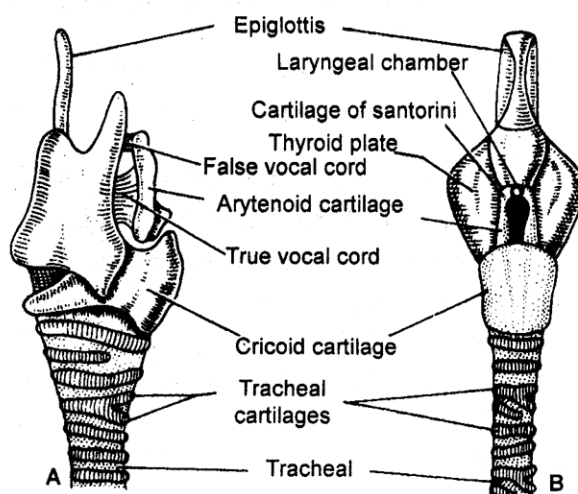
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

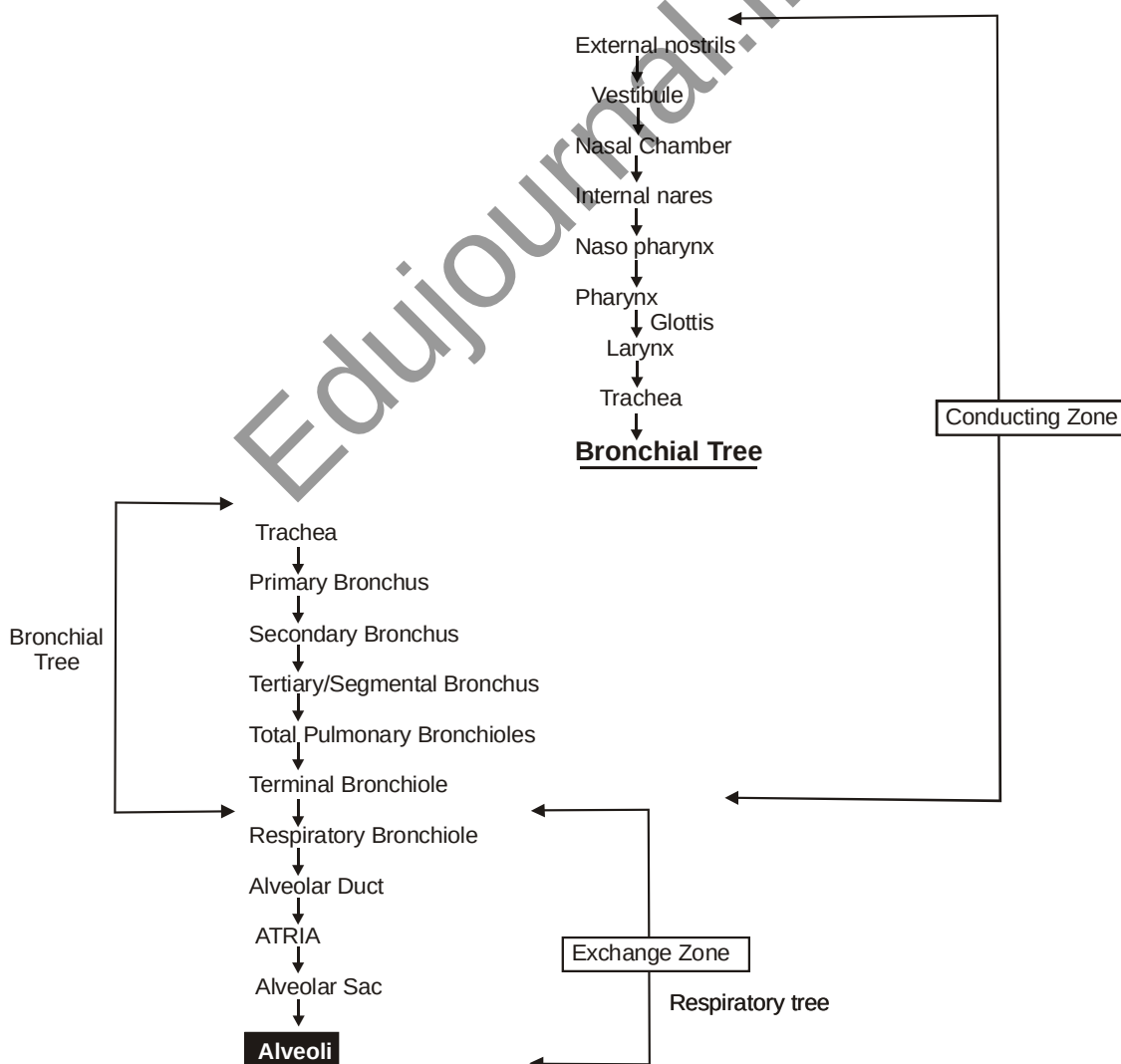
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

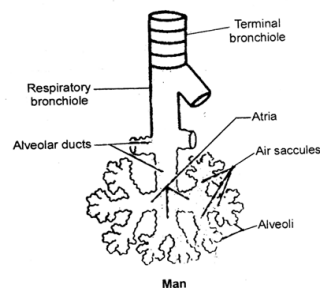
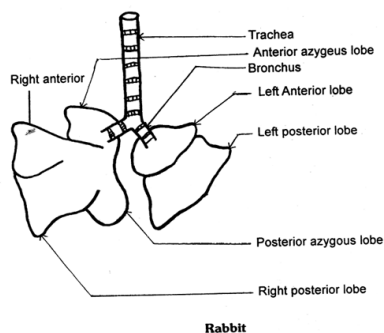
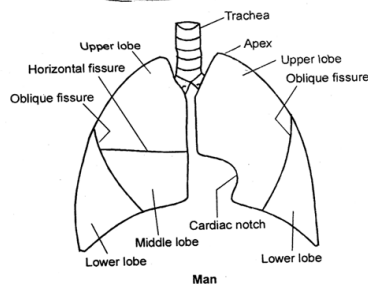
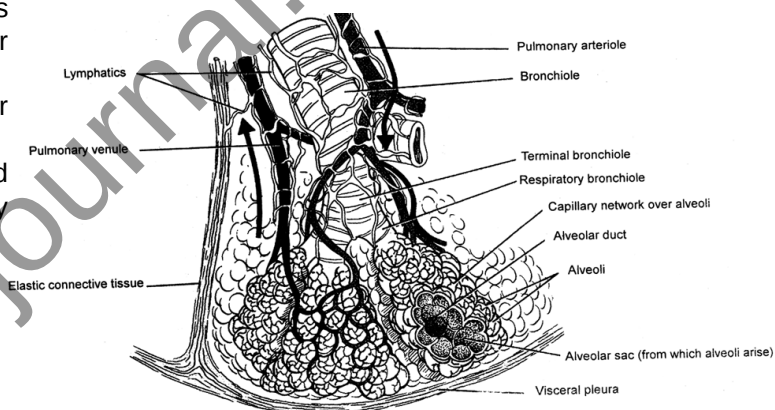
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

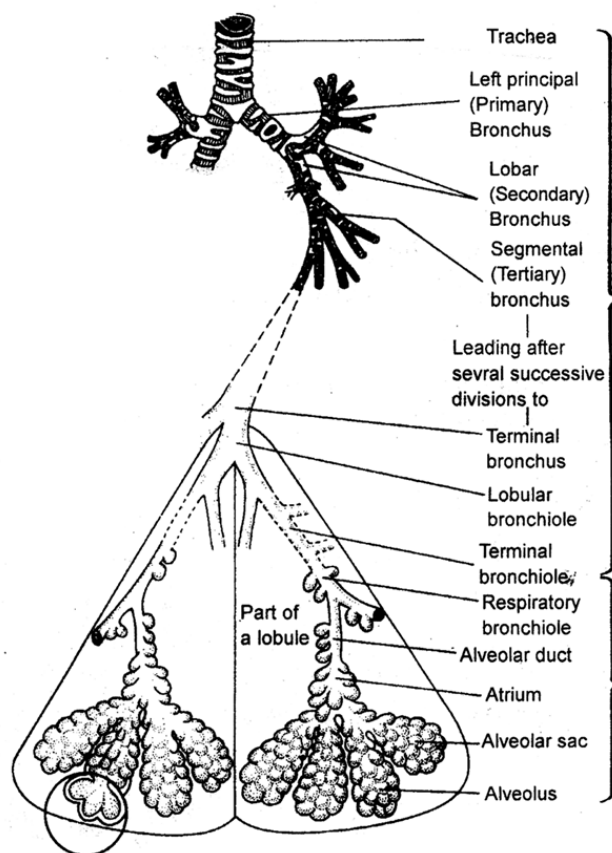
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

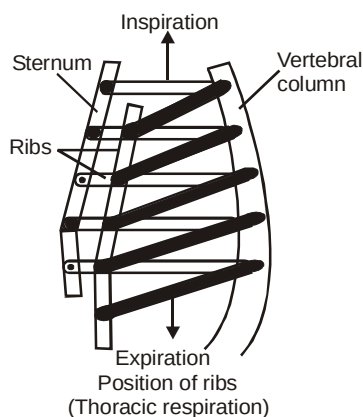
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

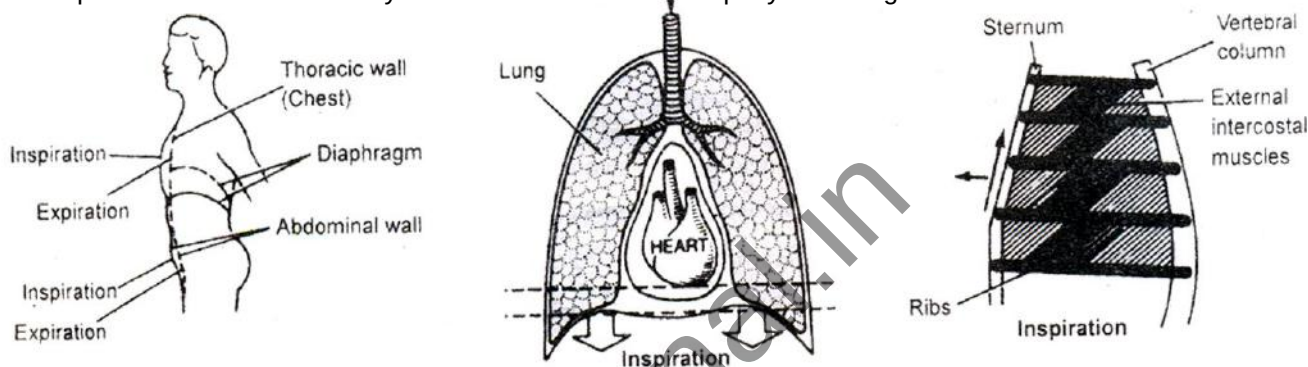
Inspiration

Expiration



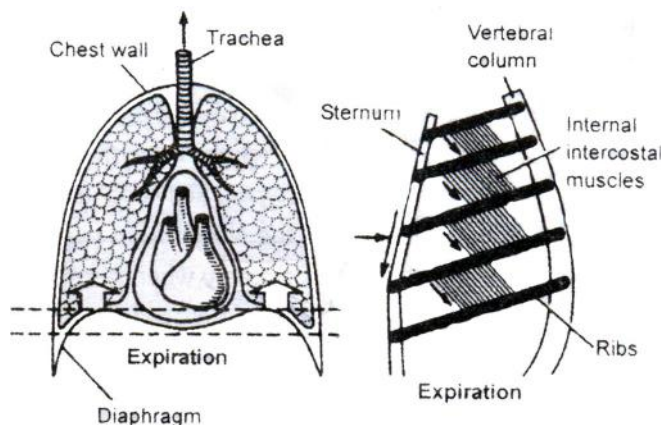
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

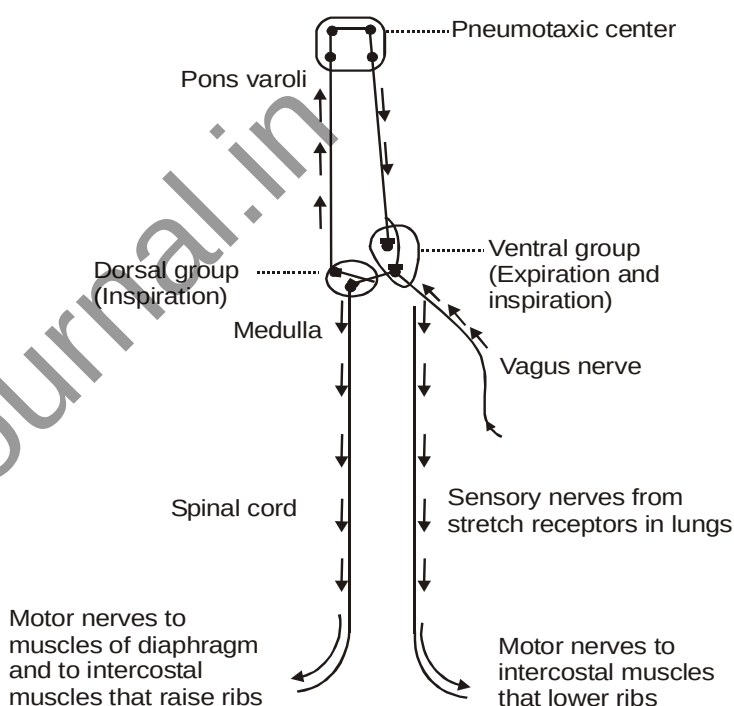


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

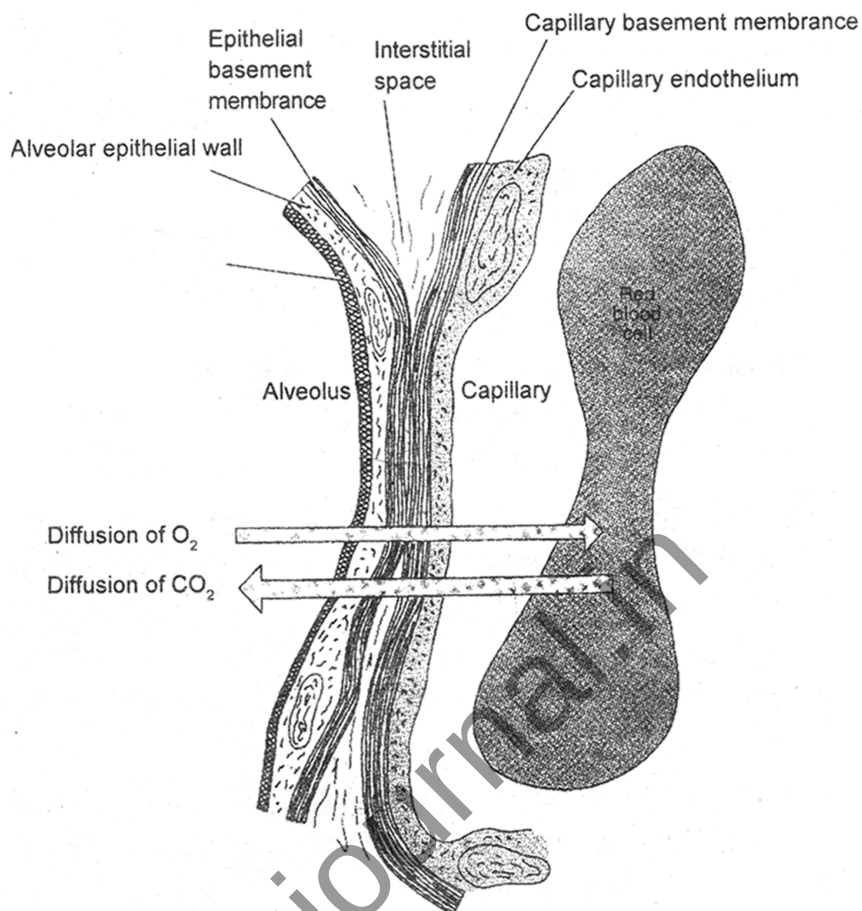
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

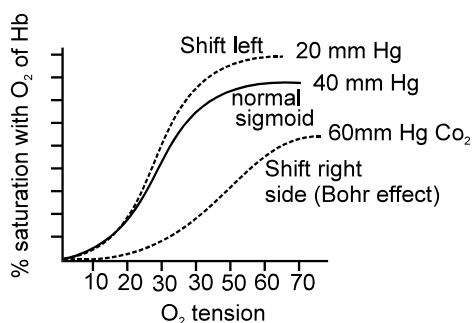
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

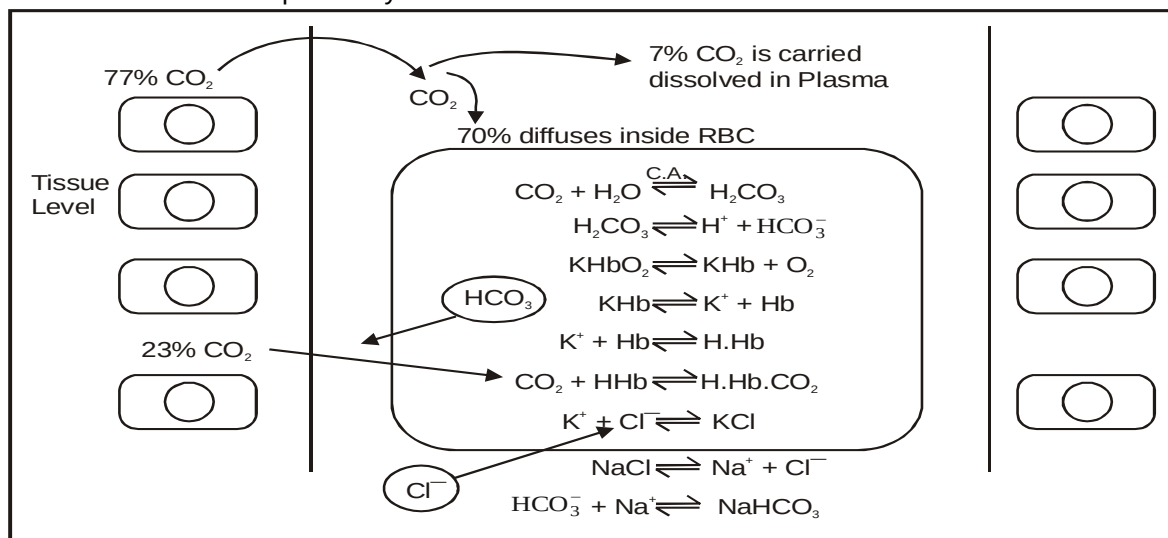
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

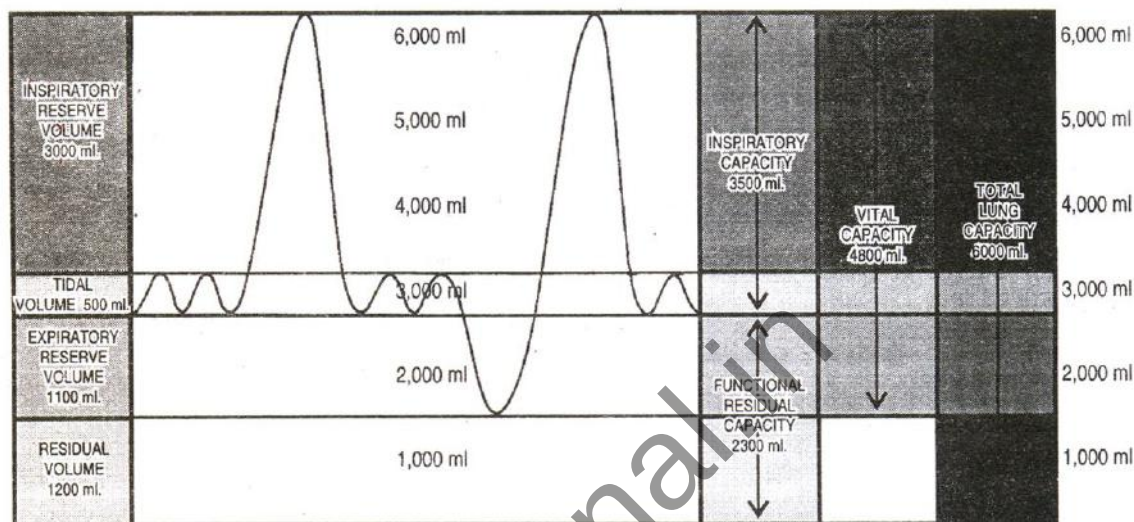
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned}
 \text{IC} &= \text{TV} + \text{IRV} \\
 &= 500 + 3000 \\
 &= 3500 \text{ mL}
 \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbamino haemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box
 - (2) Vocal cord
 - (3) Trachea
 - (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue
 - (2) Larynx
 - (3) Trachea
 - (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million
 - (2) 450 million
 - (3) 750 million
 - (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney
 - (2) Envelop the lung
 - (3) Envelop the liver
 - (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi
 - (2) Tracheae
 - (3) Alveoli
 - (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis
 - (2) Tracheal valves
 - (3) Syrinx
 - (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three
 - (2) Four
 - (3) Two
 - (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid
 - (2) Larynx
 - (3) Trachea
 - (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries
 - (2) Alveoli
 - (3) Turbinates
 - (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

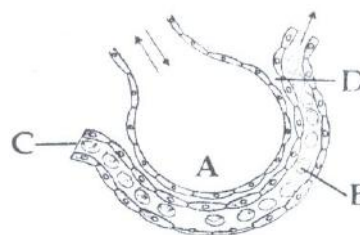
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing , by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

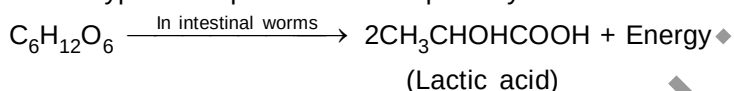
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

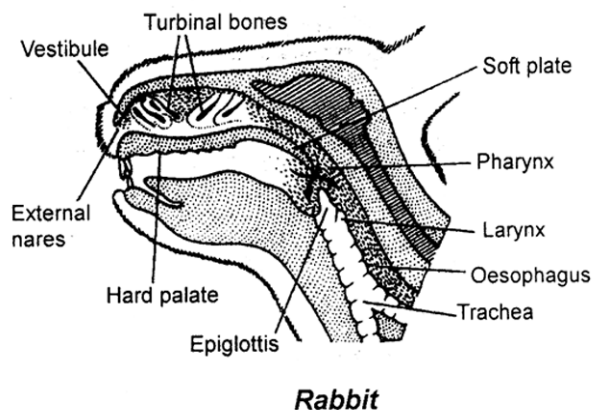
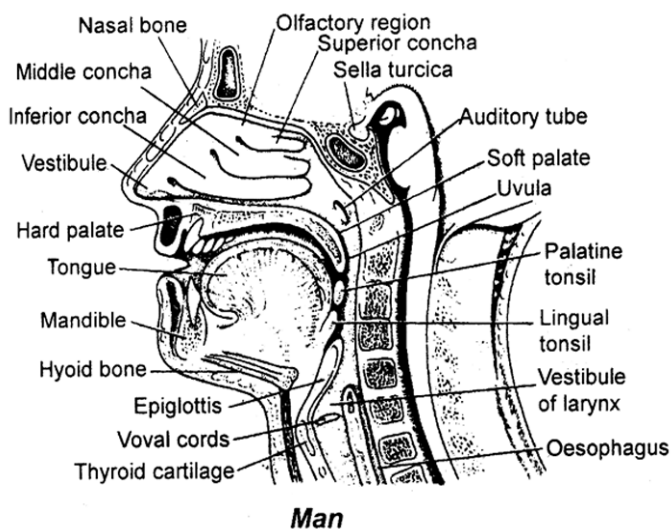
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

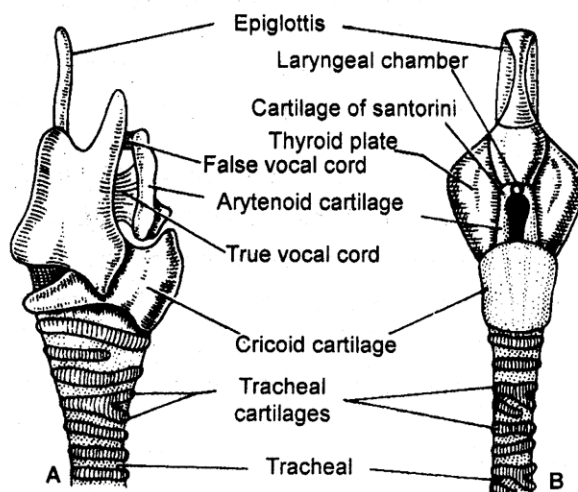
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

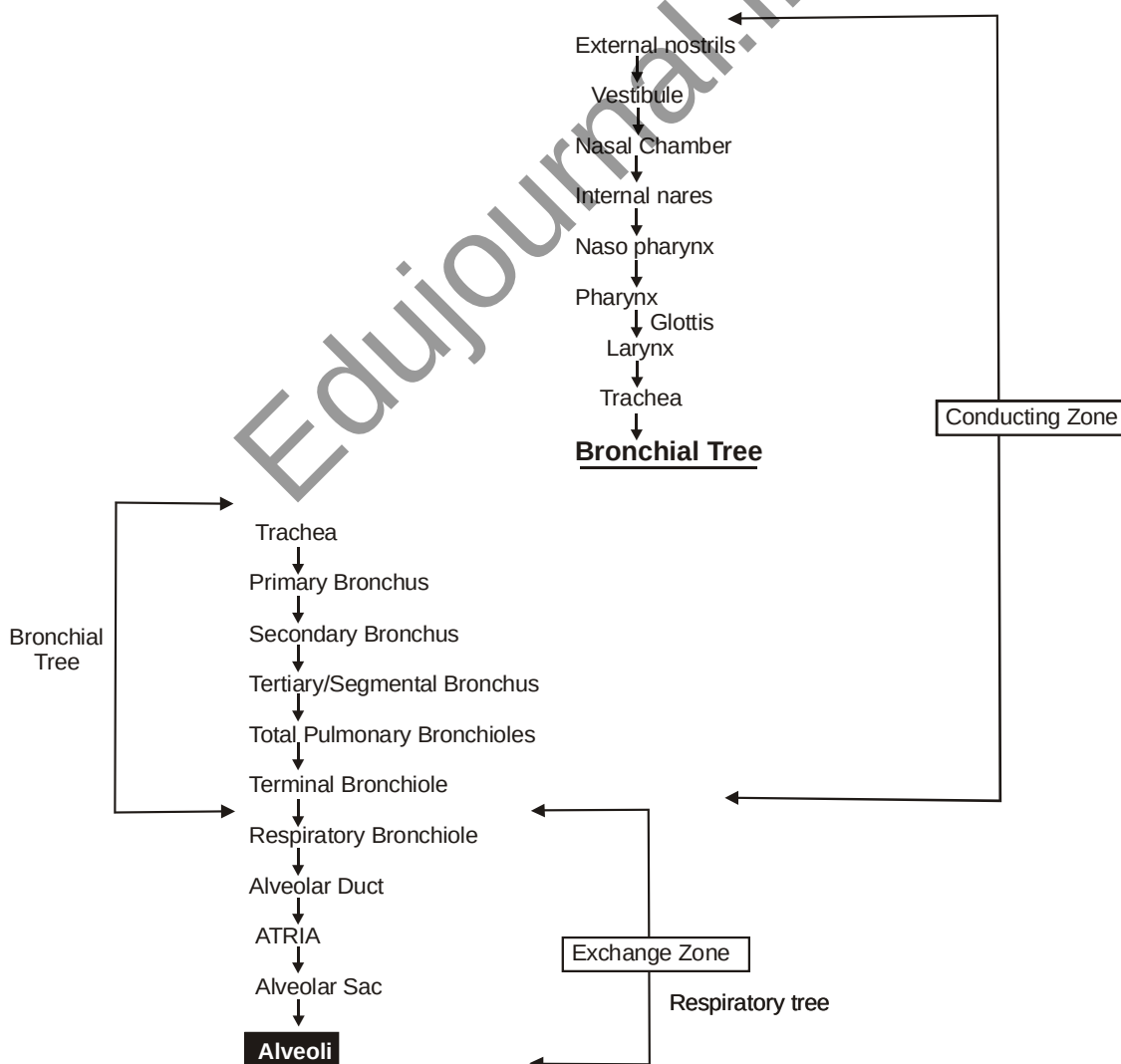
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters thoracic cavity, it divides into two branches called primary bronchus. Branches of primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

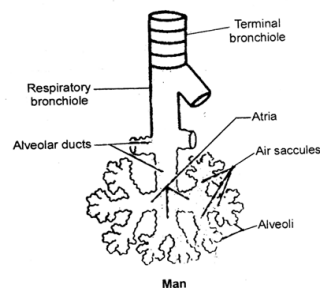
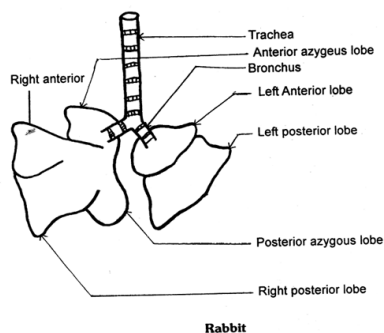
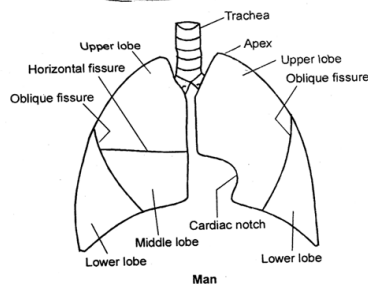
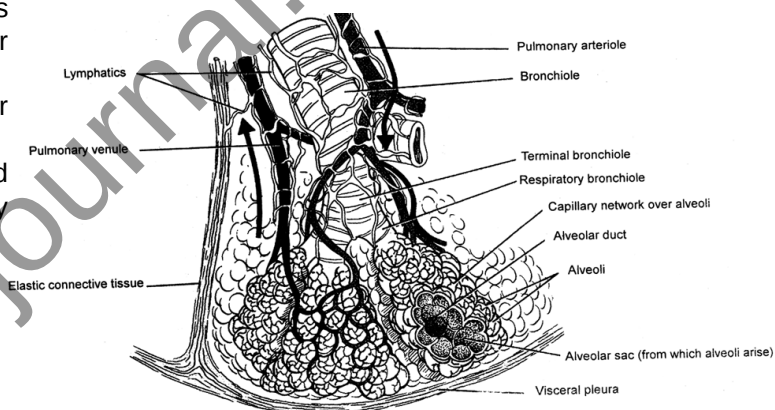
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

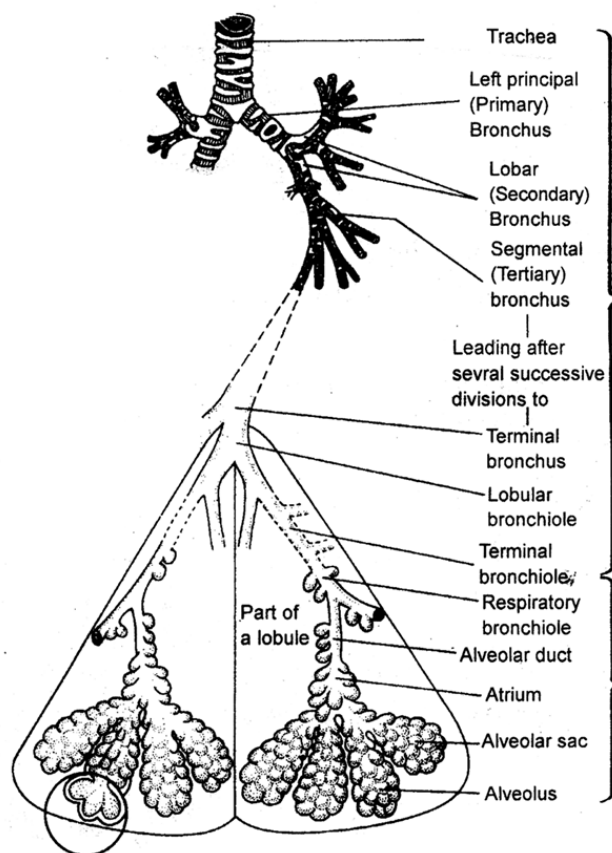
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

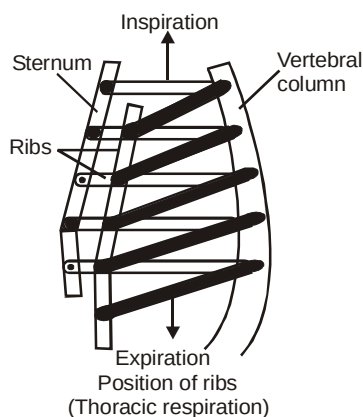
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

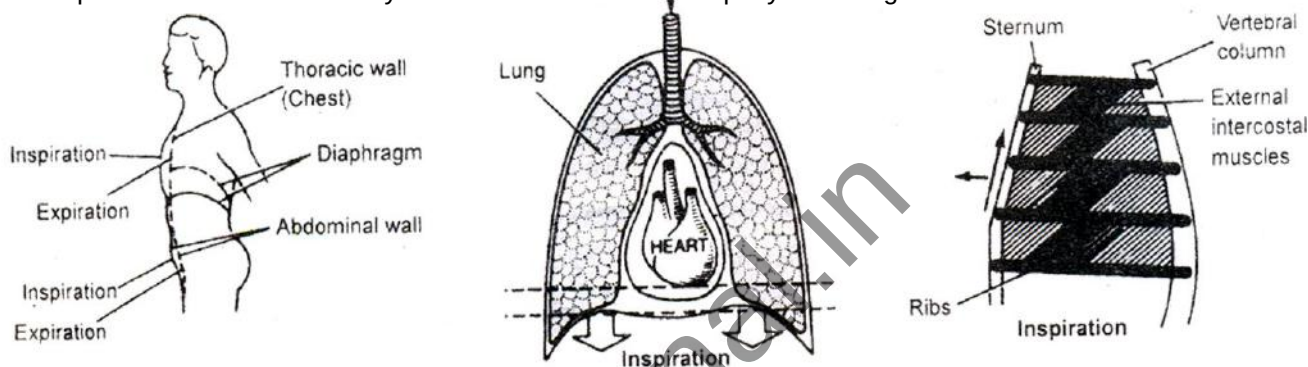
Inspiration

Expiration



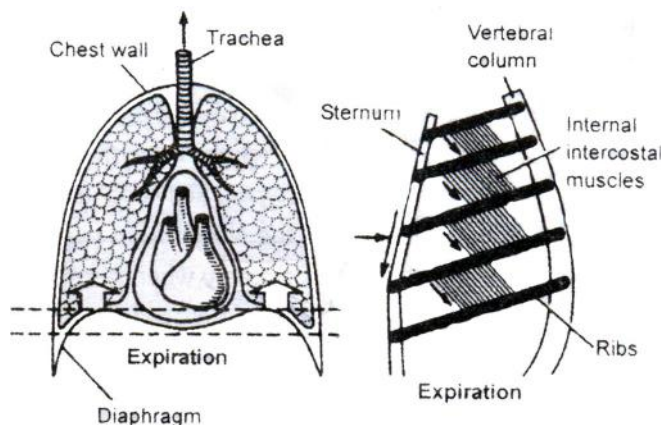
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

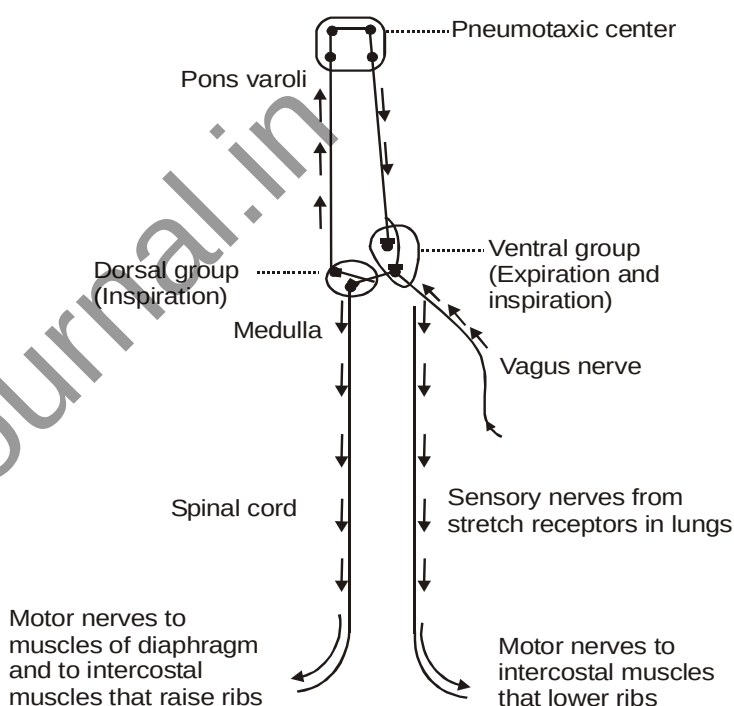


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

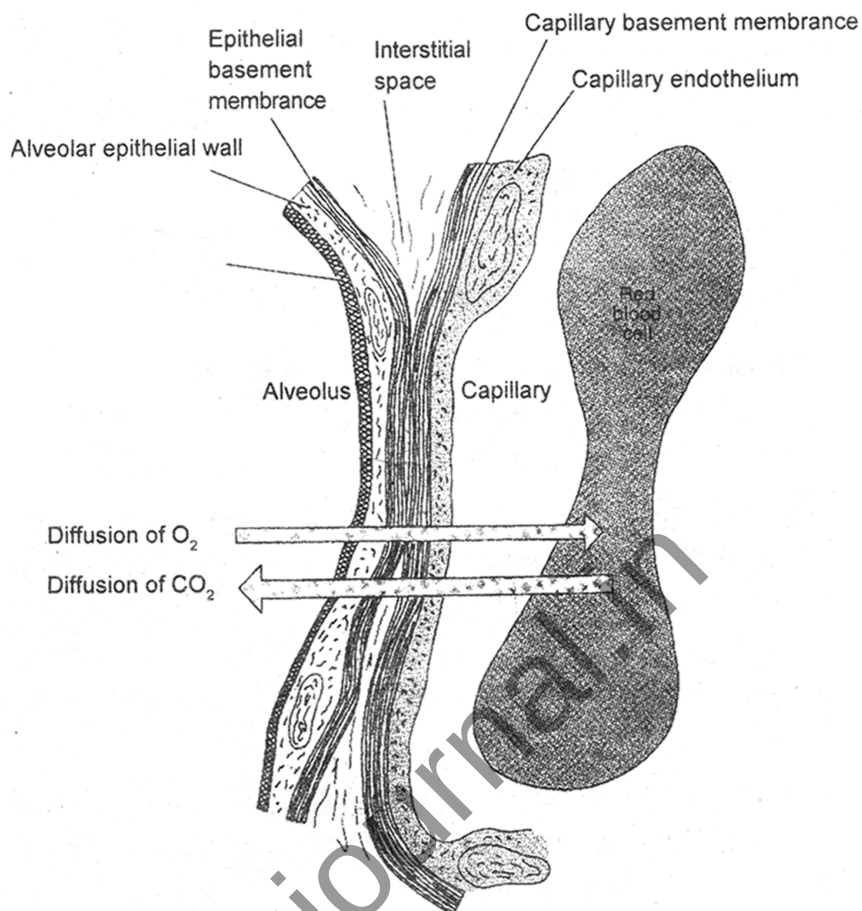
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

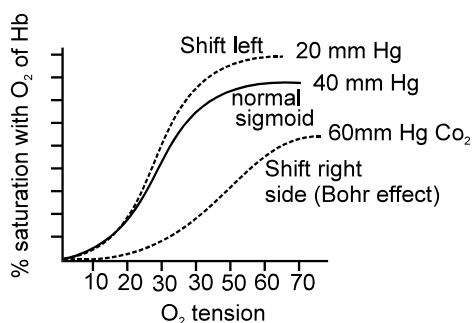
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25% O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

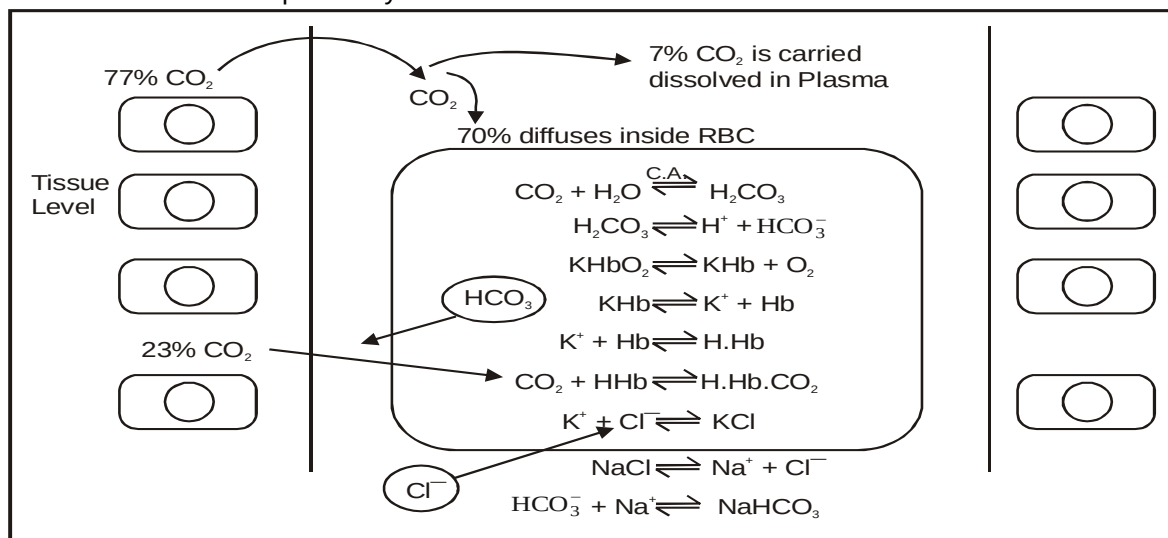
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

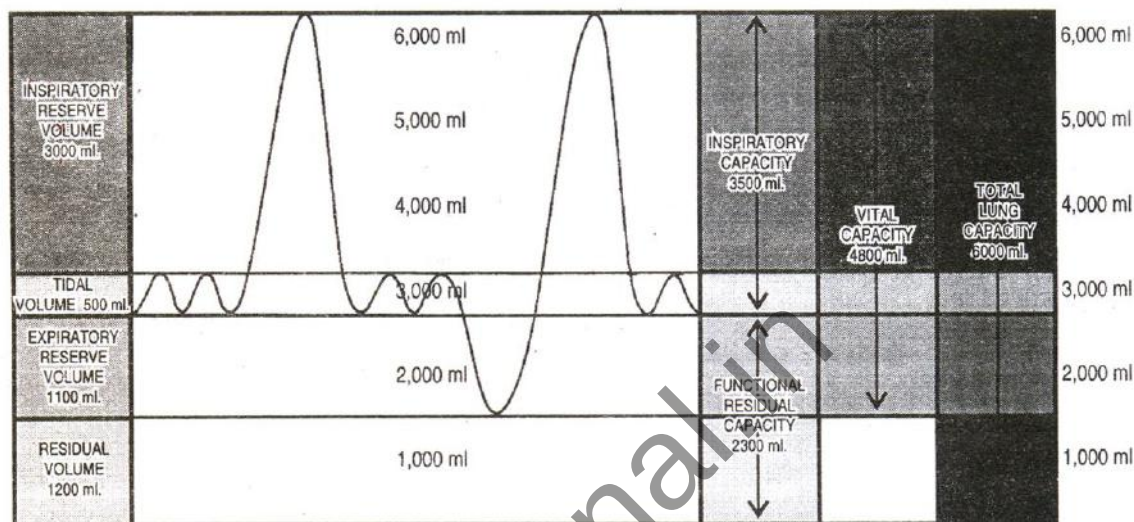
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO₂ is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO₂ with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbamino haemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box (2) Vocal cord
 - (3) Trachea (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue (2) Larynx
 - (3) Trachea (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million (2) 450 million
 - (3) 750 million (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney (2) Envelop the lung
 - (3) Envelop the liver (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi (2) Tracheae
 - (3) Alveoli (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis (2) Tracheal valves
 - (3) Syrinx (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three (2) Four
 - (3) Two (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid (2) Larynx
 - (3) Trachea (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries (2) Alveoli
 - (3) Turbinates (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Hering breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rings in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Laterally incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

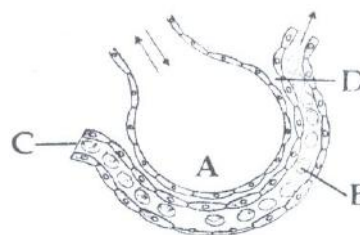
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing , by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1
Ques.	20	21	22	23	24														
Ans.	2	2	3	2	4														

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- (i) In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- (ii) Exchange of gases occurs on the principle of diffusion, through moist body surface.
- (iii) Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- (i) In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- (ii) Indirect respiration is found in complex and higher form of organism.
- (iii) Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- (i) Respiration which occurs in presence of oxygen is called aerobic respiration.
- (ii) The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- (iii) Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- (i) External respiration is also called **breathing** or **ventilation**.

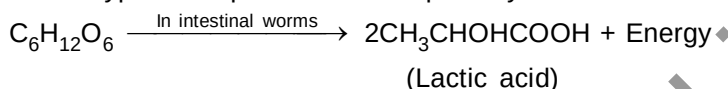
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

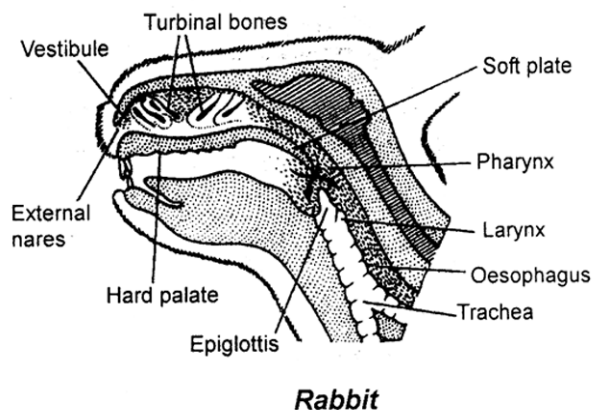
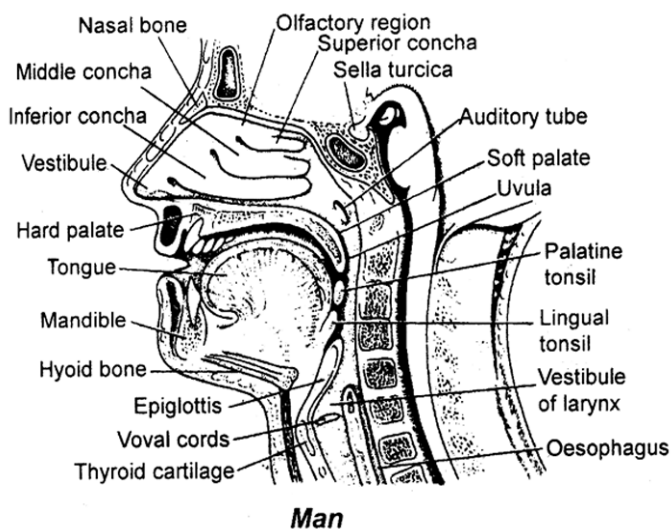
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

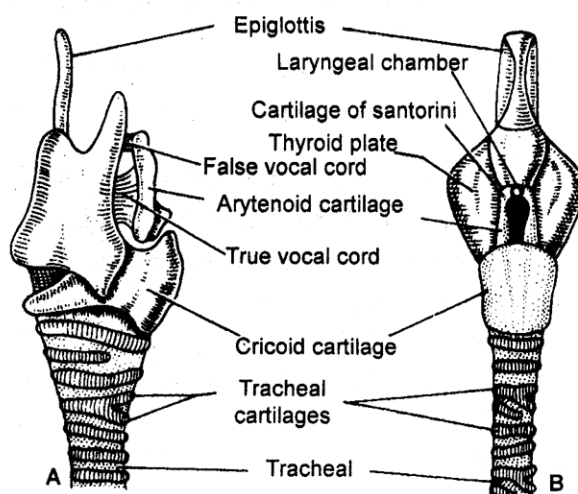
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

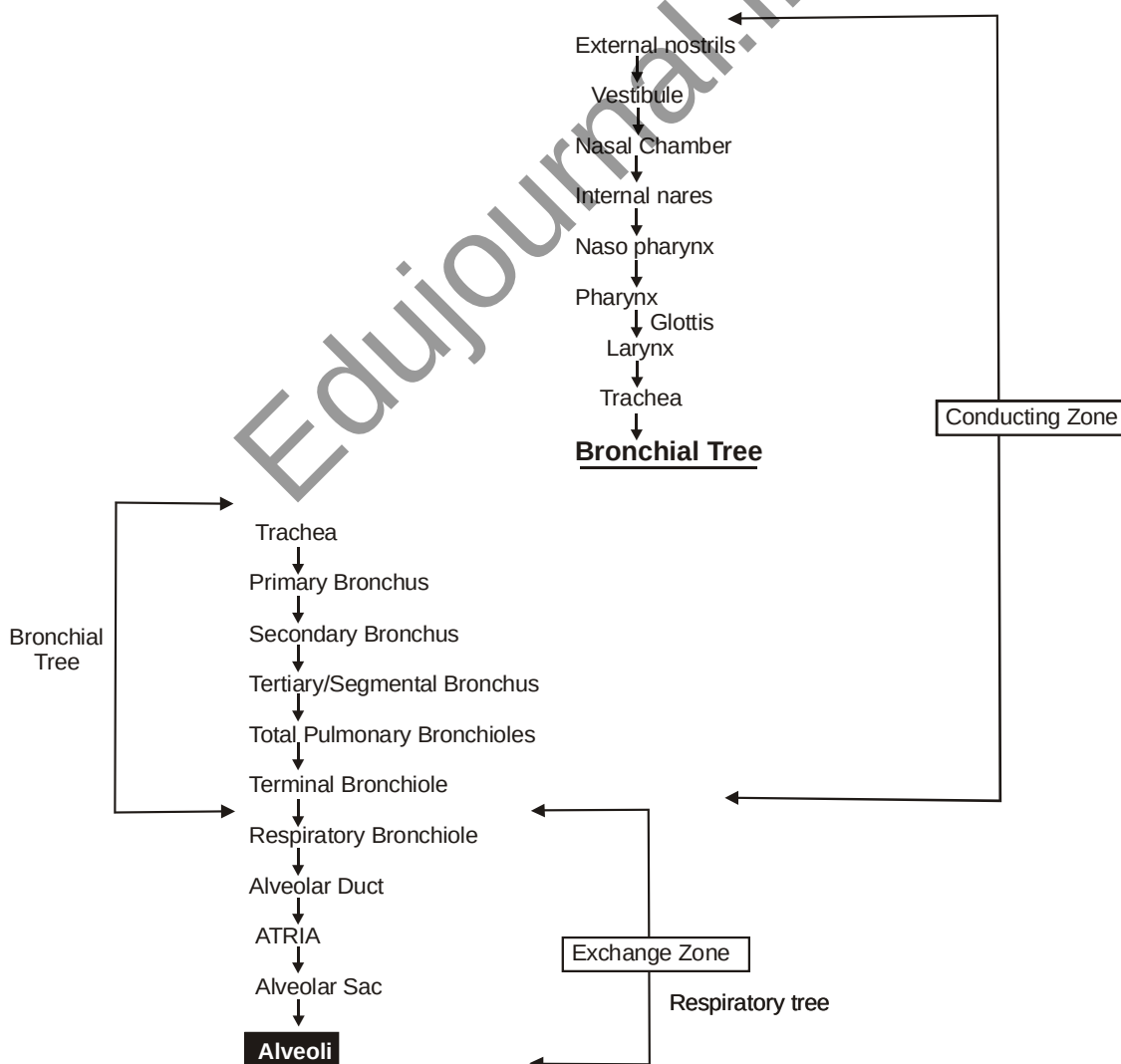
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enter into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

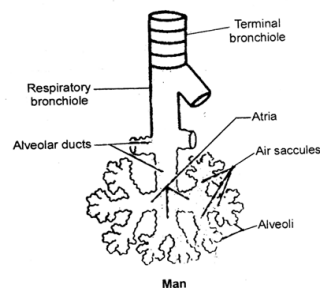
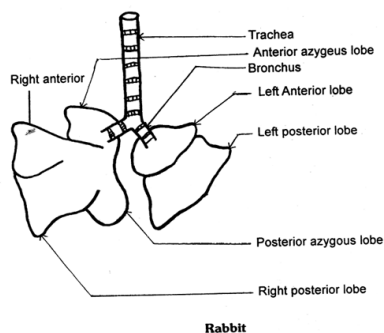
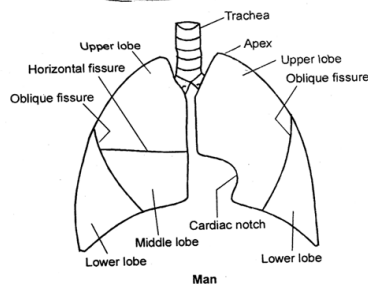
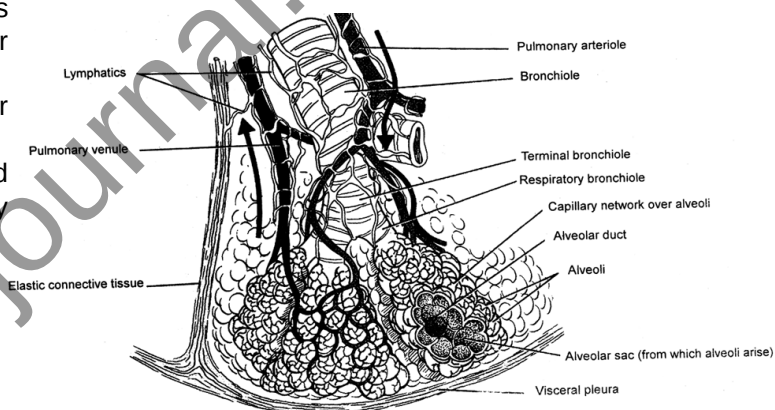
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

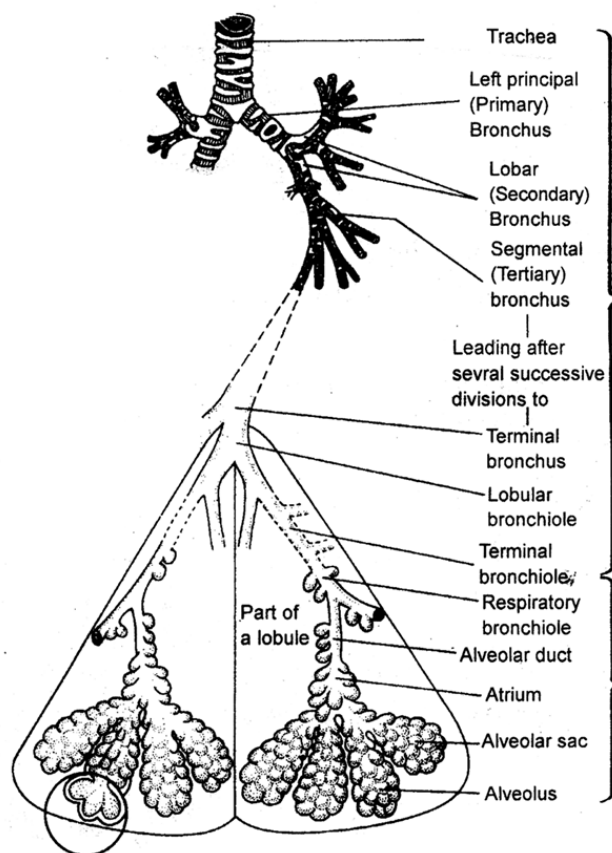
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

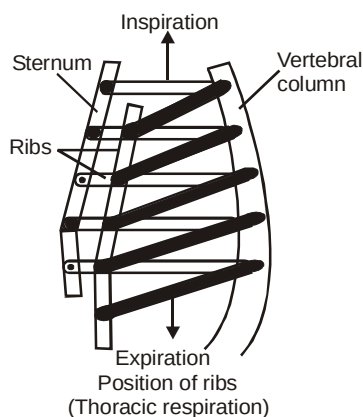
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

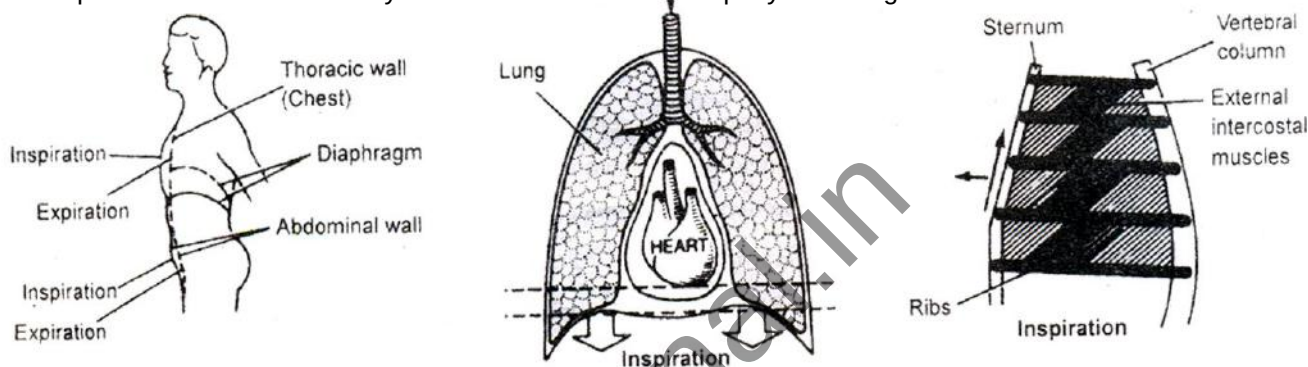
Inspiration

Expiration



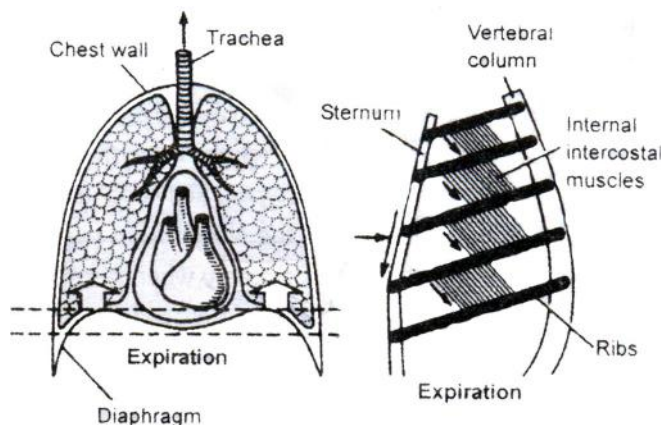
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

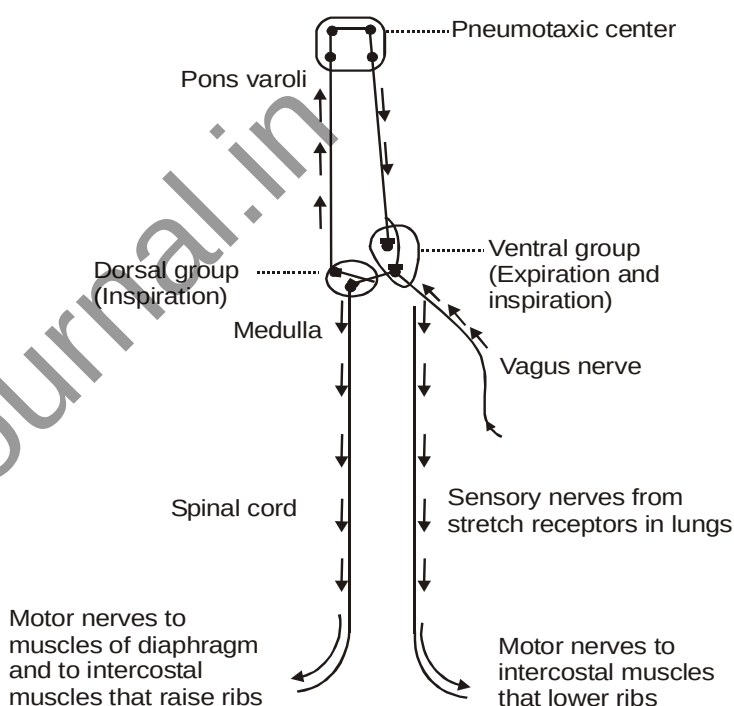


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

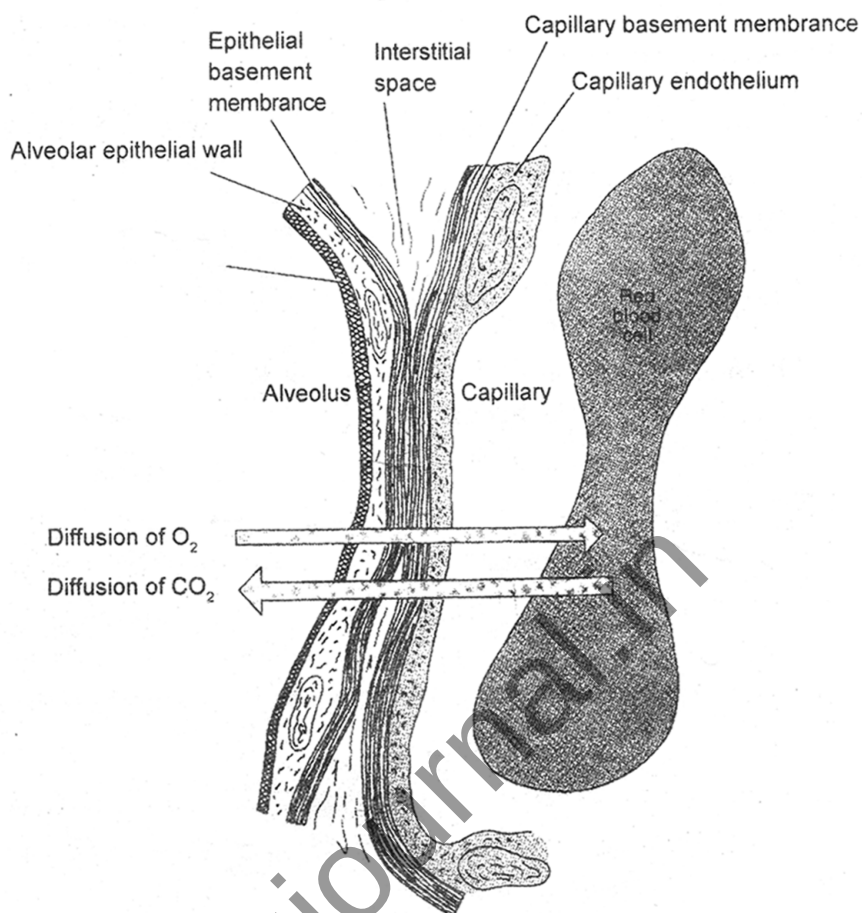
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

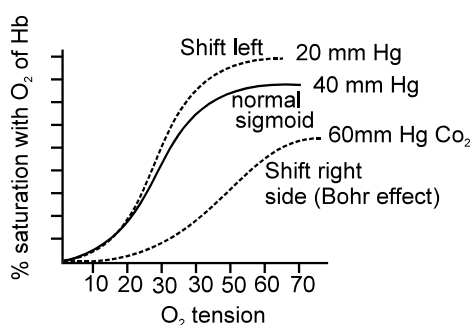
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25% O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

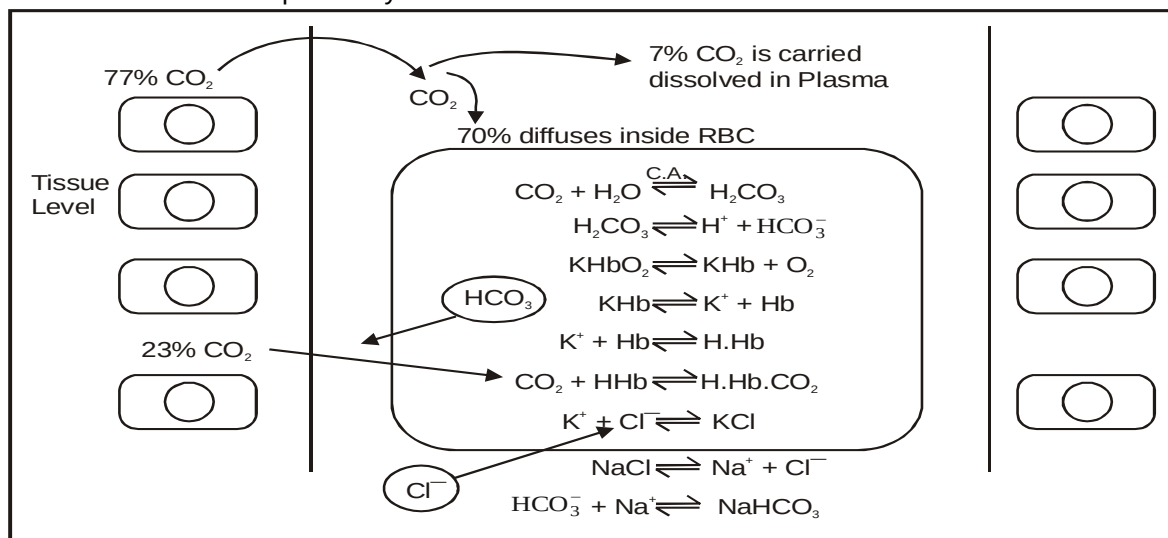
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

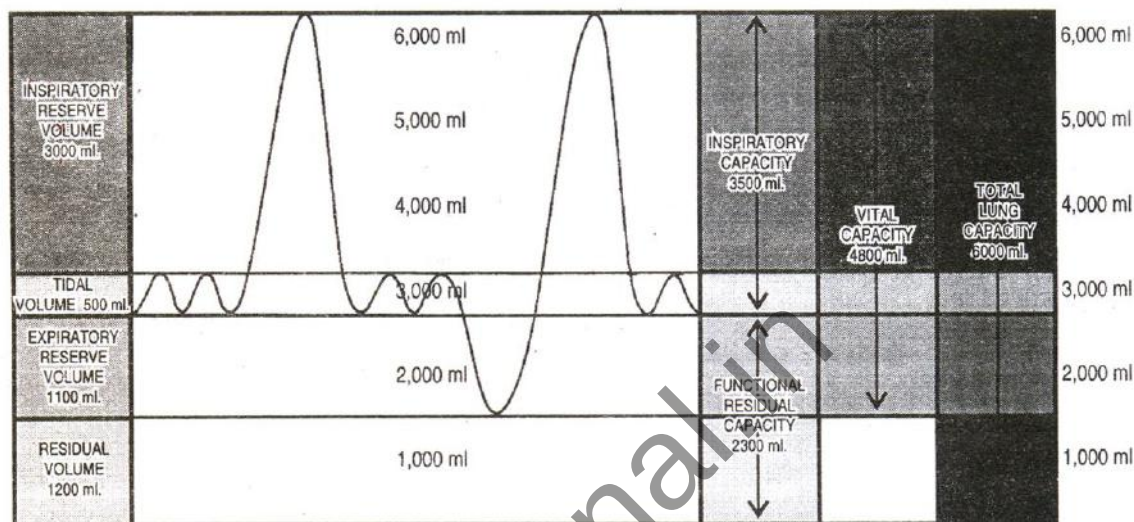
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO₂ is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO₂ with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- Dead volume
 - Dead space
 - Both A and B
 - Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- Omosis
 - Diffusion
 - Active transport
 - None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- Spherometer
 - Spirometer
 - Sphygmomanometer
 - Barometer
- Q.28** Air moves into the lungs when-
- Atmospheric pressure is less than pressure within the lungs
 - Atmospheric pressure is equal to the pressure within the lungs
 - Atmospheric pressure is greater than pressure within the lungs
 - None of these
- Q.29** Normal rate of breathing in man is-
- 20-30 times per minute
 - 12-14 times per minute
 - 5-10 times per minute
 - 40-50 times per minute
- Q.30** Choose the correct equation-
- Total capacity of lungs = Vital capacity + Residual air
 - Vital capacity of lungs = Tidal air + Complemental air
 - Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- Hypothalamus
 - Medulla oblongata
 - Cerebellum
 - Thalamus
- Q.32** Which of the following statements is correct-
- Inspiration is an active process
 - Expiration is an active process
 - Inspiration is a passive process
 - Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- Oxygen in trachea
 - Concentration of O_2
 - Diaphragm expansion
 - Concentration of CO_2
- Q.34** The breathing rate in a child is-
- Same as in an adult man
 - Less than in an adult man
 - More than in an adult man
 - None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- Inspiration
 - Normal respiration
 - Aspiration
 - Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- Backward and upward
 - Forward and upward
 - Backward and downward
 - Forward and downward
- Q.37** Tidal air in mammals is-
- Total air that can be drawn into lungs
 - Air that normally goes in and comes out of lungs during breathing
 - Air that is left in the lungs after normal expiration
 - Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
(1) Voice box (2) Vocal cord
(3) Trachea (4) None of these
- Q.119** Sound get converted into speech by-
(1) Tongue (2) Larynx
(3) Trachea (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
(1) 300 million (2) 450 million
(3) 750 million (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
(1) Envelop the kidney (2) Envelop the lung
(3) Envelop the liver (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
(1) Bronchi (2) Tracheae
(3) Alveoli (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
(1) Epiglottis (2) Tracheal valves
(3) Syrinx (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
(1) Three (2) Four
(3) Two (4) Five
- Q.125** Adams' apple corresponds to -
(1) Thyroid (2) Larynx
(3) Trachea (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
(1) Thickness
(2) Moistness
(3) Large respiratory surface
(4) Rich blood supply
- Q.127** The process of respiration is concerned with-
(1) Intake of O_2
(2) Liberation of O_2
(3) Liberation of energy
(4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
(1) Tributaries (2) Alveoli
(3) Turbinates (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
(1) Ribs
(2) Abdominal muscles
(3) Larynx
(4) Diaphragm
- Q.130** Inspiration would not occur if the -
(1) Diaphragm is lowered
(2) Diaphragm is elevated
(3) Ribs are elevated
(4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
(1) Internal respiration
(2) Cellular respiration
(3) External respiration
(4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
(1) Mainly in the erythrocytes
(2) Mainly in the blood plasma
(3) Mainly in the interstitial fluid
(4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
(1) Terminal tracheoles
(2) Tracheoles
(3) Alveoli
(4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Hering breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rings in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Laterally incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

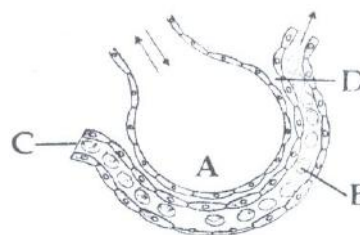
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:

- (1) Tongue
- (2) Epiglottis
- (3) Diaphragm
- (4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO₂) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO₂ in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing , by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

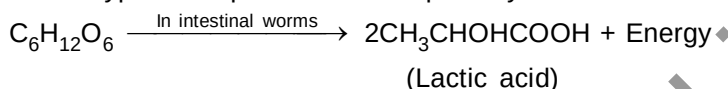
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

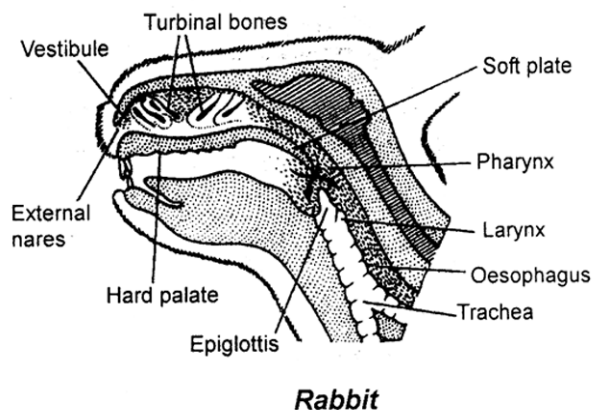
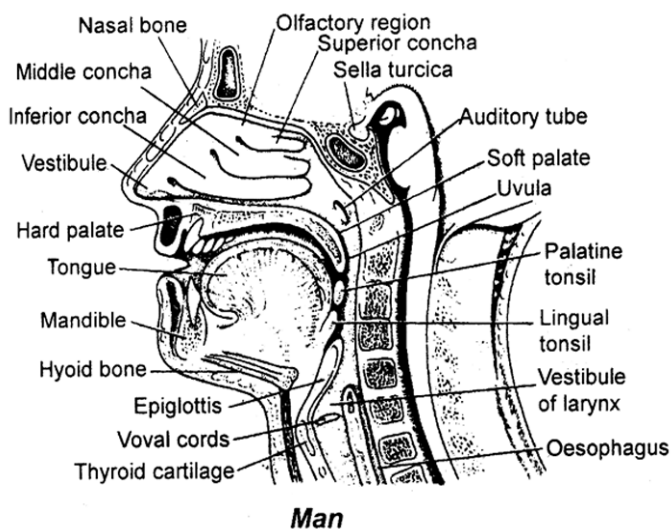
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

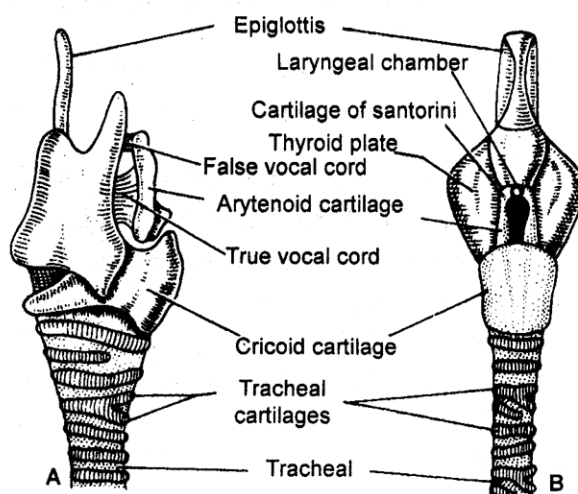
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

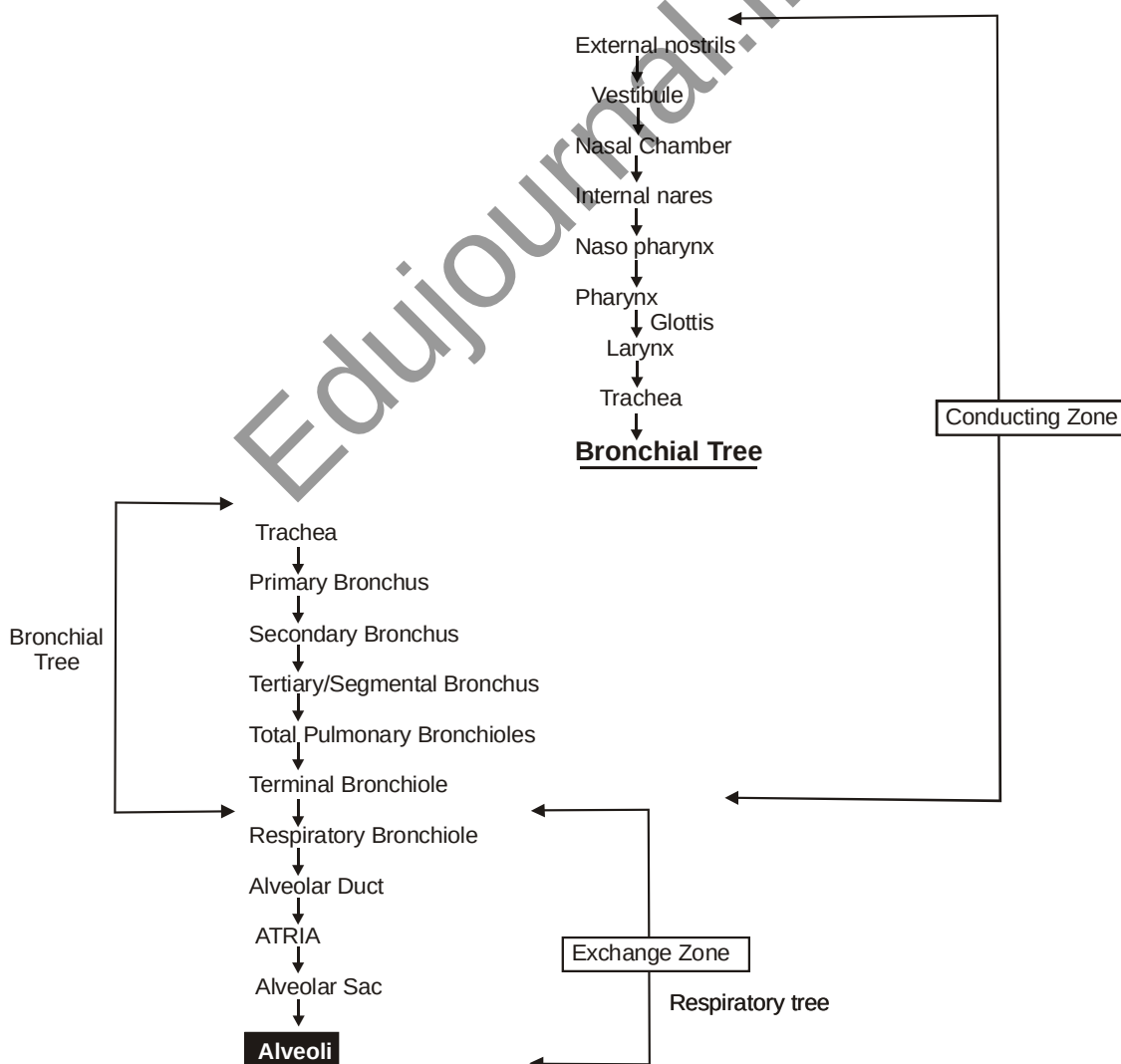
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enter into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

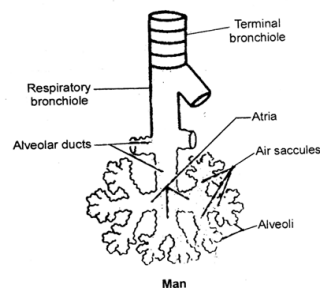
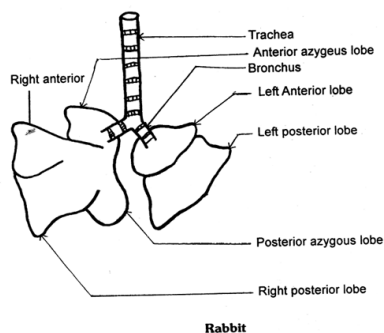
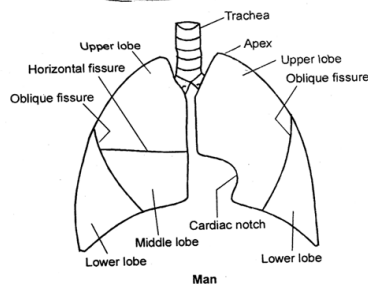
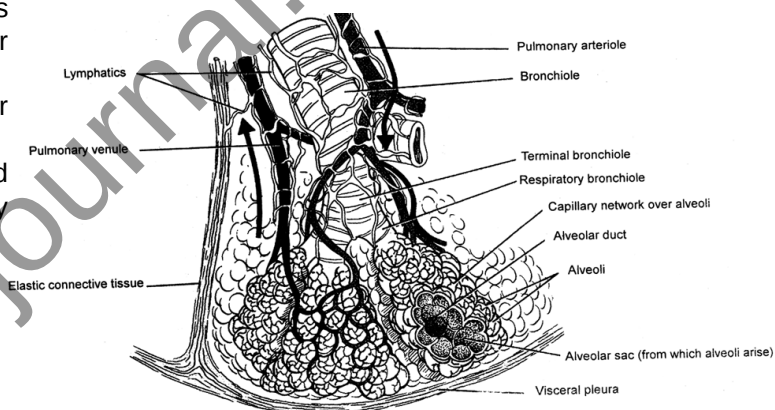
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

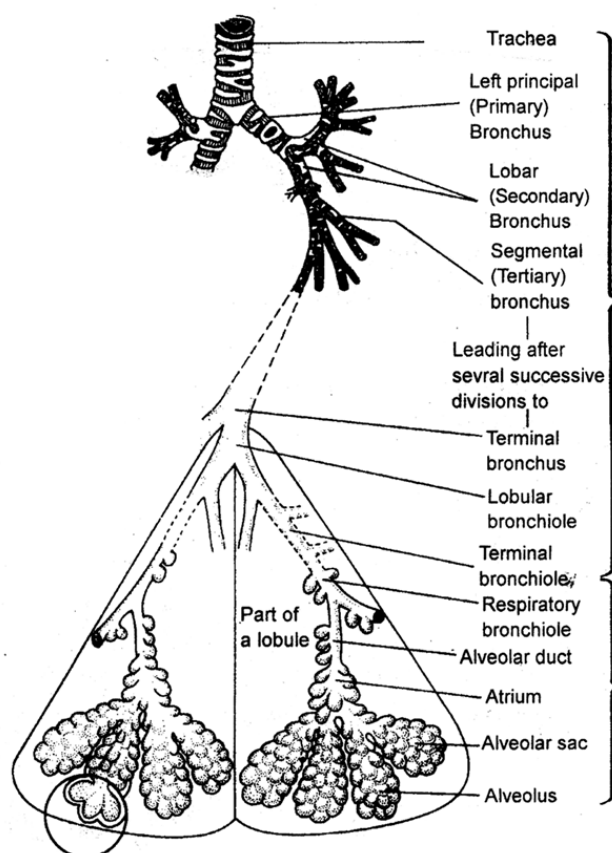
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

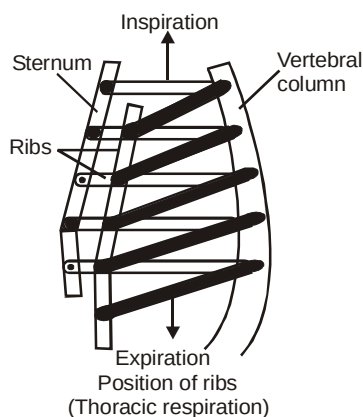
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

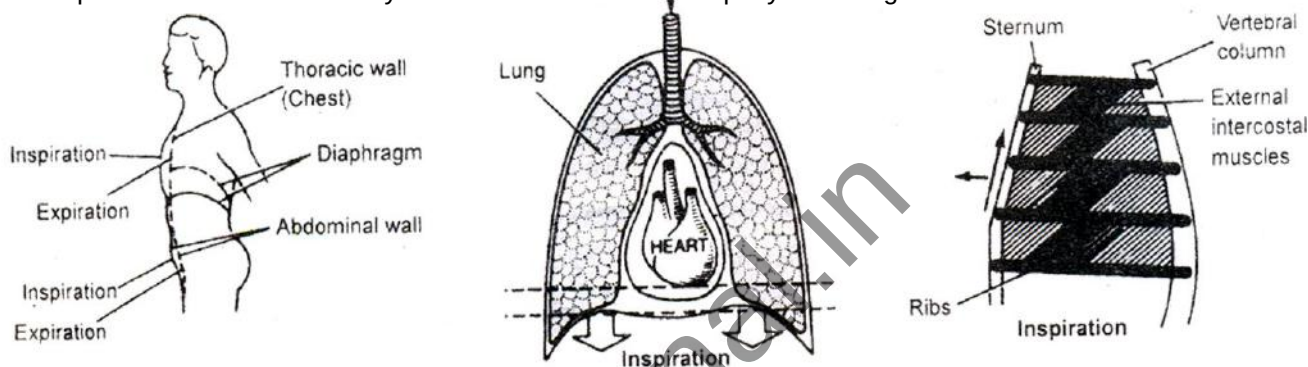
Inspiration

Expiration



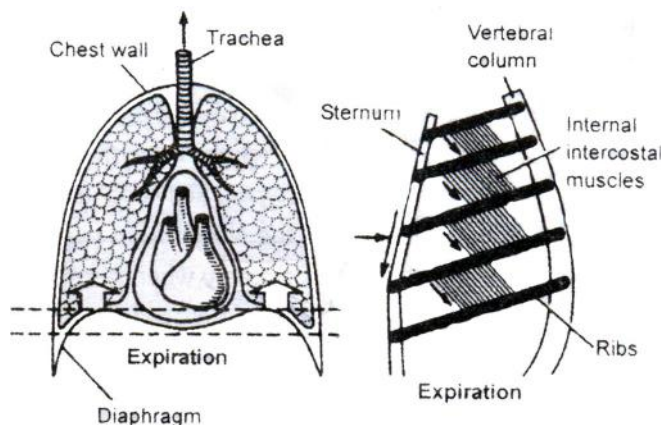
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strenuous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been identified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group. During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

The **Heiring breuer reflex arch** :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

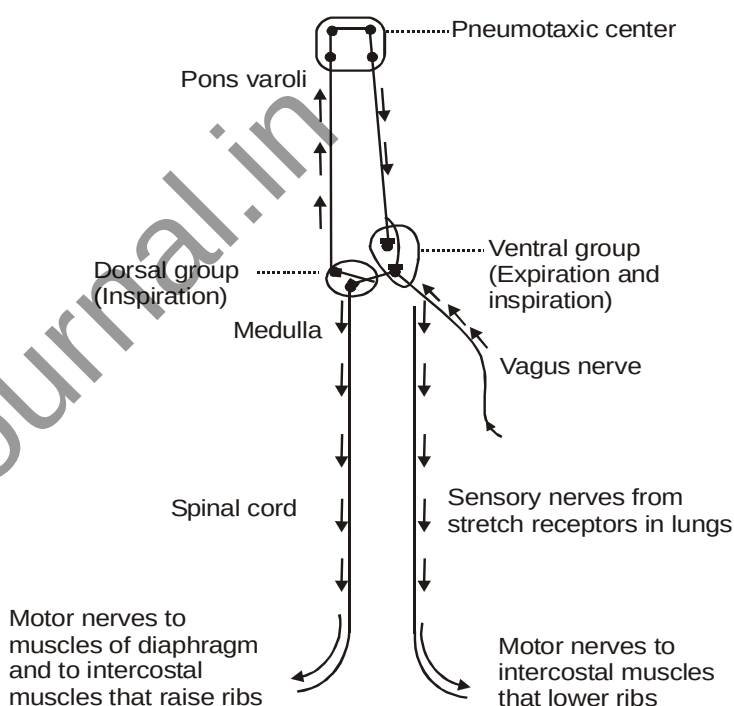


Diagram showing nervous control of breathing

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CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

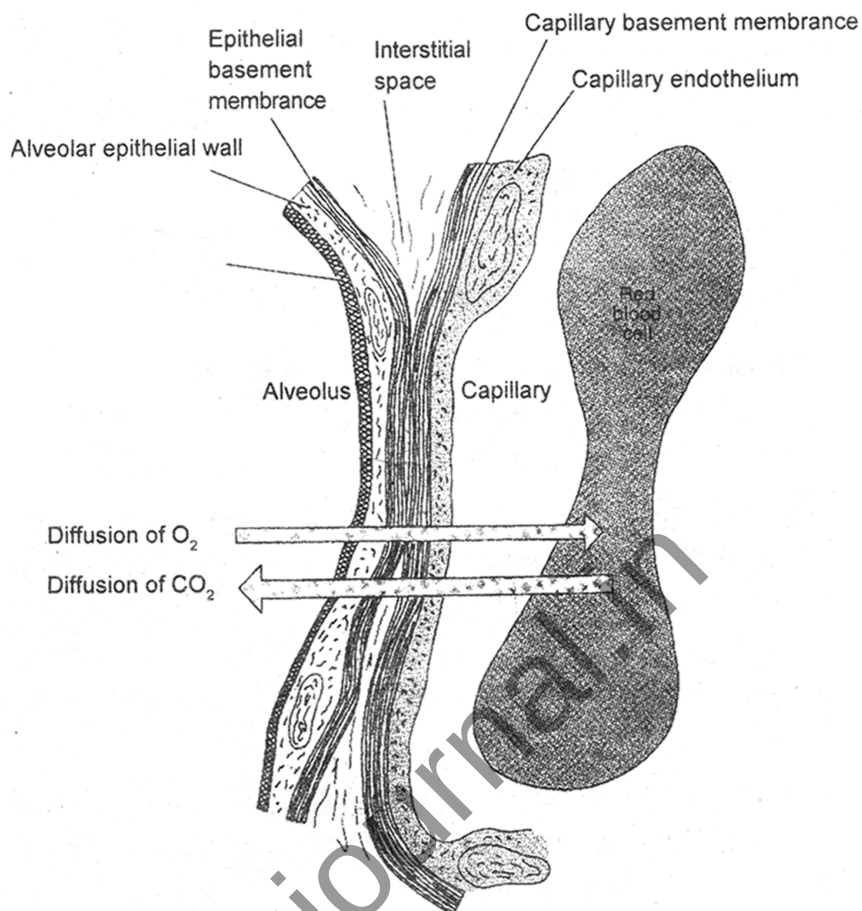
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

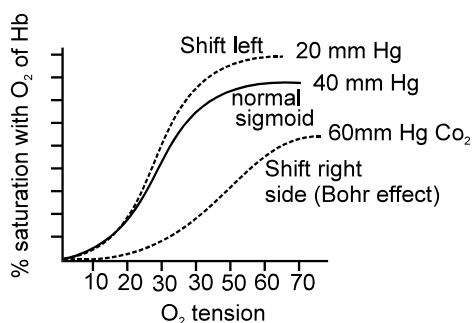
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

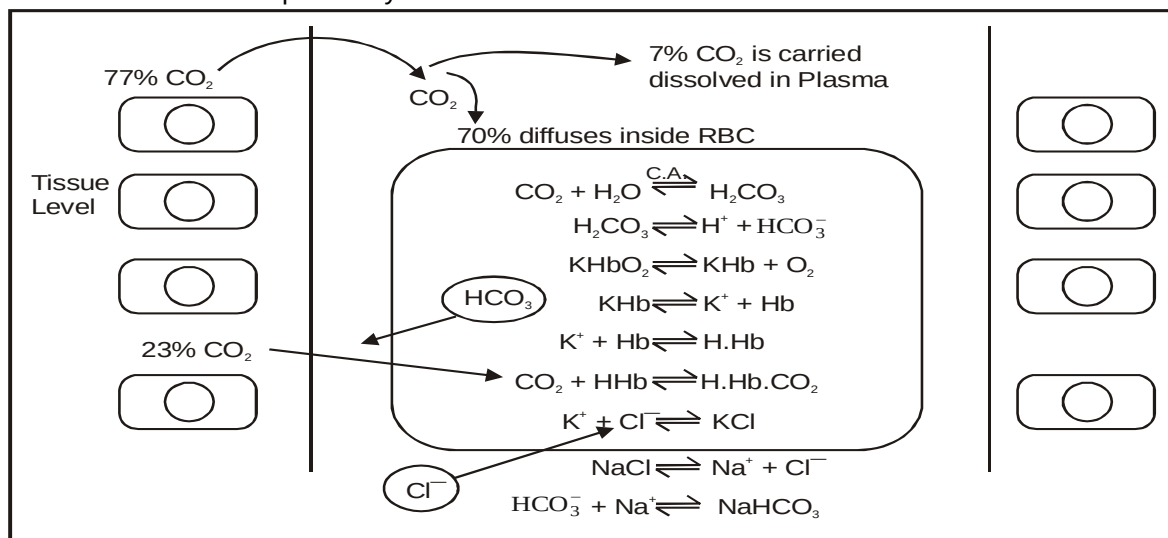
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

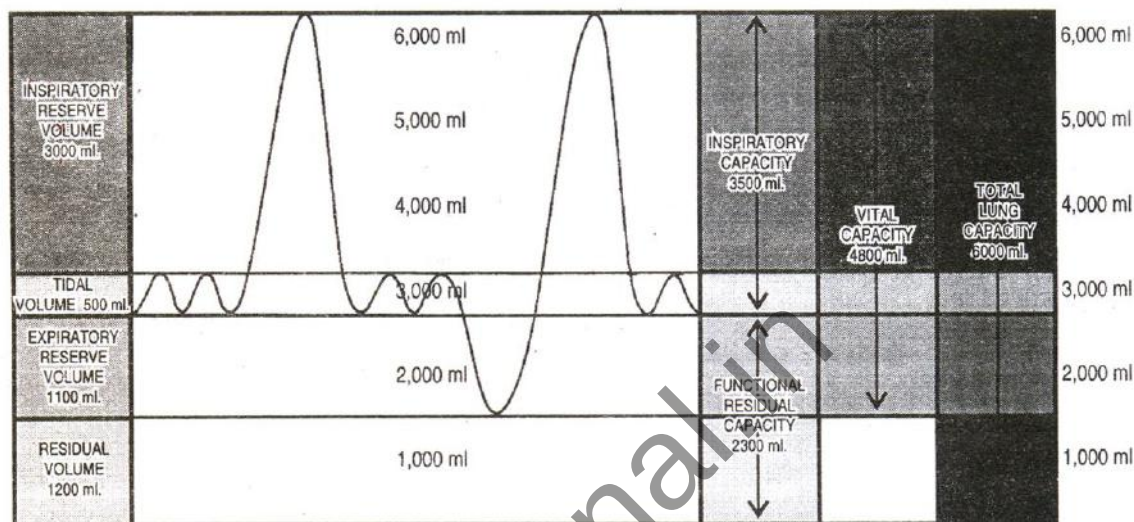
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- Dead volume
 - Dead space
 - Both A and B
 - Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- Omosis
 - Diffusion
 - Active transport
 - None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- Spherometer
 - Spirometer
 - Sphygmomanometer
 - Barometer
- Q.28** Air moves into the lungs when-
- Atmospheric pressure is less than pressure within the lungs
 - Atmospheric pressure is equal to the pressure within the lungs
 - Atmospheric pressure is greater than pressure within the lungs
 - None of these
- Q.29** Normal rate of breathing in man is-
- 20-30 times per minute
 - 12-14 times per minute
 - 5-10 times per minute
 - 40-50 times per minute
- Q.30** Choose the correct equation-
- Total capacity of lungs = Vital capacity + Residual air
 - Vital capacity of lungs = Tidal air + Complemental air
 - Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- Hypothalamus
 - Medulla oblongata
 - Cerebellum
 - Thalamus
- Q.32** Which of the following statements is correct-
- Inspiration is an active process
 - Expiration is an active process
 - Inspiration is a passive process
 - Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- Oxygen in trachea
 - Concentration of O_2
 - Diaphragm expansion
 - Concentration of CO_2
- Q.34** The breathing rate in a child is-
- Same as in an adult man
 - Less than in an adult man
 - More than in an adult man
 - None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- Inspiration
 - Normal respiration
 - Aspiration
 - Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- Backward and upward
 - Forward and upward
 - Backward and downward
 - Forward and downward
- Q.37** Tidal air in mammals is-
- Total air that can be drawn into lungs
 - Air that normally goes in and comes out of lungs during breathing
 - Air that is left in the lungs after normal expiration
 - Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbamino haemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box
 - (2) Vocal cord
 - (3) Trachea
 - (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue
 - (2) Larynx
 - (3) Trachea
 - (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million
 - (2) 450 million
 - (3) 750 million
 - (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney
 - (2) Envelop the lung
 - (3) Envelop the liver
 - (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi
 - (2) Tracheae
 - (3) Alveoli
 - (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis
 - (2) Tracheal valves
 - (3) Syrinx
 - (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three
 - (2) Four
 - (3) Two
 - (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid
 - (2) Larynx
 - (3) Trachea
 - (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries
 - (2) Alveoli
 - (3) Turbinates
 - (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

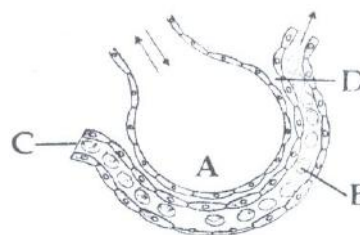
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:

- (1) Tongue
- (2) Epiglottis
- (3) Diaphragm
- (4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1
Ques.	20	21	22	23	24														
Ans.	2	2	3	2	4														

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

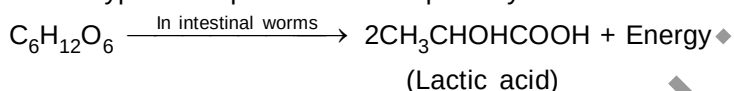
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

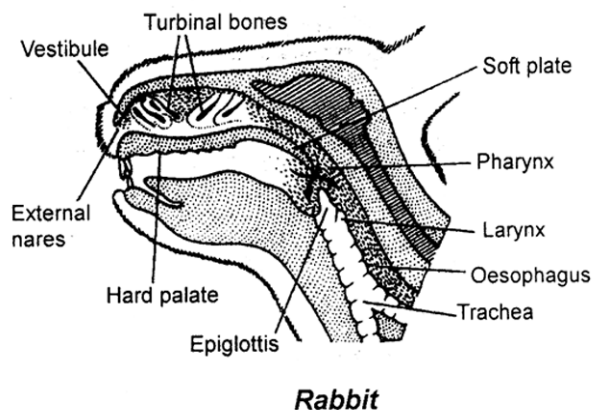
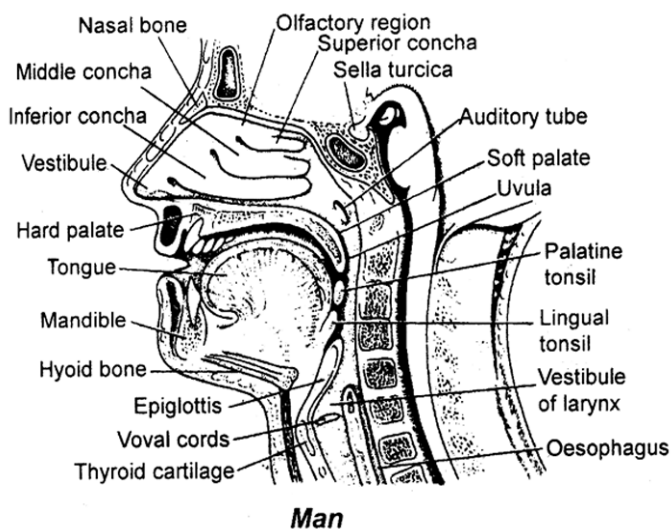
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

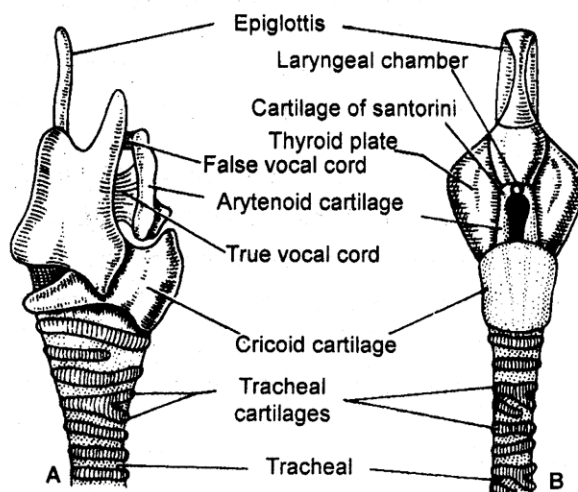
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

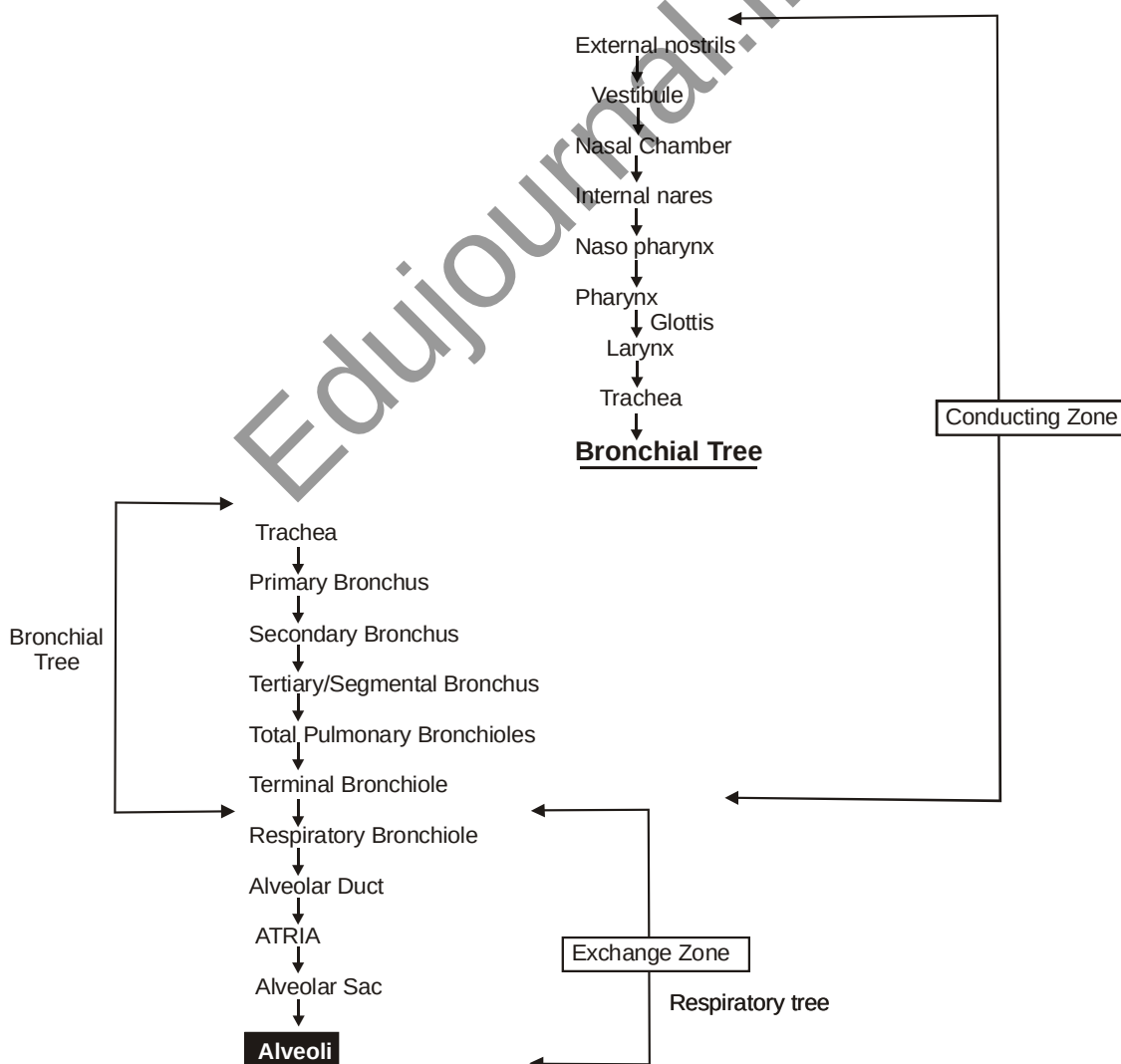
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters thoracic cavity, it divides into two branches called primary bronchus. Branches of primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

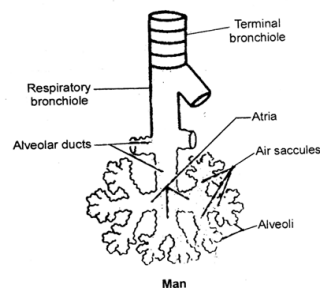
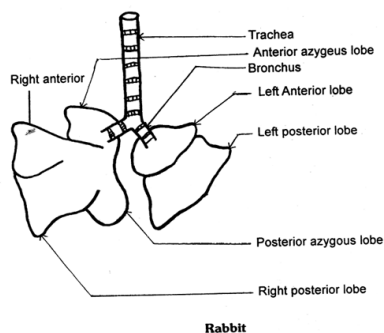
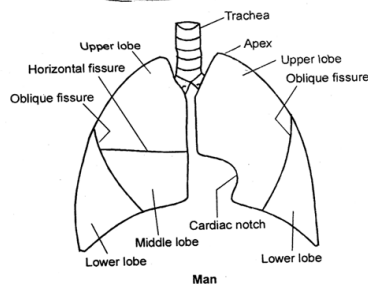
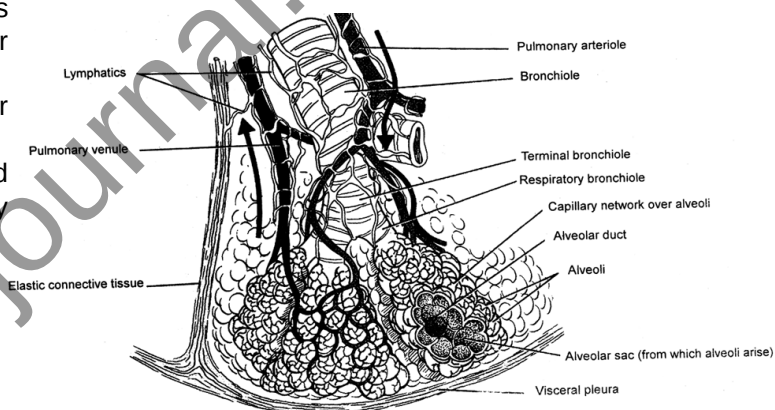
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

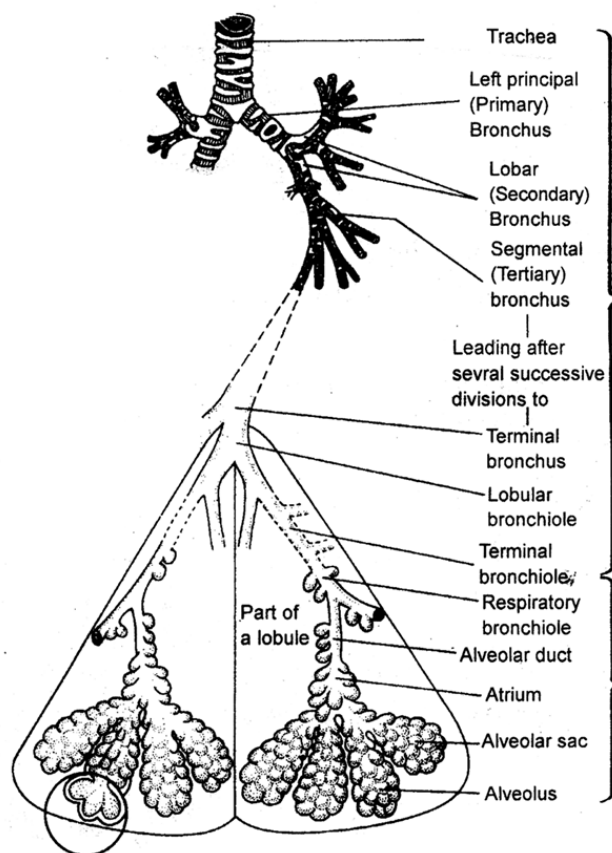
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

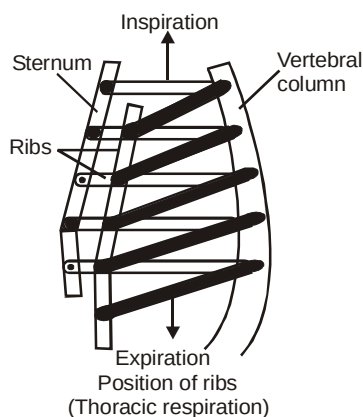
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

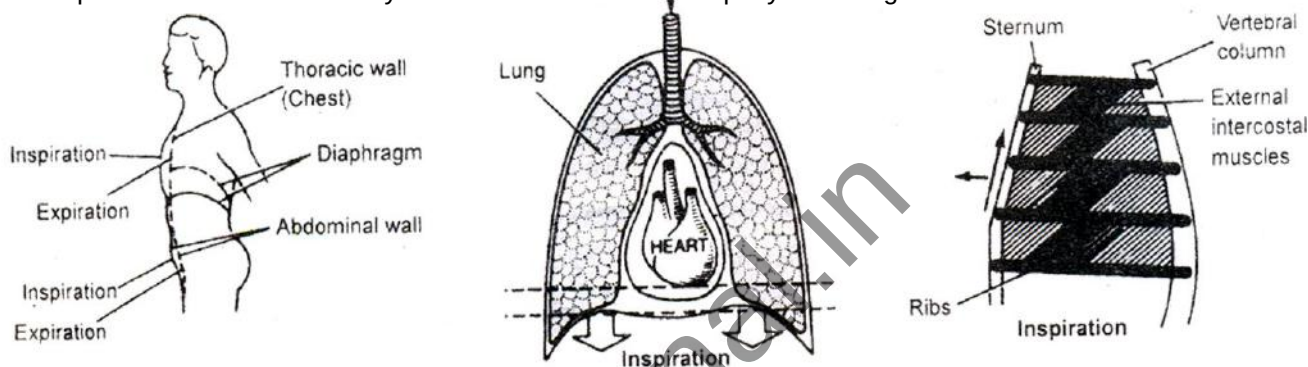
Inspiration

Expiration



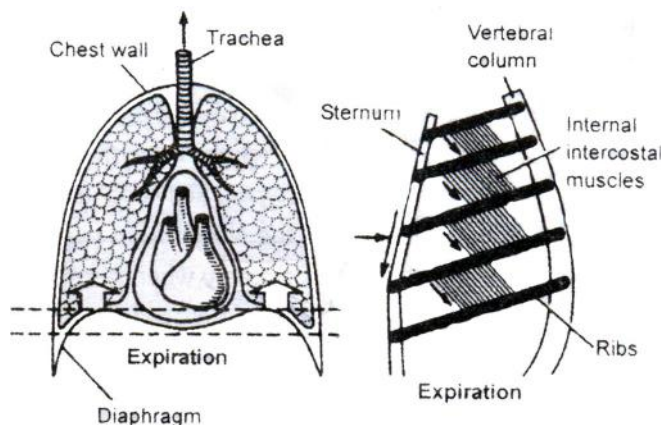
INSPIRATION ::

- (i) It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- (ii) During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- (iii) Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- (iv) Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- (i) It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- (ii) It is passive process
- (iii) During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- (iv) Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- (v) Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

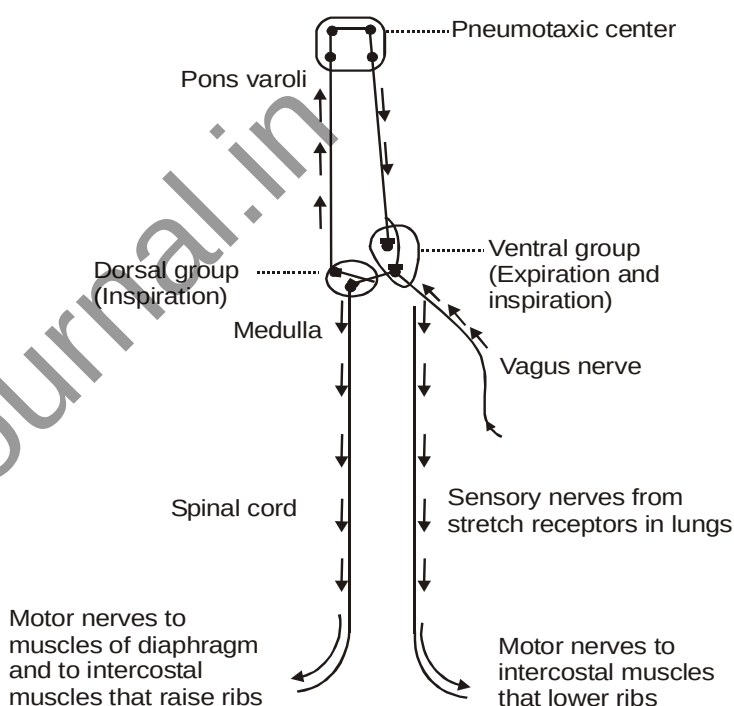


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

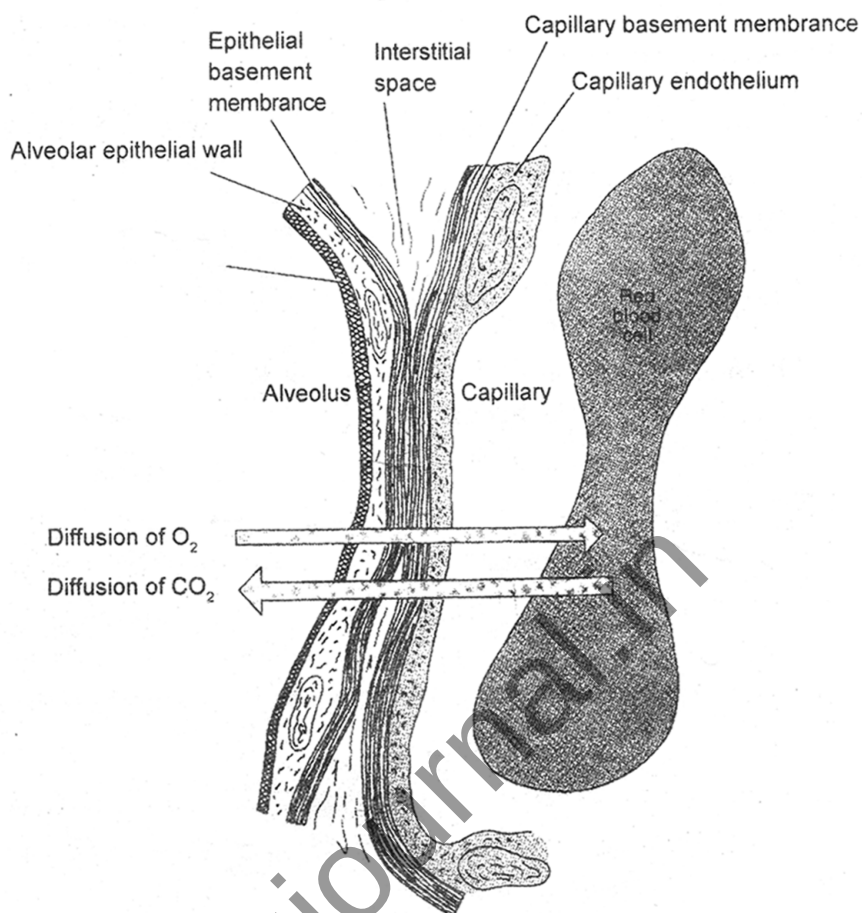
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

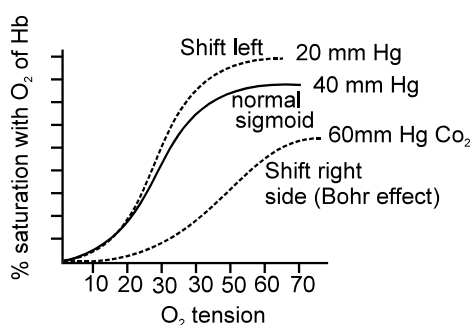
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO₂ in tissues curve shifts towards right side and % of O₂ in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO₂ in tissues curve shifts towards left side and % of O₂ in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p50 is the partial pressure of O₂ at which Hb is 50% saturated with O₂. Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

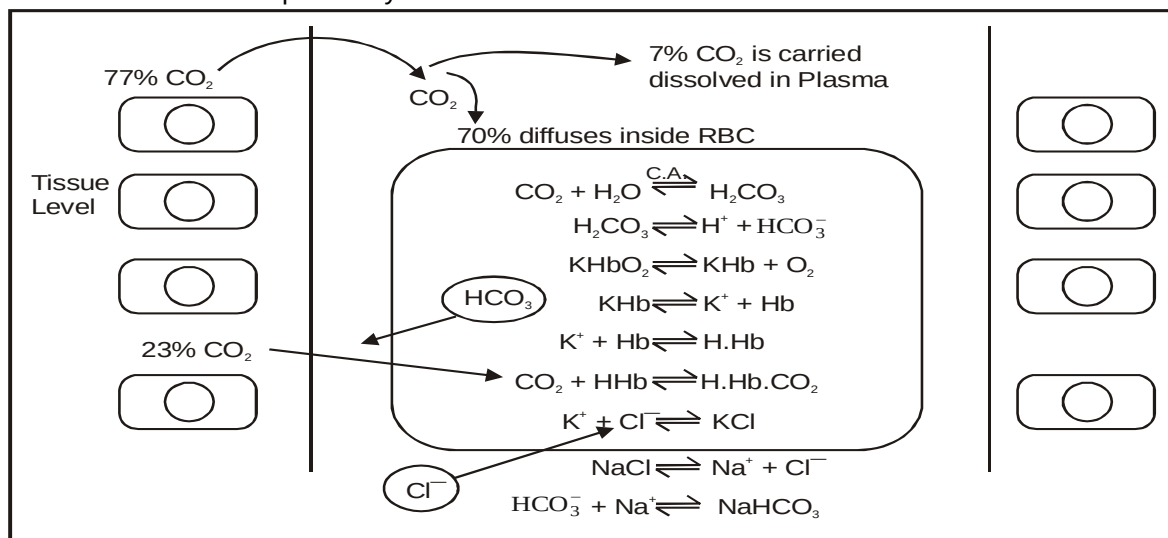
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

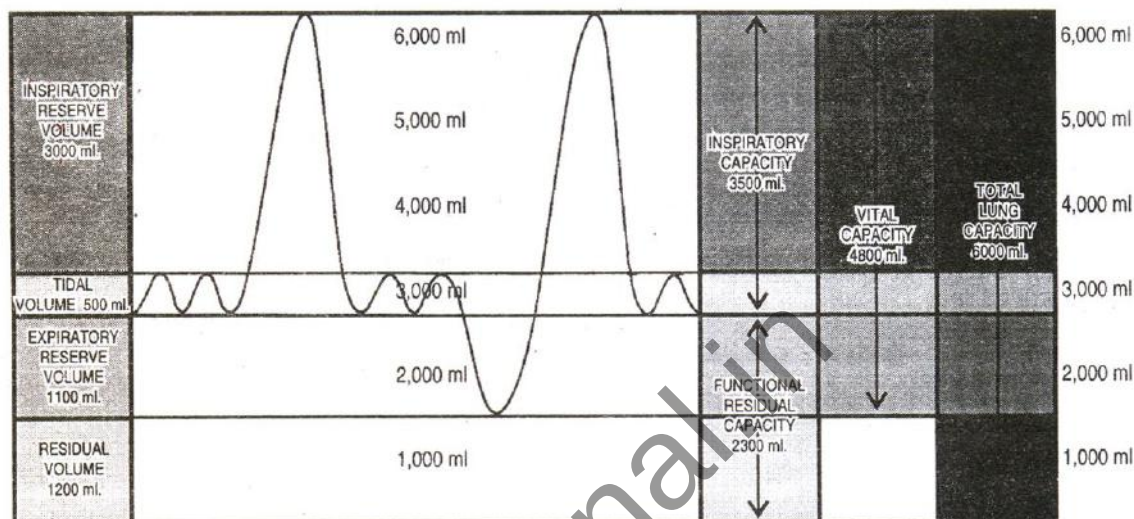
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- Dead volume
 - Dead space
 - Both A and B
 - Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- Omosis
 - Diffusion
 - Active transport
 - None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- Spherometer
 - Spirometer
 - Sphygmomanometer
 - Barometer
- Q.28** Air moves into the lungs when-
- Atmospheric pressure is less than pressure within the lungs
 - Atmospheric pressure is equal to the pressure within the lungs
 - Atmospheric pressure is greater than pressure within the lungs
 - None of these
- Q.29** Normal rate of breathing in man is-
- 20-30 times per minute
 - 12-14 times per minute
 - 5-10 times per minute
 - 40-50 times per minute
- Q.30** Choose the correct equation-
- Total capacity of lungs = Vital capacity + Residual air
 - Vital capacity of lungs = Tidal air + Complemental air
 - Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- Hypothalamus
 - Medulla oblongata
 - Cerebellum
 - Thalamus
- Q.32** Which of the following statements is correct-
- Inspiration is an active process
 - Expiration is an active process
 - Inspiration is a passive process
 - Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- Oxygen in trachea
 - Concentration of O_2
 - Diaphragm expansion
 - Concentration of CO_2
- Q.34** The breathing rate in a child is-
- Same as in an adult man
 - Less than in an adult man
 - More than in an adult man
 - None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- Inspiration
 - Normal respiration
 - Aspiration
 - Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- Backward and upward
 - Forward and upward
 - Backward and downward
 - Forward and downward
- Q.37** Tidal air in mammals is-
- Total air that can be drawn into lungs
 - Air that normally goes in and comes out of lungs during breathing
 - Air that is left in the lungs after normal expiration
 - Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box (2) Vocal cord
 - (3) Trachea (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue (2) Larynx
 - (3) Trachea (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million (2) 450 million
 - (3) 750 million (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney (2) Envelop the lung
 - (3) Envelop the liver (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi (2) Tracheae
 - (3) Alveoli (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis (2) Tracheal valves
 - (3) Syrinx (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three (2) Four
 - (3) Two (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid (2) Larynx
 - (3) Trachea (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries (2) Alveoli
 - (3) Turbinates (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

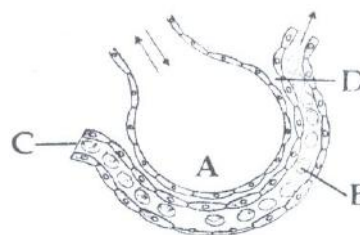
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventillation**.

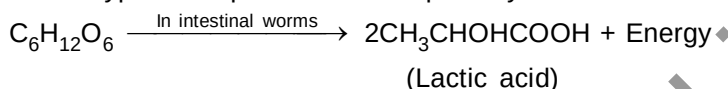
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

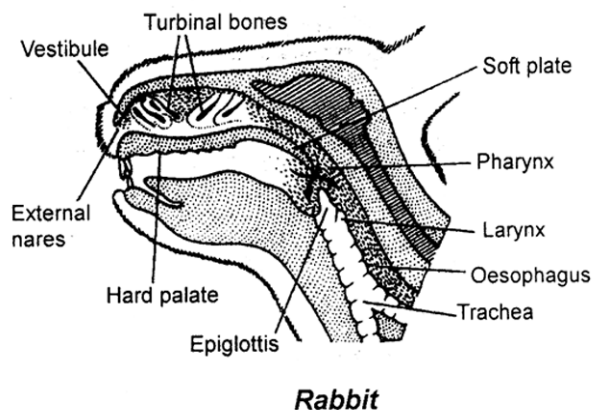
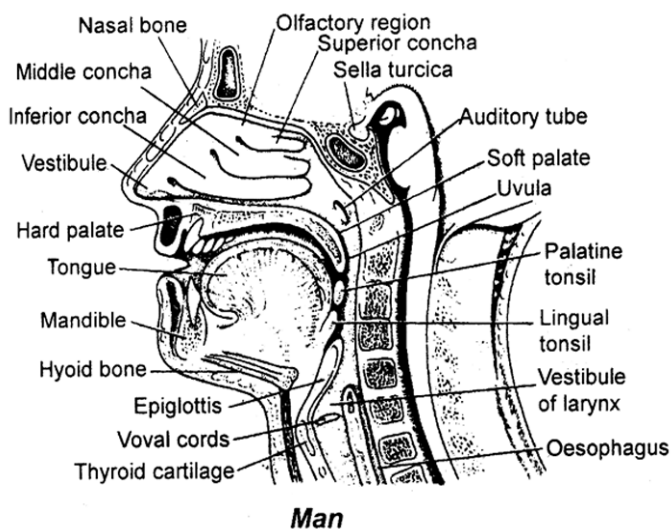
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

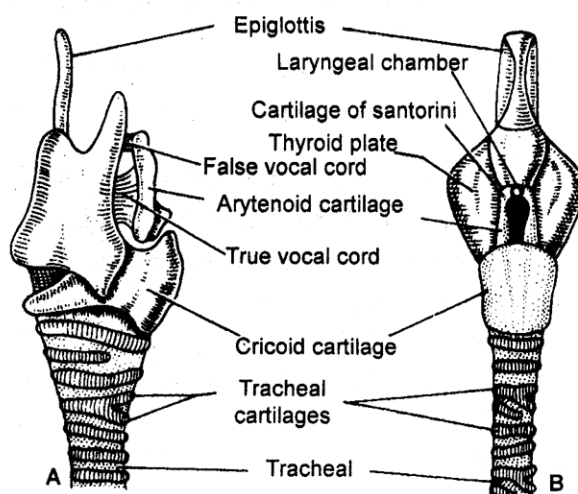
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

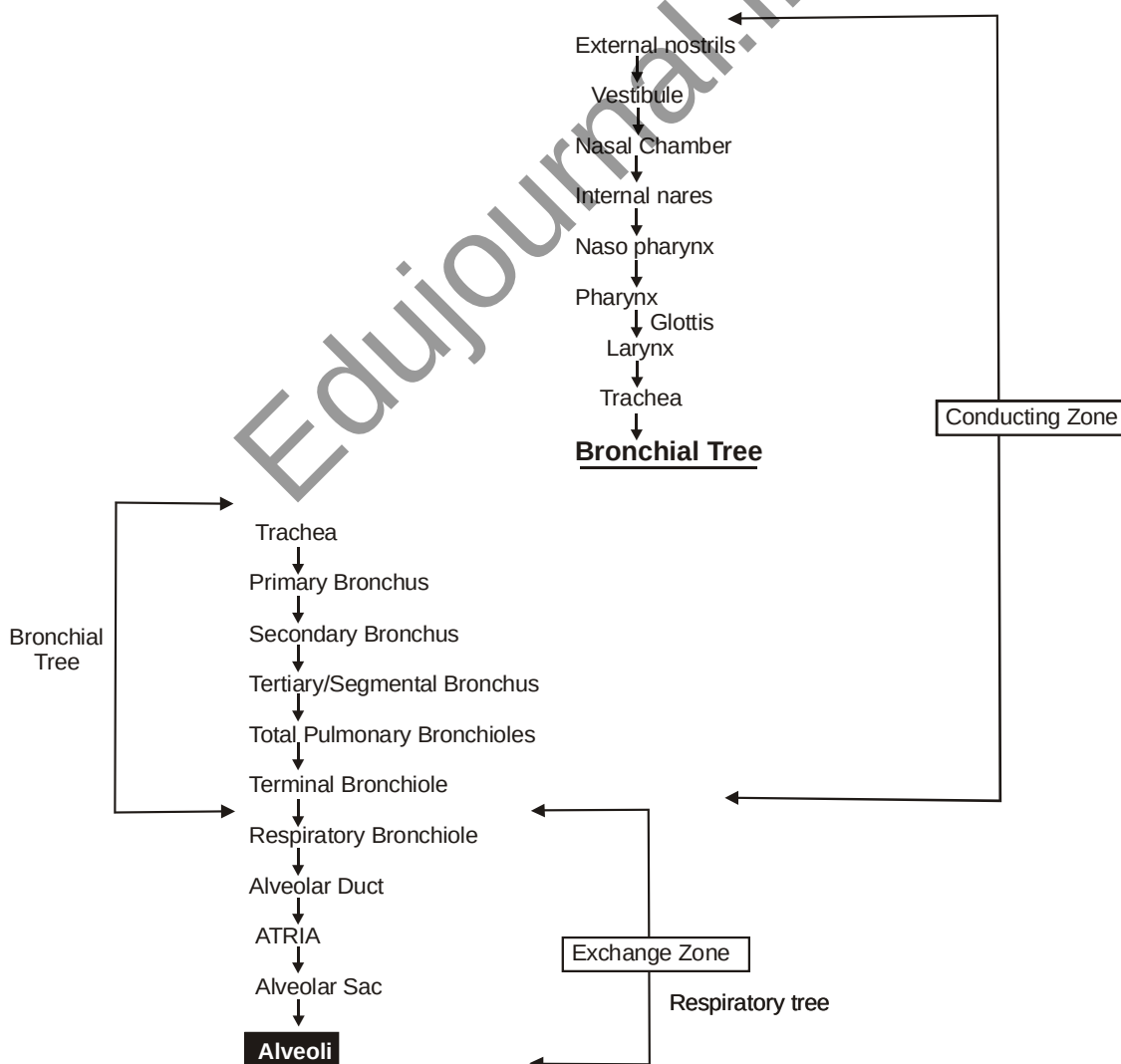
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters thoracic cavity, it divides into two branches called primary bronchus. Branches of primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

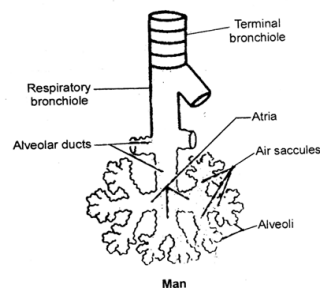
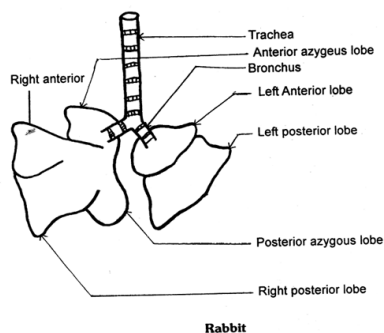
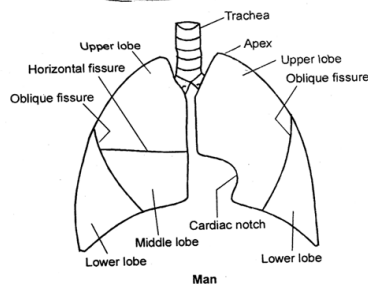
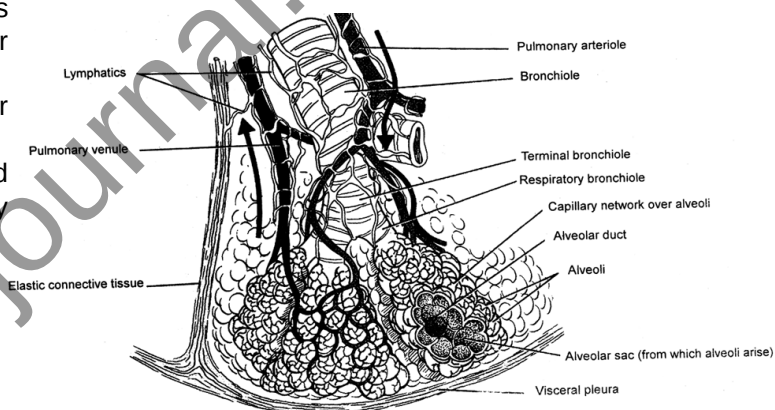
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

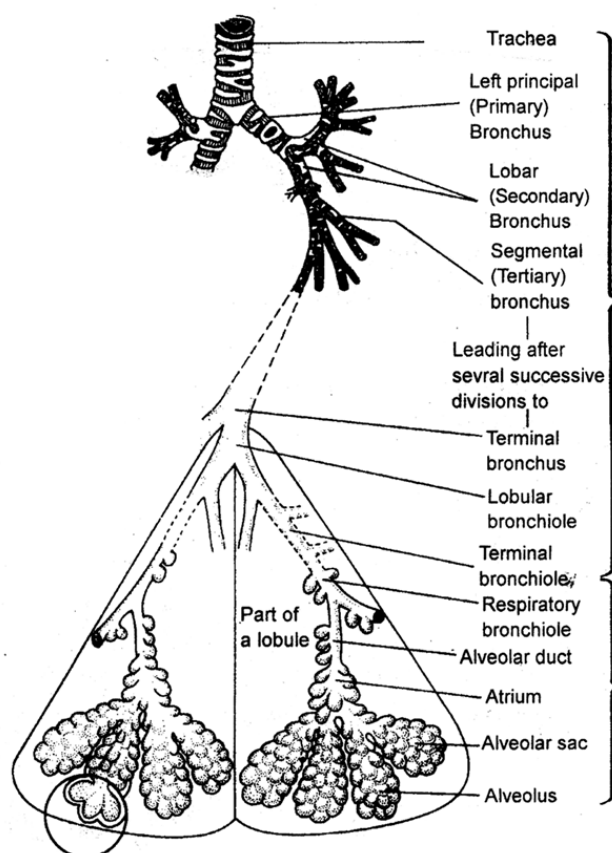
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

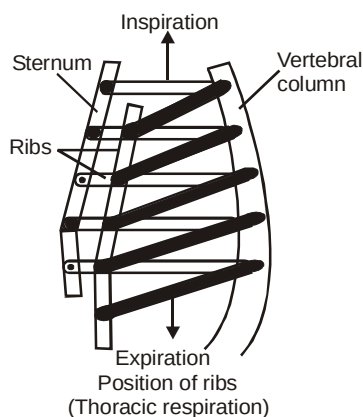
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

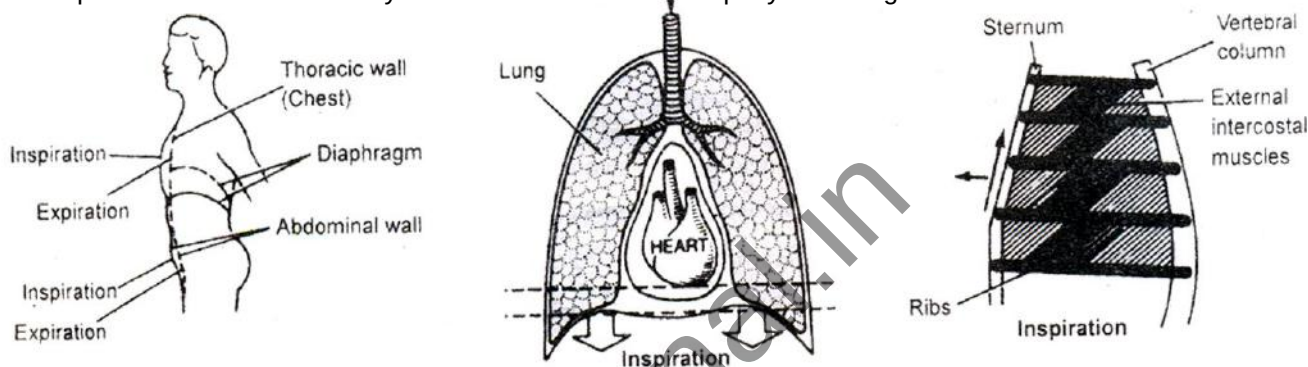
Inspiration

Expiration



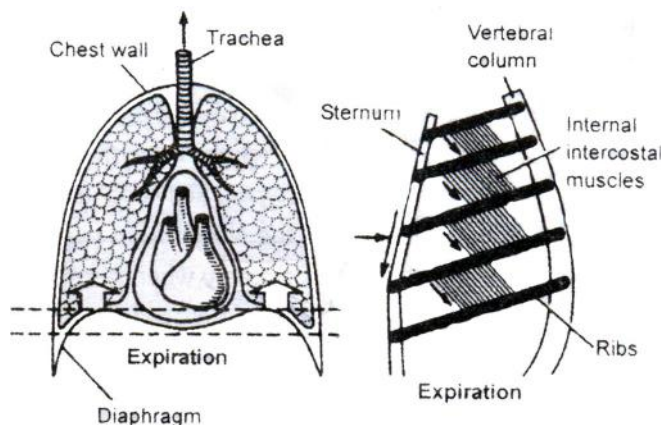
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

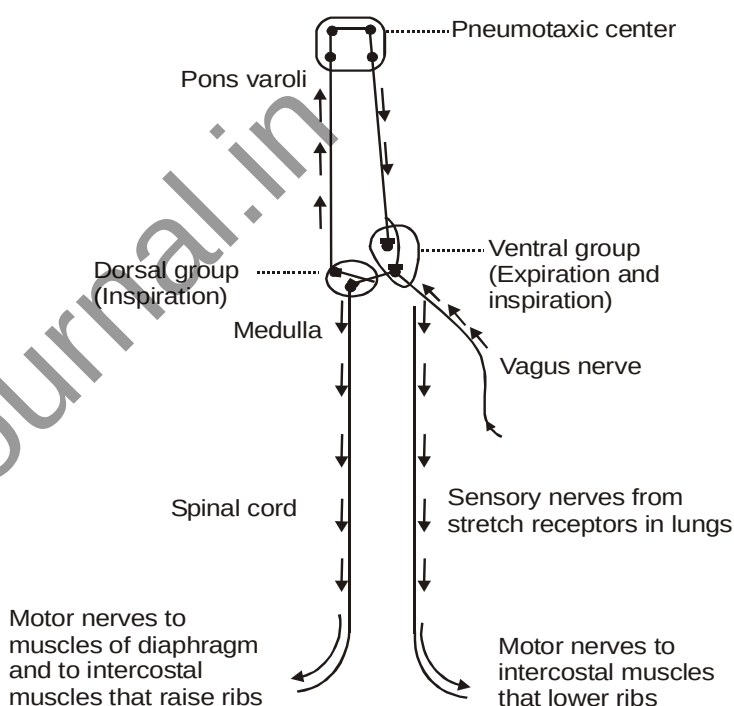


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

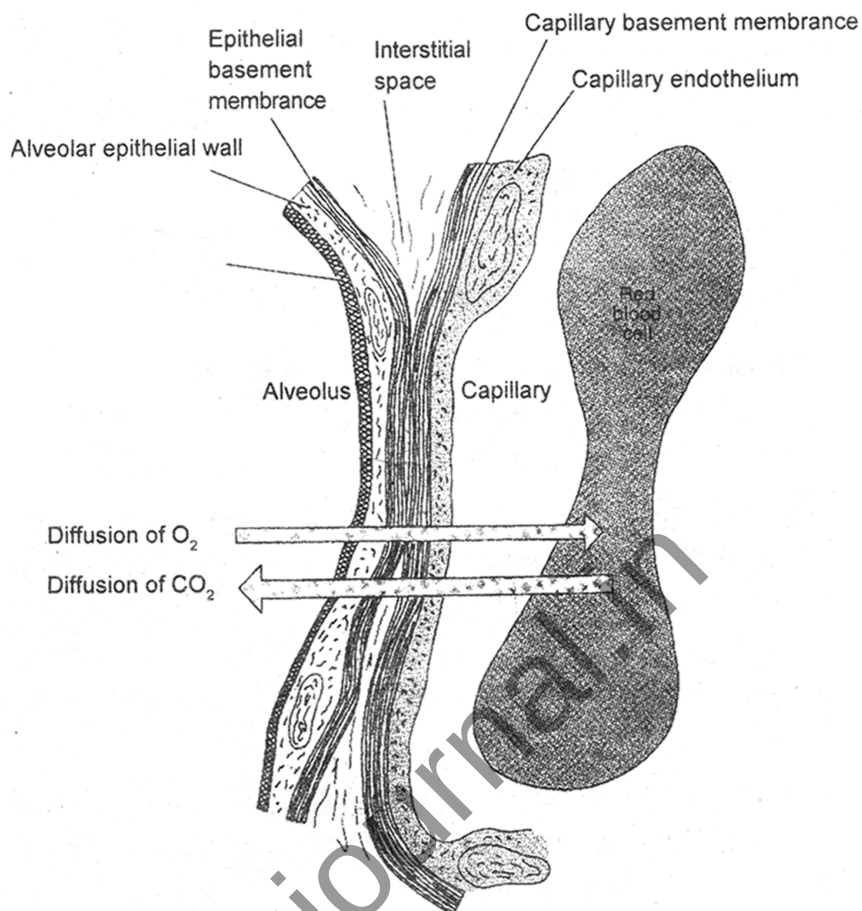
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

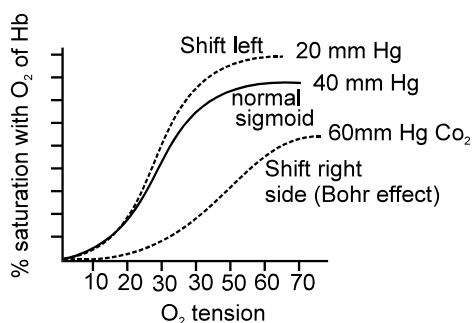
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25% O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

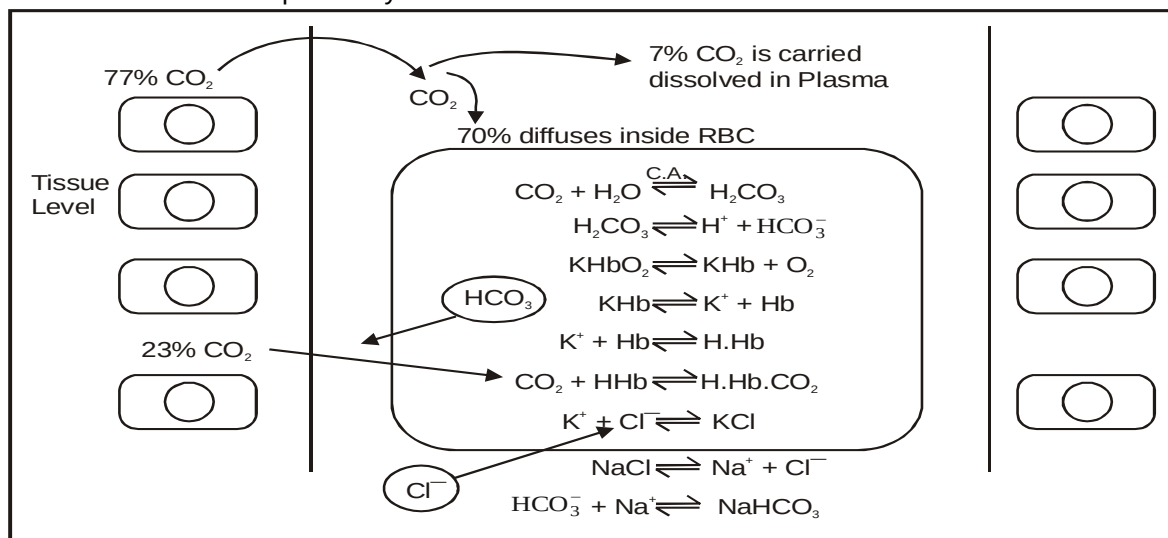
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

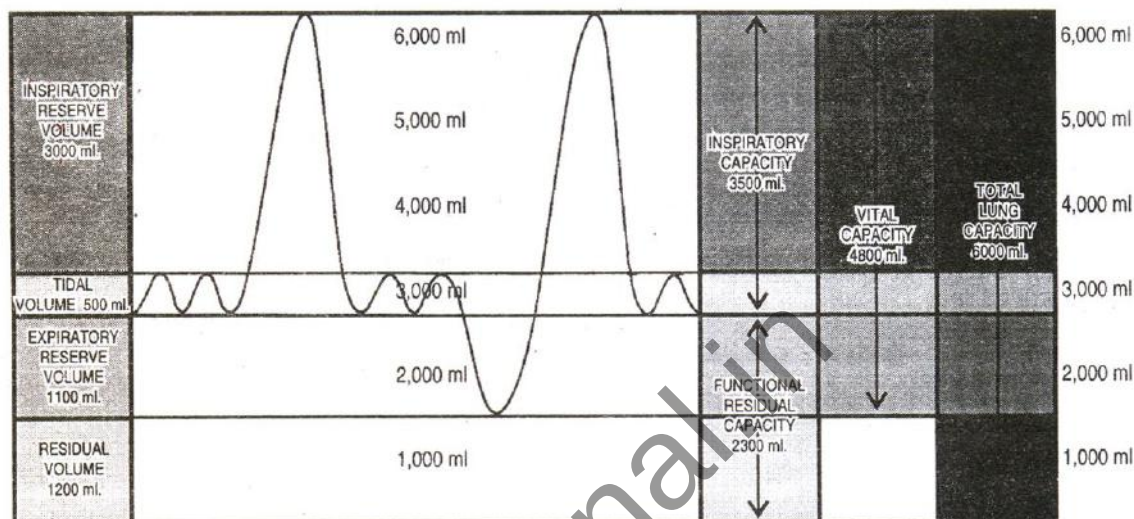
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- (1) Dead volume (2) Dead space
 - (3) Both A and B (4) Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- (1) Omosis (2) Diffusion
 - (3) Active transport (4) None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- (1) Spherometer (2) Spirometer
 - (3) Sphygmomanometer (4) Barometer
- Q.28** Air moves into the lungs when-
- (1) Atmospheric pressure is less than pressure within the lungs
 - (2) Atmospheric pressure is equal to the pressure within the lungs
 - (3) Atmospheric pressure is greater than pressure within the lungs
 - (4) None of these
- Q.29** Normal rate of breathing in man is-
- (1) 20-30 times per minute
 - (2) 12-14 times per minute
 - (3) 5-10 times per minute
 - (4) 40-50 times per minute
- Q.30** Choose the correct equation-
- (1) Total capacity of lungs = Vital capacity + Residual air
 - (2) Vital capacity of lungs = Tidal air + Complemental air
 - (3) Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - (4) Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- (1) Hypothalamus (2) Medulla oblongata
 - (3) Cerebellum (4) Thalamus
- Q.32** Which of the following statements is correct-
- (1) Inspiration is an active process
 - (2) Expiration is an active process
 - (3) Inspiration is a passive process
 - (4) Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- (1) Oxygen in trachea
 - (2) Concentration of O_2
 - (3) Diaphragm expansion
 - (4) Concentration of CO_2
- Q.34** The breathing rate in a child is-
- (1) Same as in an adult man
 - (2) Less than in an adult man
 - (3) More than in an adult man
 - (4) None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- (1) Inspiration
 - (2) Normal respiration
 - (3) Aspiration
 - (4) Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- (1) Backward and upward
 - (2) Forward and upward
 - (3) Backward and downward
 - (4) Forward and downward
- Q.37** Tidal air in mammals is-
- (1) Total air that can be drawn into lungs
 - (2) Air that normally goes in and comes out of lungs during breathing
 - (3) Air that is left in the lungs after normal expiration
 - (4) Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box
 - (2) Vocal cord
 - (3) Trachea
 - (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue
 - (2) Larynx
 - (3) Trachea
 - (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million
 - (2) 450 million
 - (3) 750 million
 - (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney
 - (2) Envelop the lung
 - (3) Envelop the liver
 - (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi
 - (2) Tracheae
 - (3) Alveoli
 - (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis
 - (2) Tracheal valves
 - (3) Syrinx
 - (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three
 - (2) Four
 - (3) Two
 - (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid
 - (2) Larynx
 - (3) Trachea
 - (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries
 - (2) Alveoli
 - (3) Turbinates
 - (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

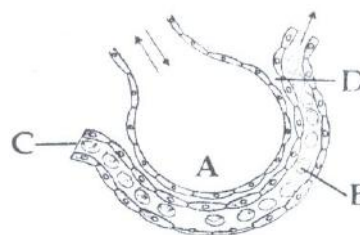
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing , by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

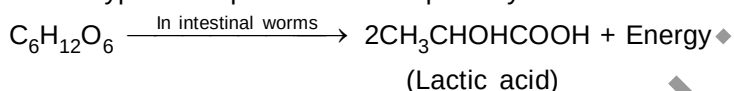
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

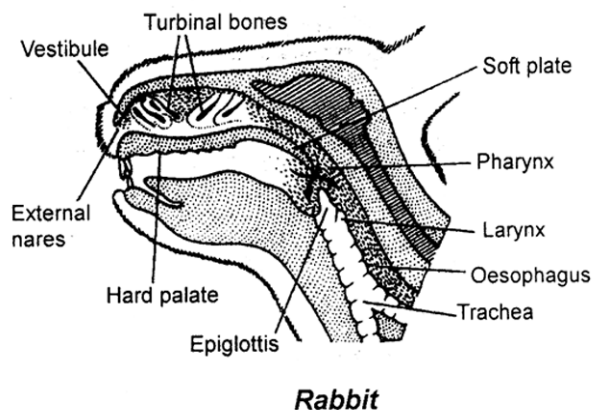
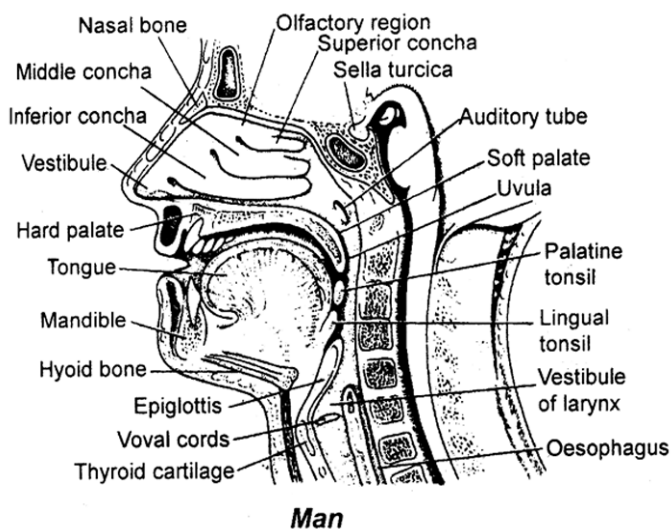
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

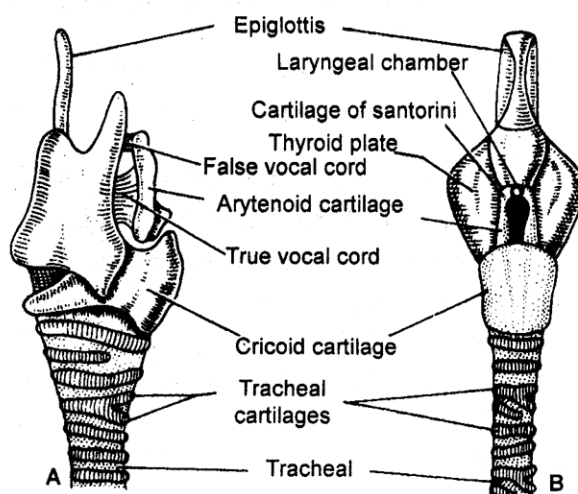
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

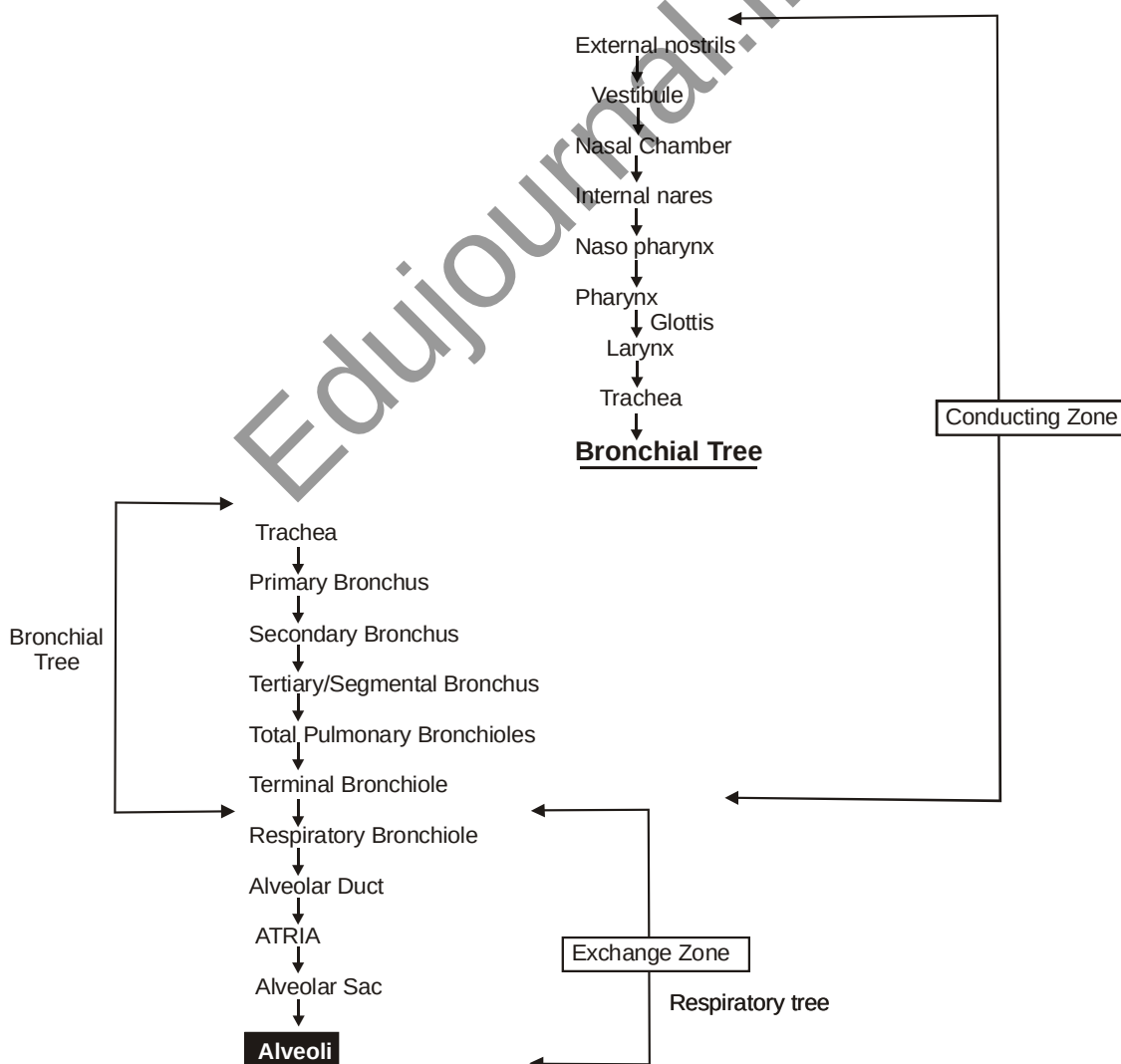
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enter into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

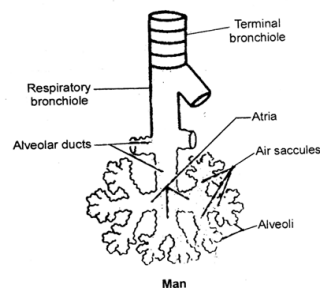
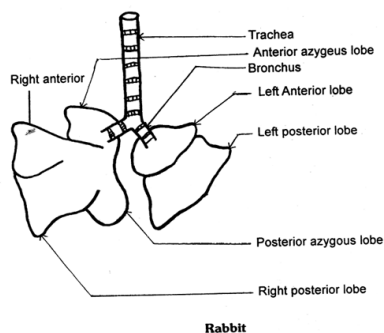
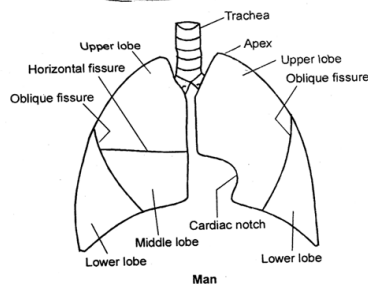
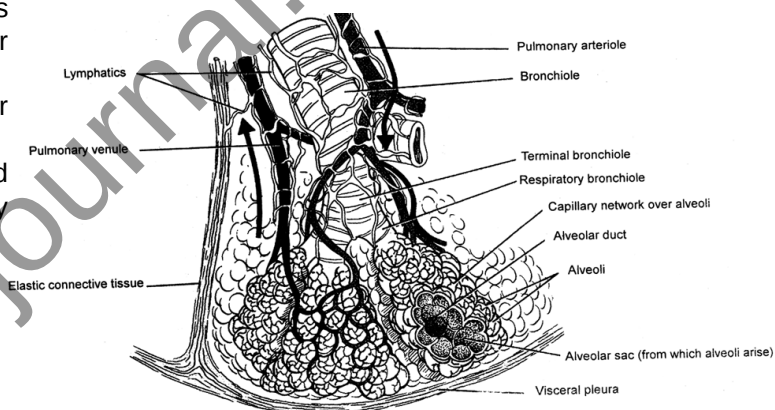
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

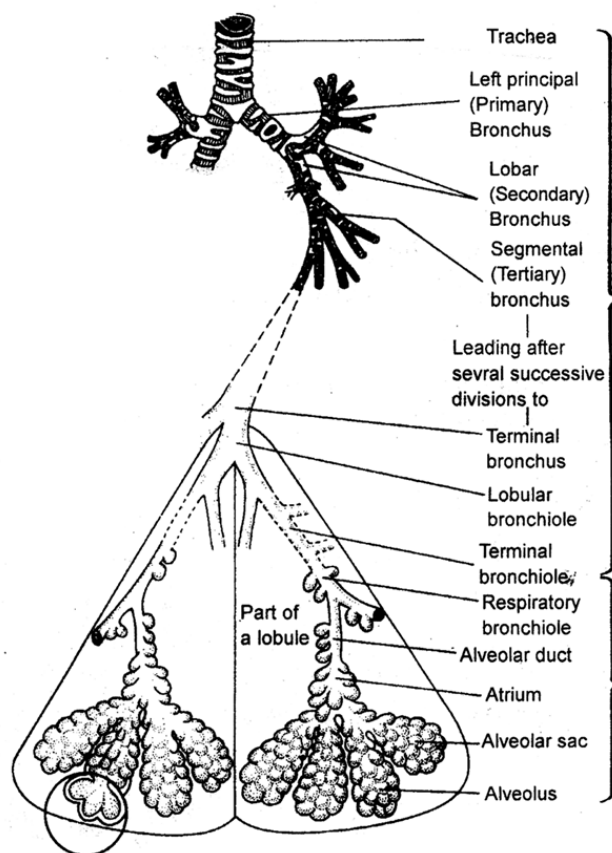
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

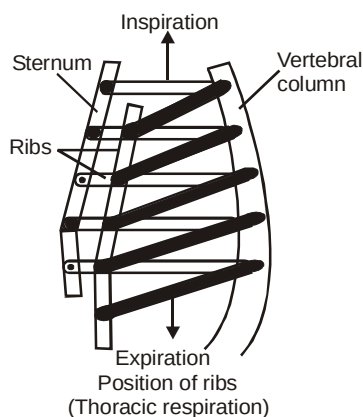
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

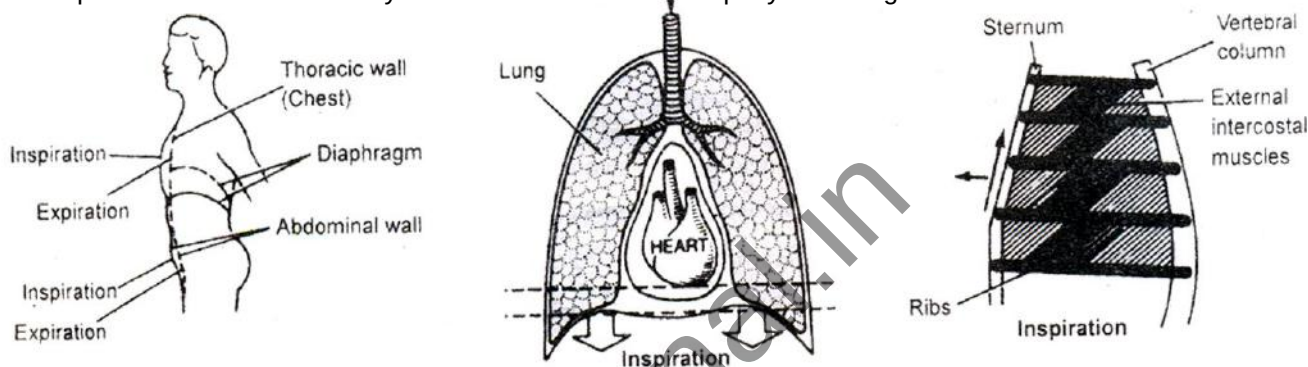
Inspiration

Expiration



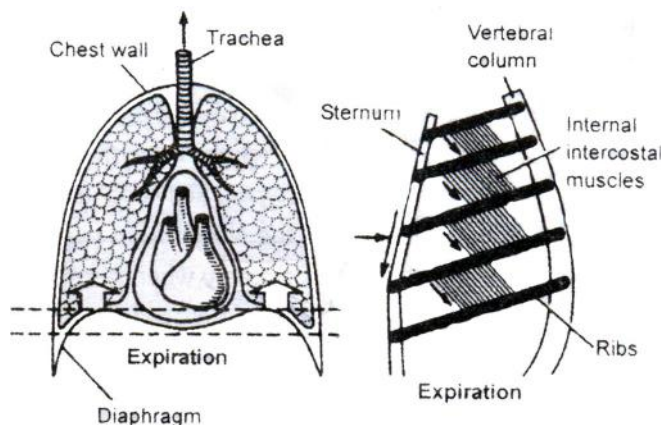
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

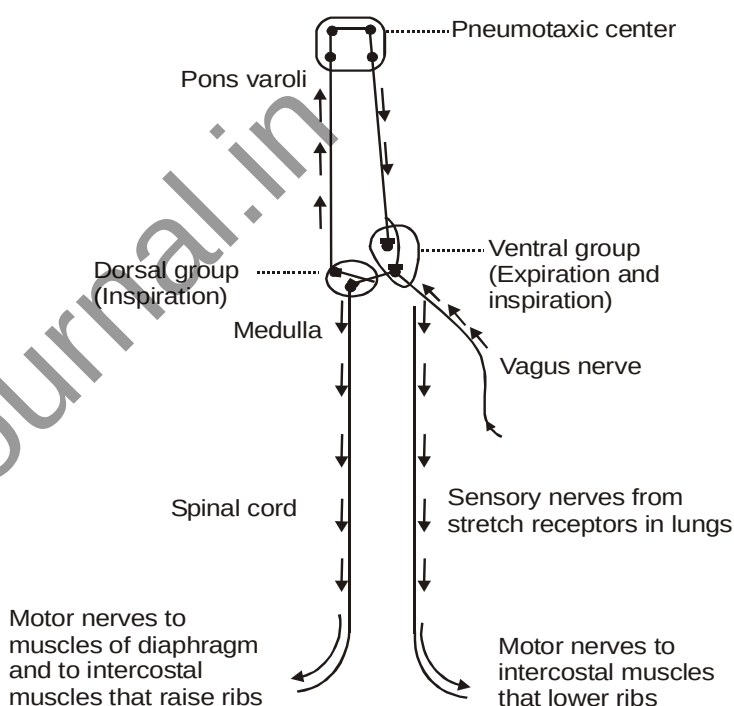


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

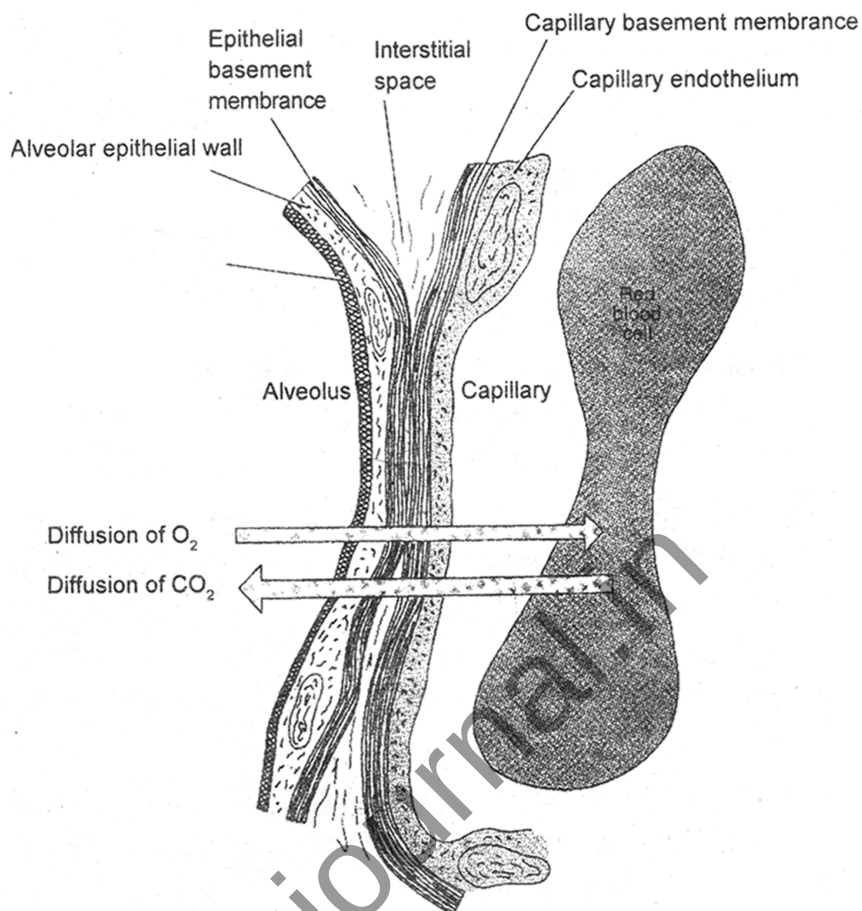
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

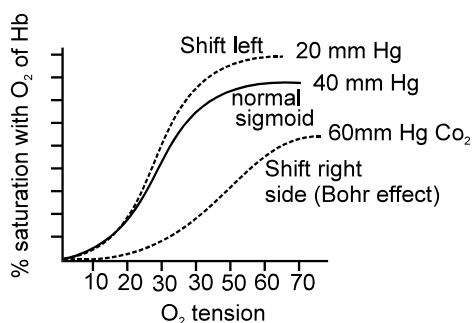
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

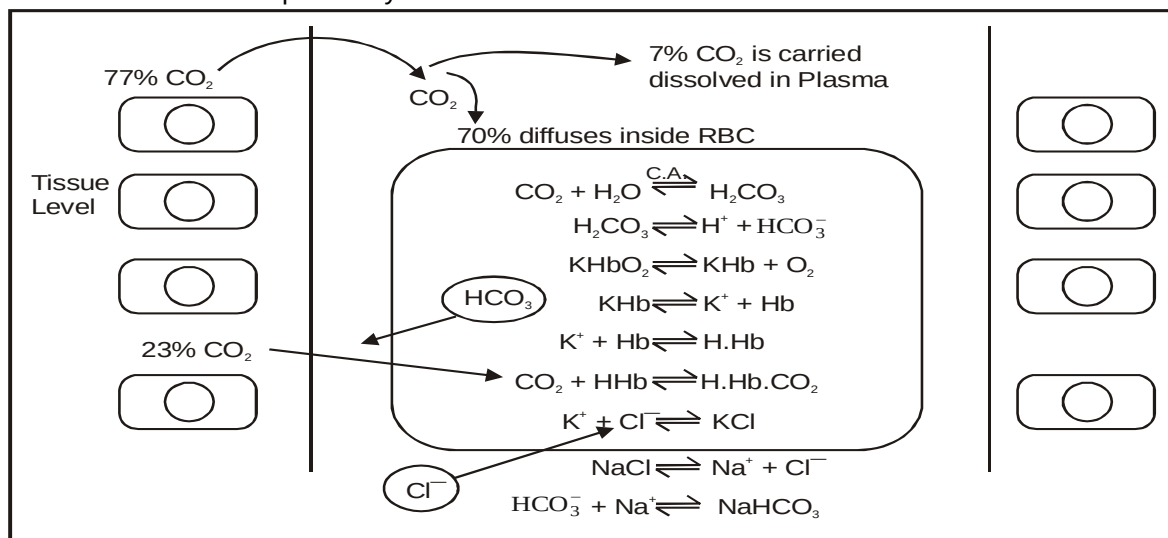
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

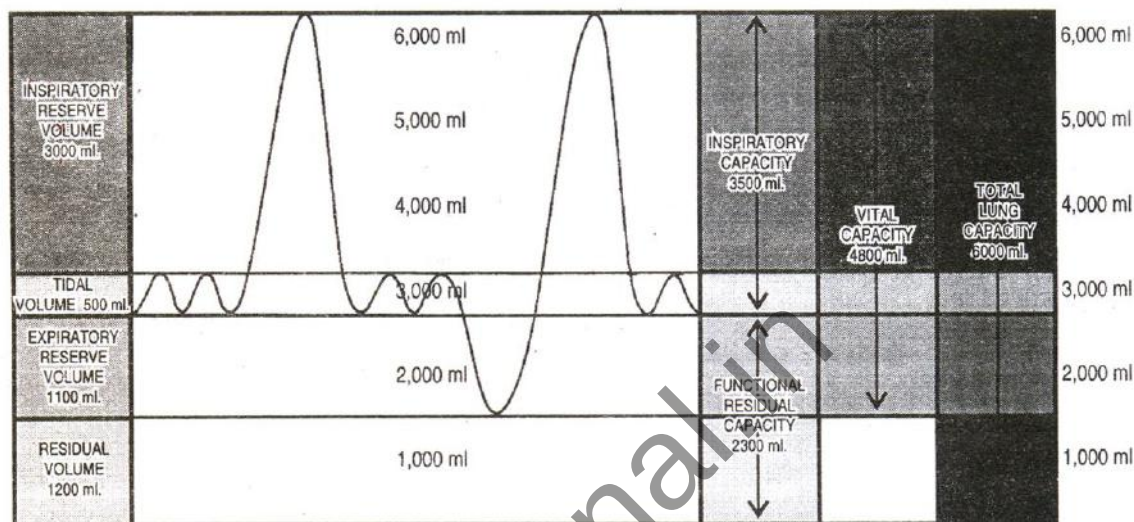
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- Dead volume
 - Dead space
 - Both A and B
 - Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- Omosis
 - Diffusion
 - Active transport
 - None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- Spherometer
 - Spirometer
 - Sphygmomanometer
 - Barometer
- Q.28** Air moves into the lungs when-
- Atmospheric pressure is less than pressure within the lungs
 - Atmospheric pressure is equal to the pressure within the lungs
 - Atmospheric pressure is greater than pressure within the lungs
 - None of these
- Q.29** Normal rate of breathing in man is-
- 20-30 times per minute
 - 12-14 times per minute
 - 5-10 times per minute
 - 40-50 times per minute
- Q.30** Choose the correct equation-
- Total capacity of lungs = Vital capacity + Residual air
 - Vital capacity of lungs = Tidal air + Complemental air
 - Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- Hypothalamus
 - Medulla oblongata
 - Cerebellum
 - Thalamus
- Q.32** Which of the following statements is correct-
- Inspiration is an active process
 - Expiration is an active process
 - Inspiration is a passive process
 - Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- Oxygen in trachea
 - Concentration of O_2
 - Diaphragm expansion
 - Concentration of CO_2
- Q.34** The breathing rate in a child is-
- Same as in an adult man
 - Less than in an adult man
 - More than in an adult man
 - None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- Inspiration
 - Normal respiration
 - Aspiration
 - Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- Backward and upward
 - Forward and upward
 - Backward and downward
 - Forward and downward
- Q.37** Tidal air in mammals is-
- Total air that can be drawn into lungs
 - Air that normally goes in and comes out of lungs during breathing
 - Air that is left in the lungs after normal expiration
 - Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO₂ in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO₂ (pCO₂) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO₂ concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO₂
 - (2) High pCO₂
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P₅₀ of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O₂

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box
 - (2) Vocal cord
 - (3) Trachea
 - (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue
 - (2) Larynx
 - (3) Trachea
 - (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million
 - (2) 450 million
 - (3) 750 million
 - (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney
 - (2) Envelop the lung
 - (3) Envelop the liver
 - (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi
 - (2) Tracheae
 - (3) Alveoli
 - (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis
 - (2) Tracheal valves
 - (3) Syrinx
 - (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three
 - (2) Four
 - (3) Two
 - (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid
 - (2) Larynx
 - (3) Trachea
 - (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries
 - (2) Alveoli
 - (3) Turbinates
 - (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Hering breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rings in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Laterally incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

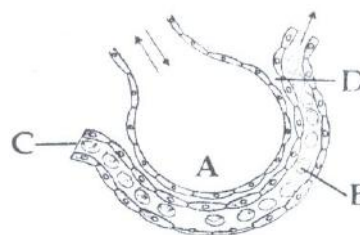
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

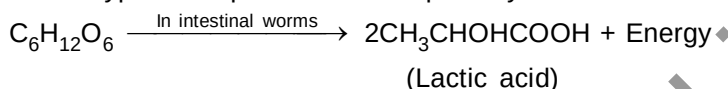
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

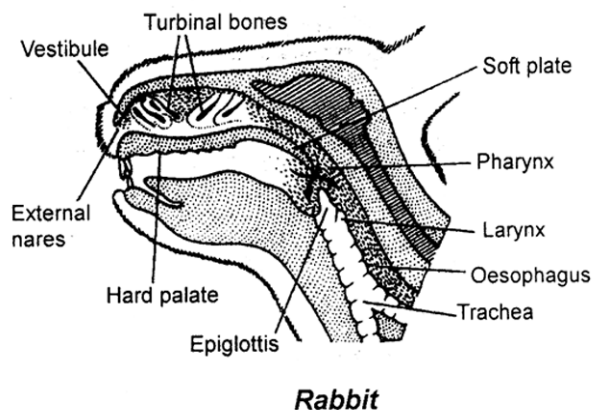
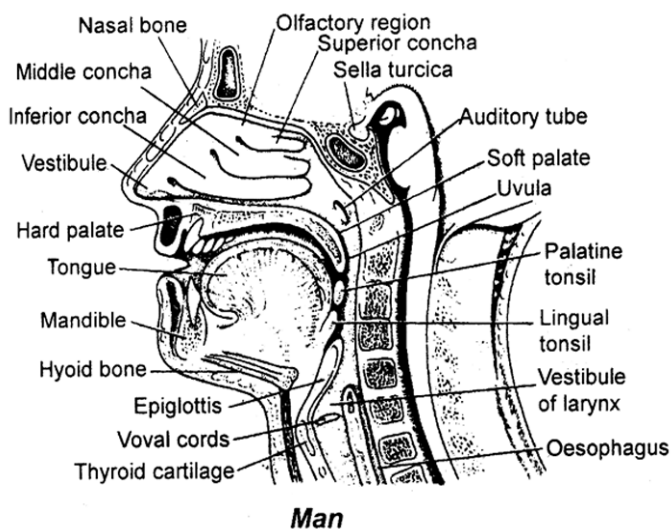
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

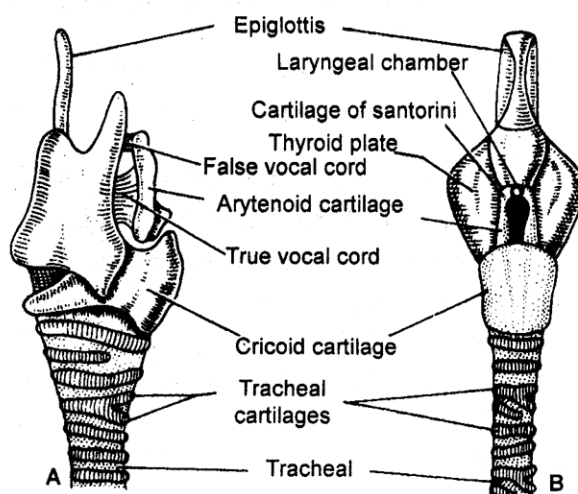
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

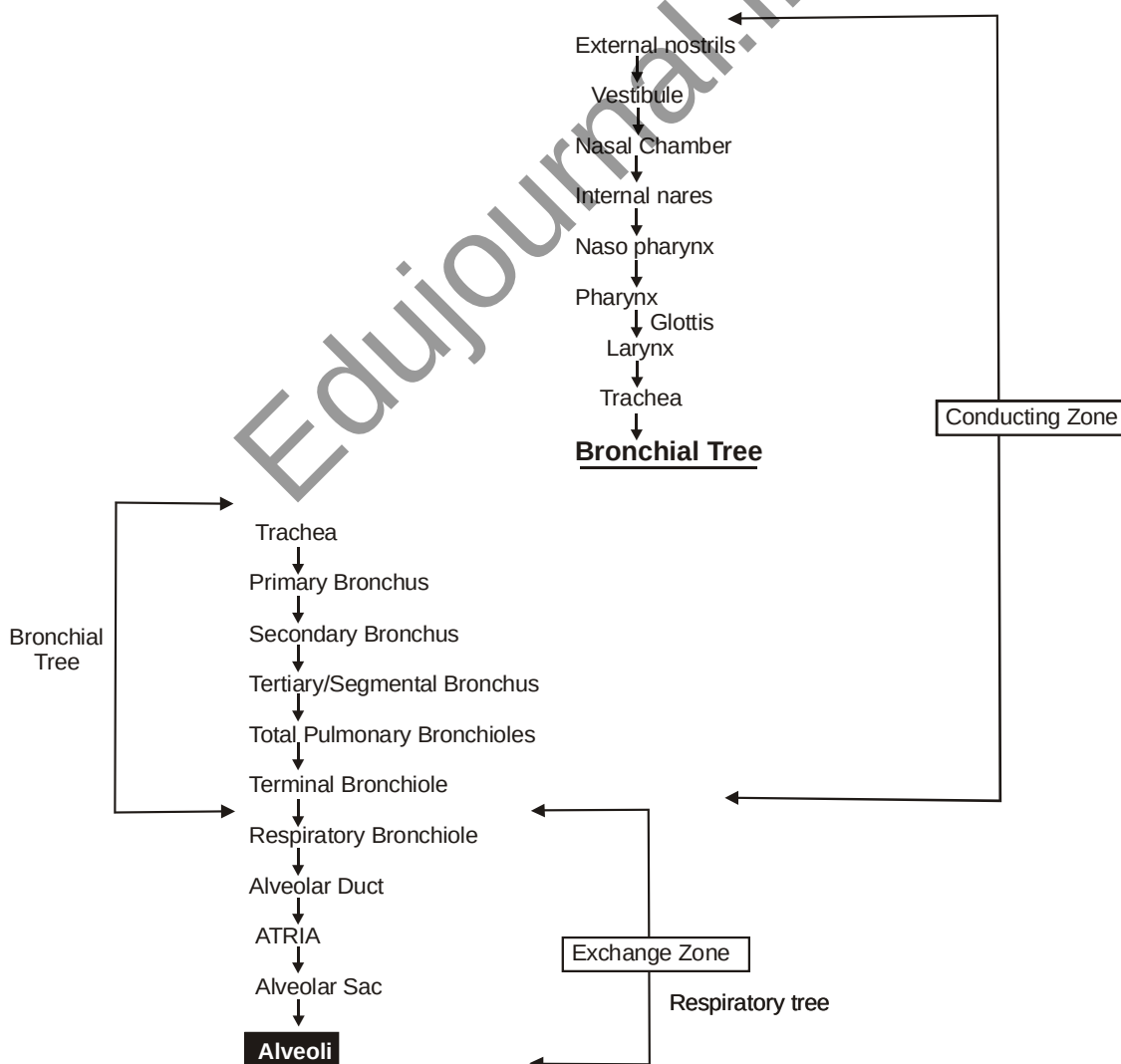
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enter into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

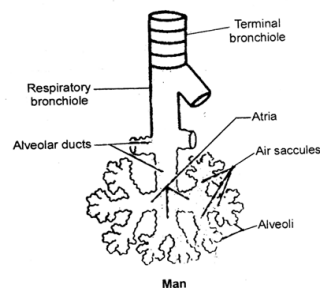
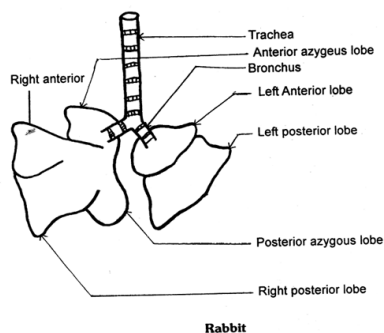
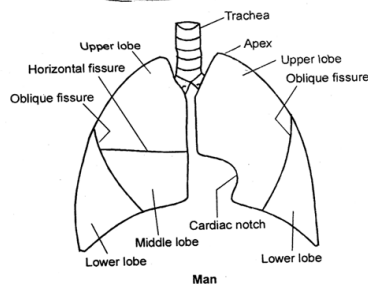
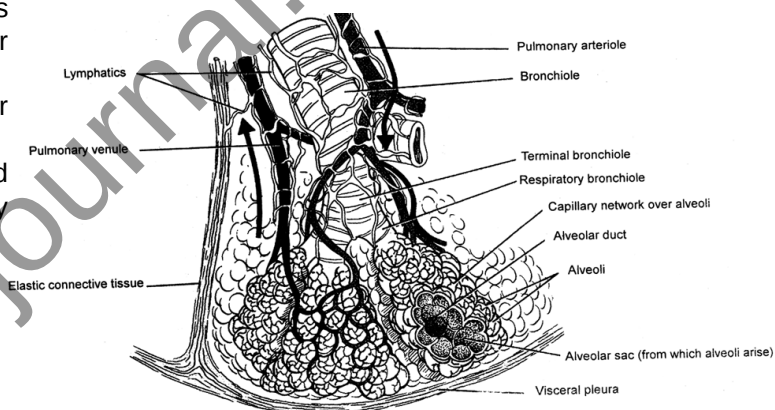
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

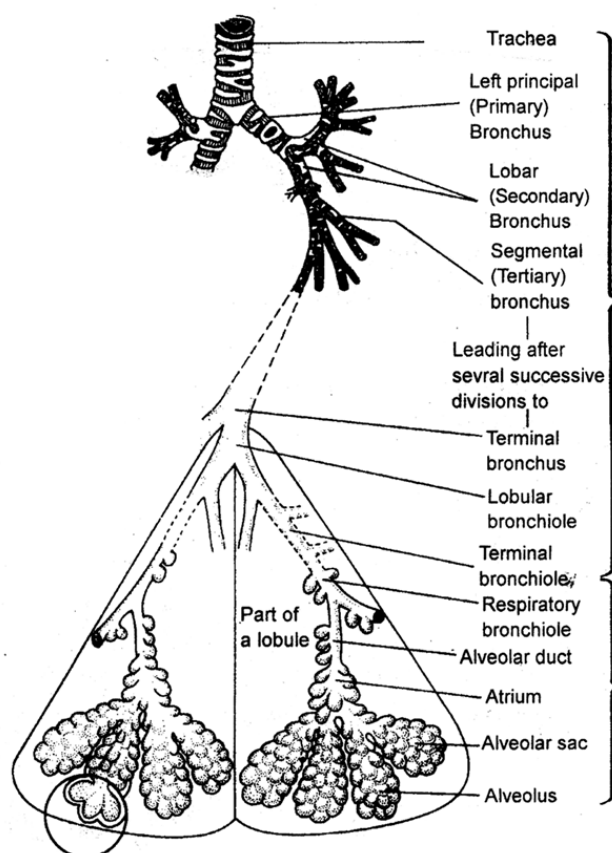
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

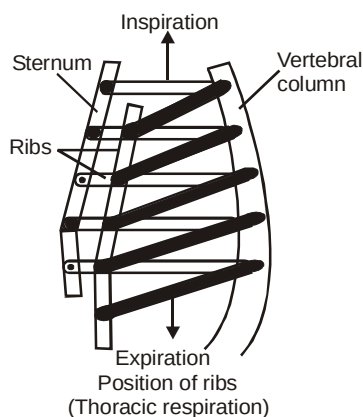
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

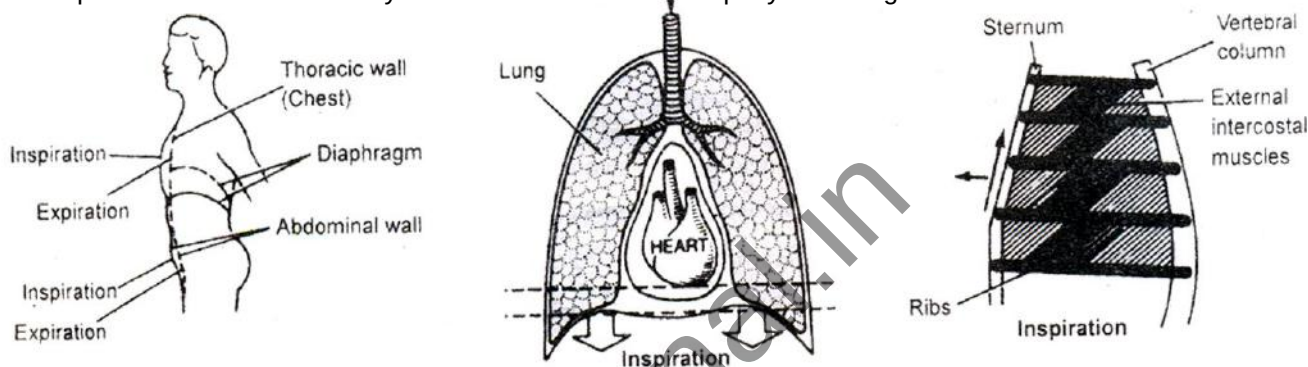
Inspiration

Expiration



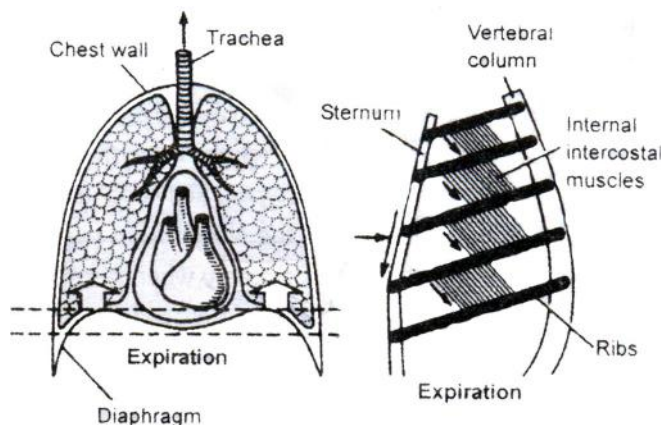
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

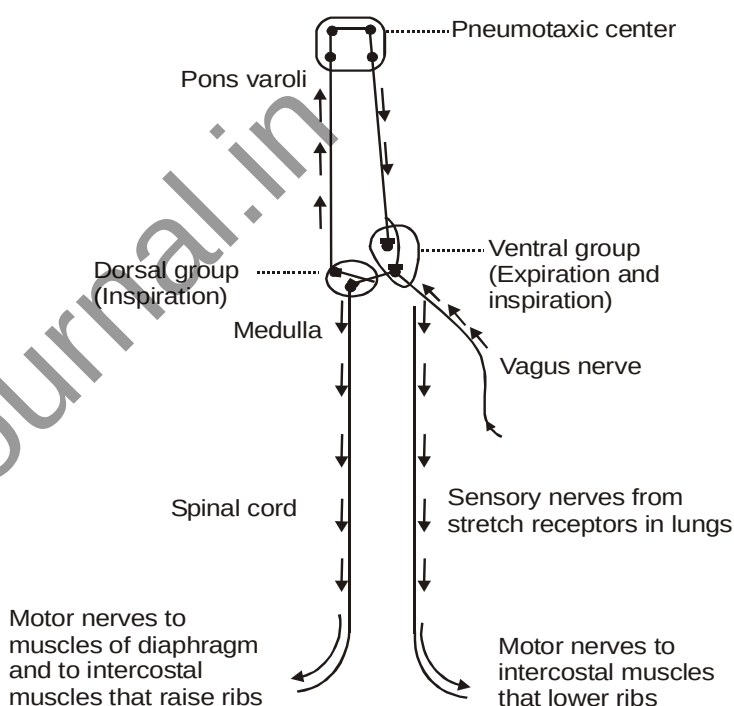


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

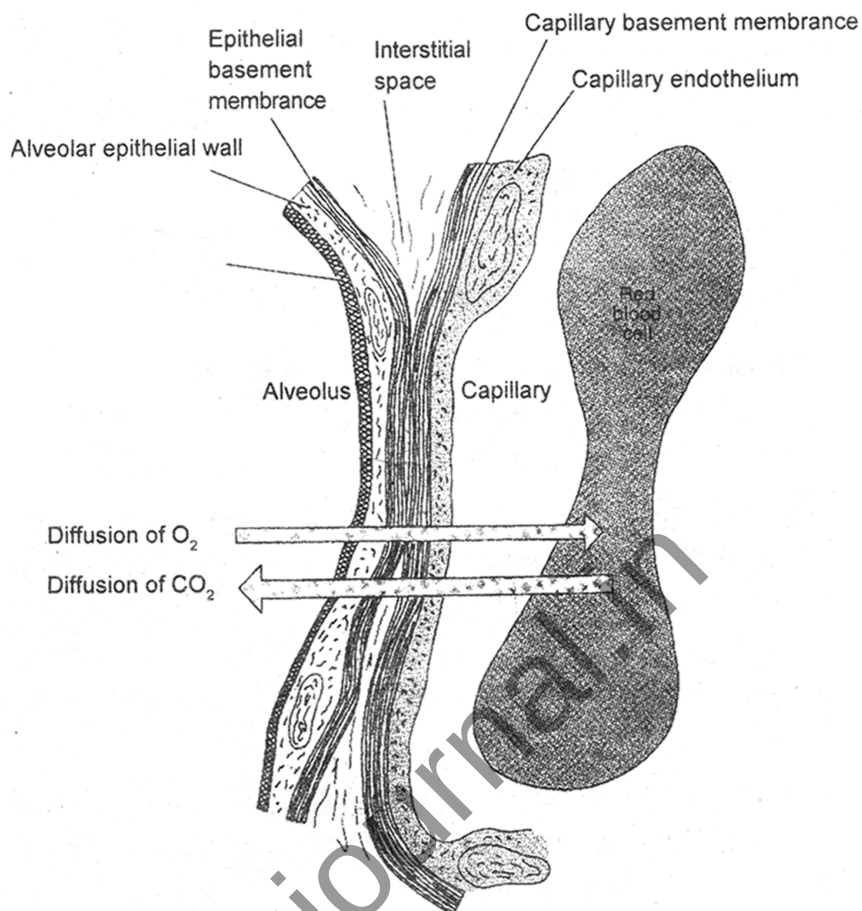
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

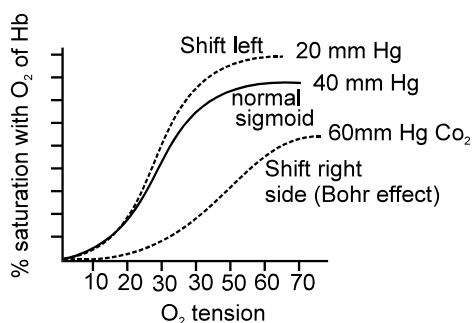
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

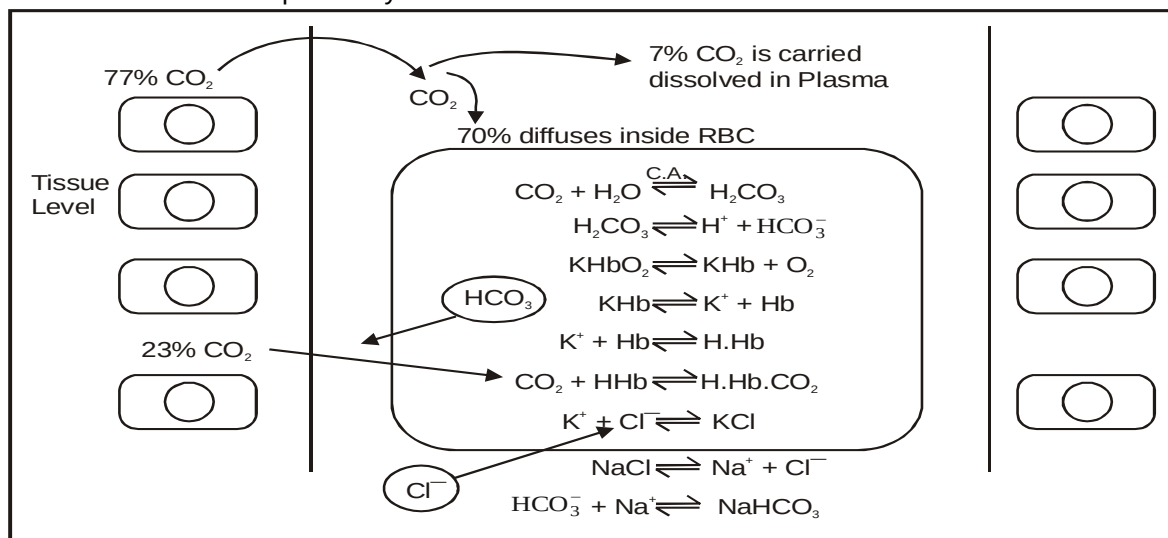
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

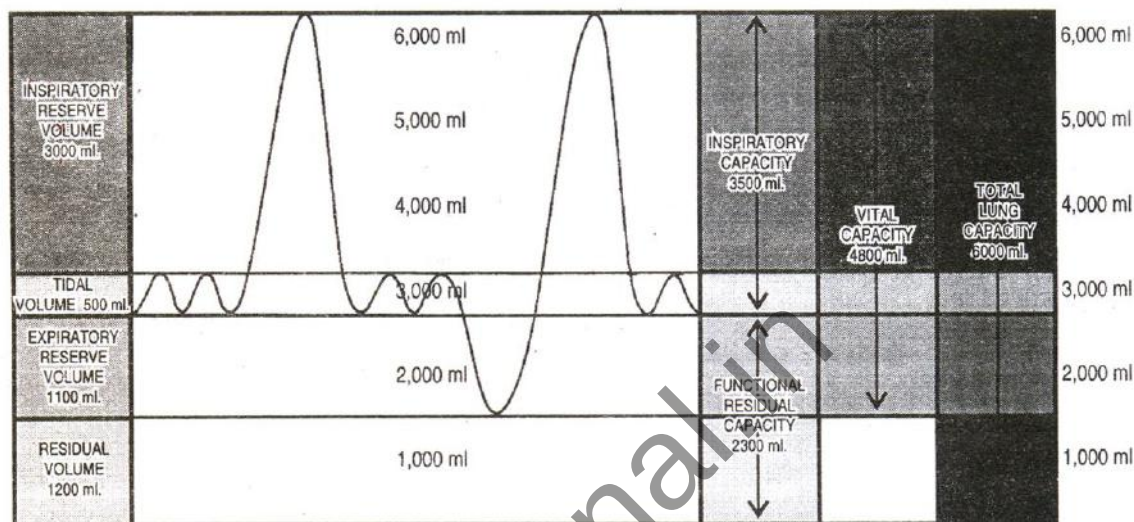
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned}
 \text{IC} &= \text{TV} + \text{IRV} \\
 &= 500 + 3000 \\
 &= 3500 \text{ mL.}
 \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- Dead volume
 - Dead space
 - Both A and B
 - Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- Omosis
 - Diffusion
 - Active transport
 - None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- Spherometer
 - Spirometer
 - Sphygmomanometer
 - Barometer
- Q.28** Air moves into the lungs when-
- Atmospheric pressure is less than pressure within the lungs
 - Atmospheric pressure is equal to the pressure within the lungs
 - Atmospheric pressure is greater than pressure within the lungs
 - None of these
- Q.29** Normal rate of breathing in man is-
- 20-30 times per minute
 - 12-14 times per minute
 - 5-10 times per minute
 - 40-50 times per minute
- Q.30** Choose the correct equation-
- Total capacity of lungs = Vital capacity + Residual air
 - Vital capacity of lungs = Tidal air + Complemental air
 - Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- Hypothalamus
 - Medulla oblongata
 - Cerebellum
 - Thalamus
- Q.32** Which of the following statements is correct-
- Inspiration is an active process
 - Expiration is an active process
 - Inspiration is a passive process
 - Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- Oxygen in trachea
 - Concentration of O_2
 - Diaphragm expansion
 - Concentration of CO_2
- Q.34** The breathing rate in a child is-
- Same as in an adult man
 - Less than in an adult man
 - More than in an adult man
 - None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- Inspiration
 - Normal respiration
 - Aspiration
 - Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- Backward and upward
 - Forward and upward
 - Backward and downward
 - Forward and downward
- Q.37** Tidal air in mammals is-
- Total air that can be drawn into lungs
 - Air that normally goes in and comes out of lungs during breathing
 - Air that is left in the lungs after normal expiration
 - Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box (2) Vocal cord
 - (3) Trachea (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue (2) Larynx
 - (3) Trachea (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million (2) 450 million
 - (3) 750 million (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney (2) Envelop the lung
 - (3) Envelop the liver (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi (2) Tracheae
 - (3) Alveoli (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis (2) Tracheal valves
 - (3) Syrinx (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three (2) Four
 - (3) Two (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid (2) Larynx
 - (3) Trachea (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries (2) Alveoli
 - (3) Turbinates (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

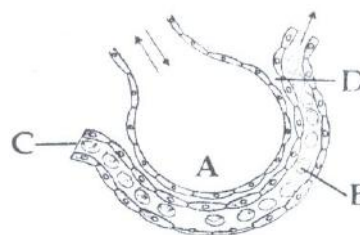
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- Exchange of gases occurs on the principle of diffusion, through moist body surface.
- Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- Indirect respiration is found in complex and higher form of organism.
- Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- Respiration which occurs in presence of oxygen is called aerobic respiration.
- The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- External respiration is also called **breathing** or **ventilation**.

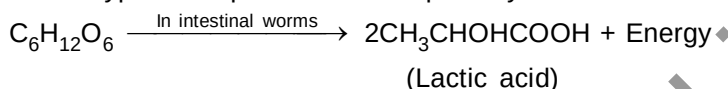
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

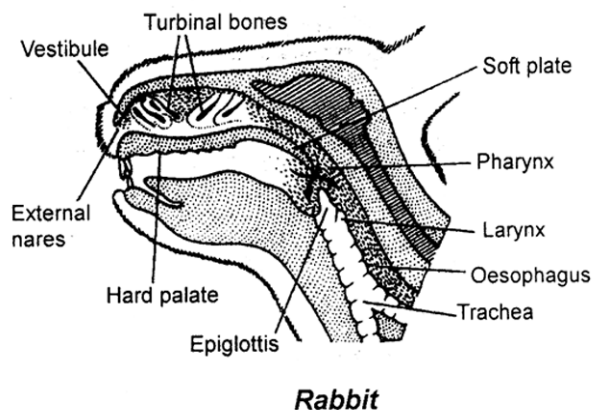
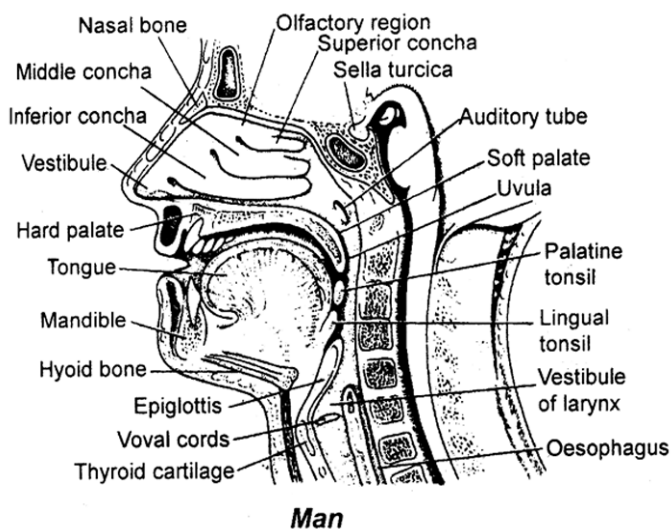
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

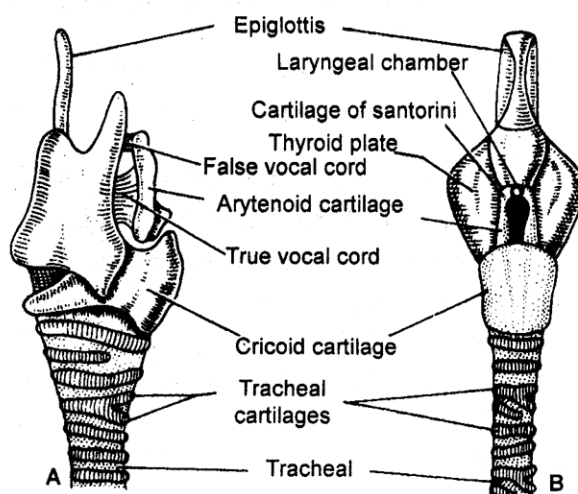
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

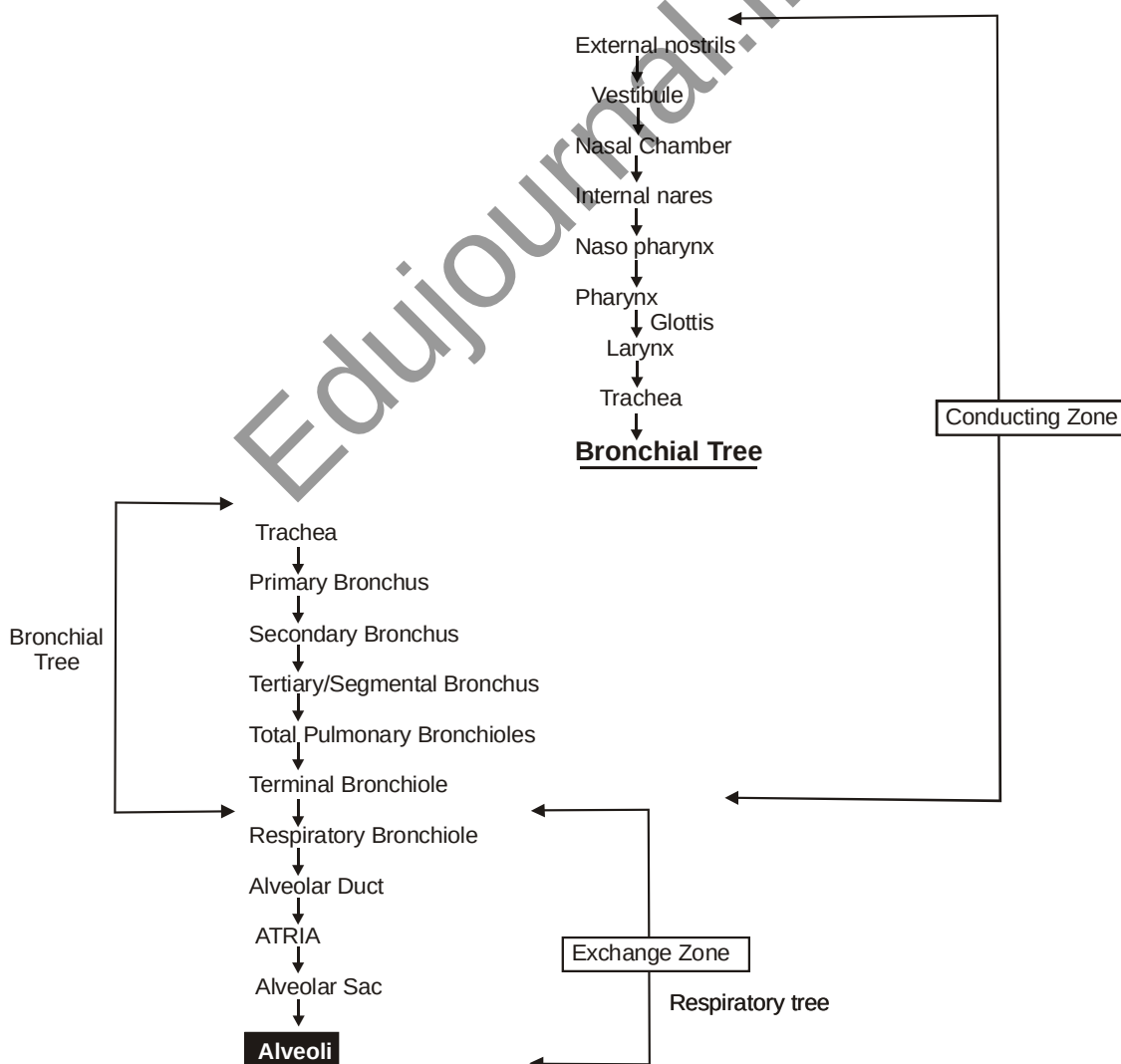
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enter into thoracic cavity, it divides into two branches called as primary bronchus. Branches of Primary bronchus up to terminal bronchioles make the **bronchial tree**
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

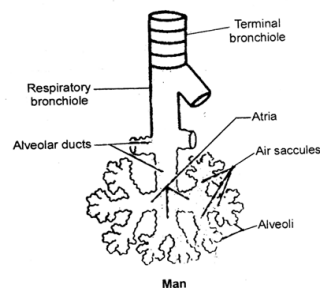
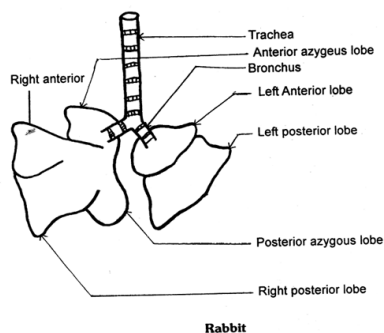
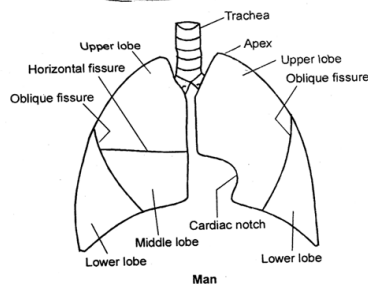
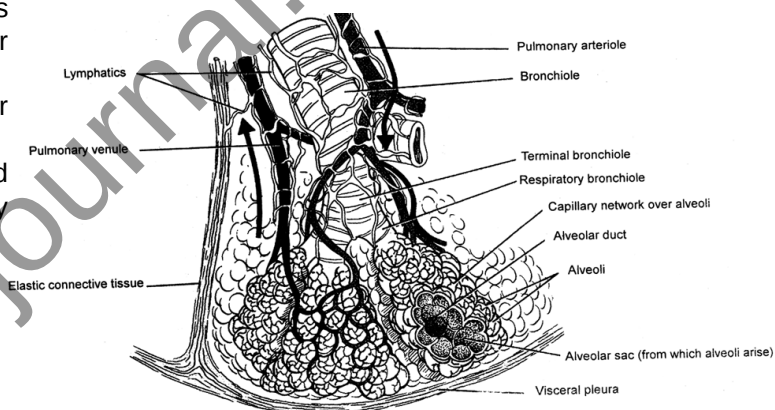
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

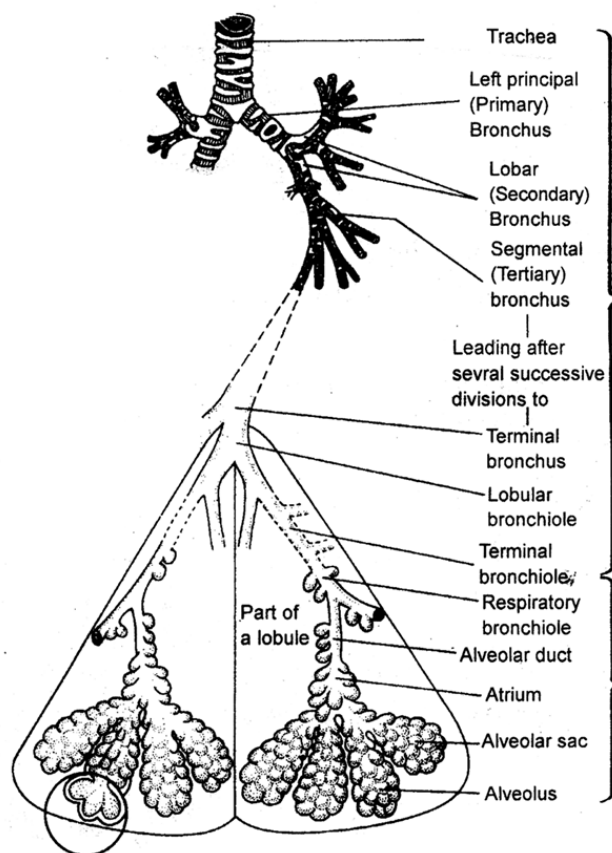
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

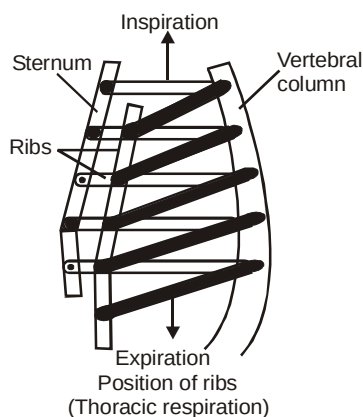
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

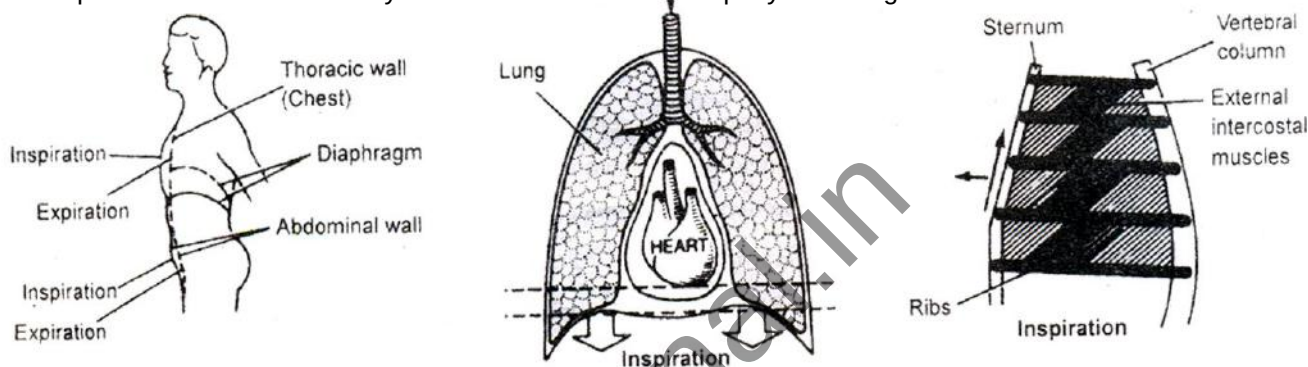
Inspiration

Expiration



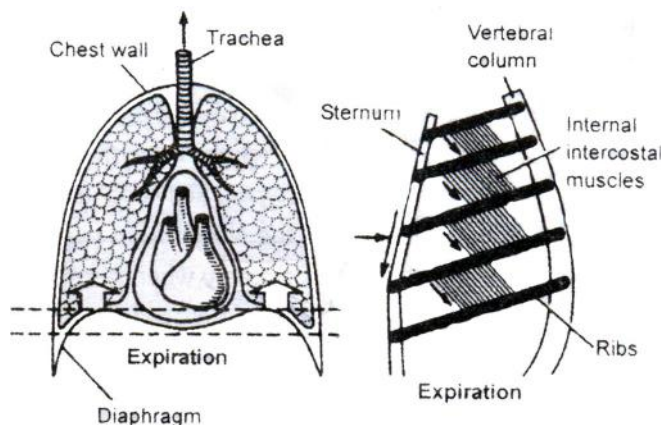
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

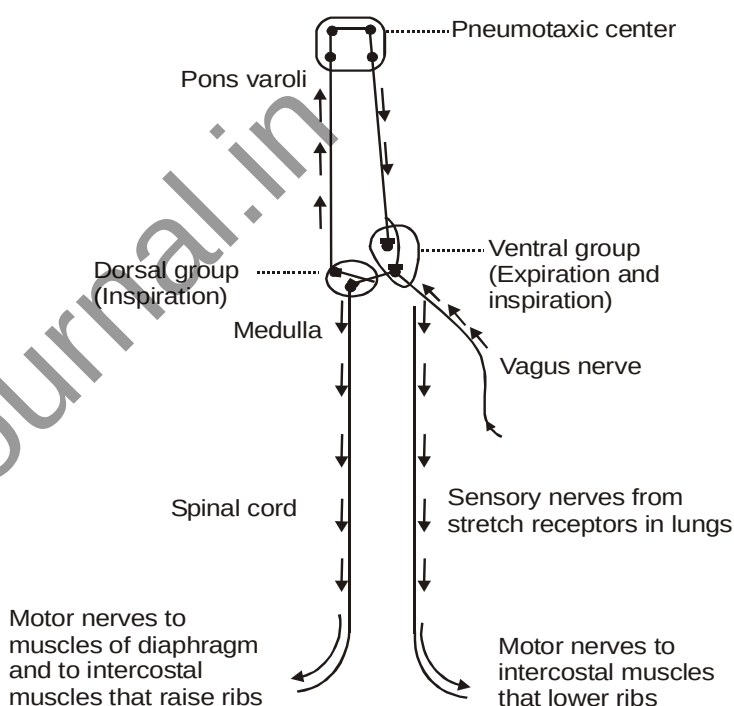


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

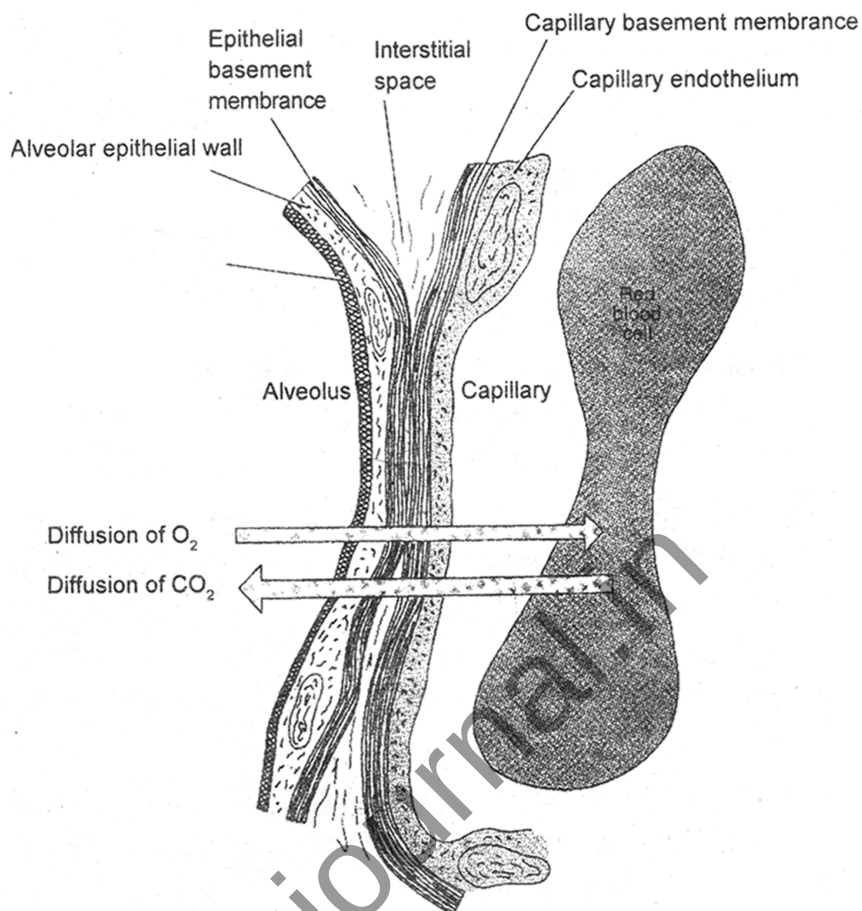
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

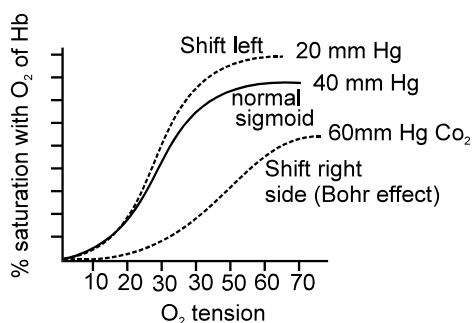
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25%O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

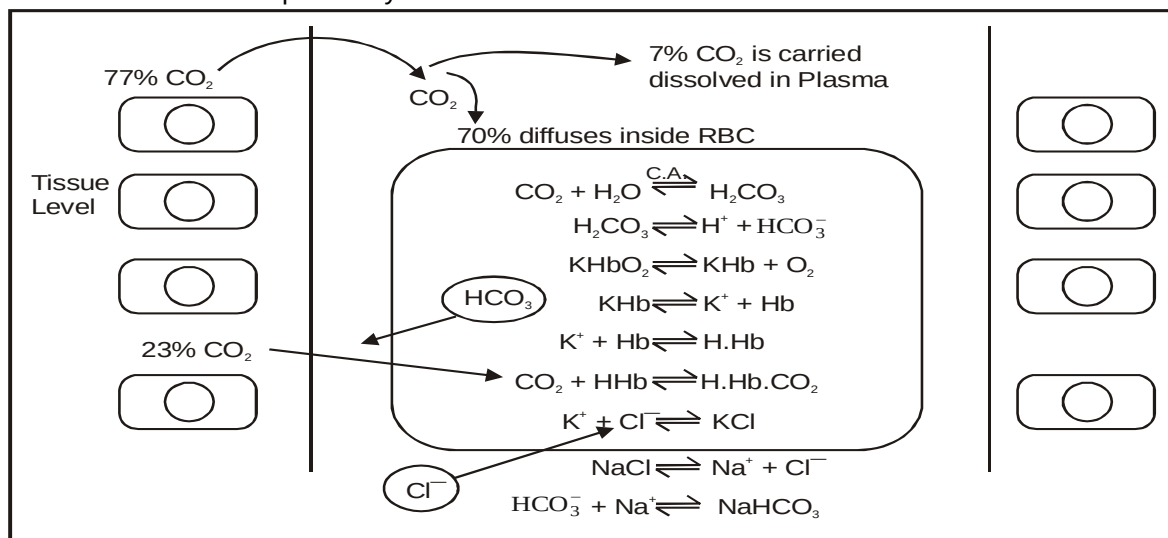
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

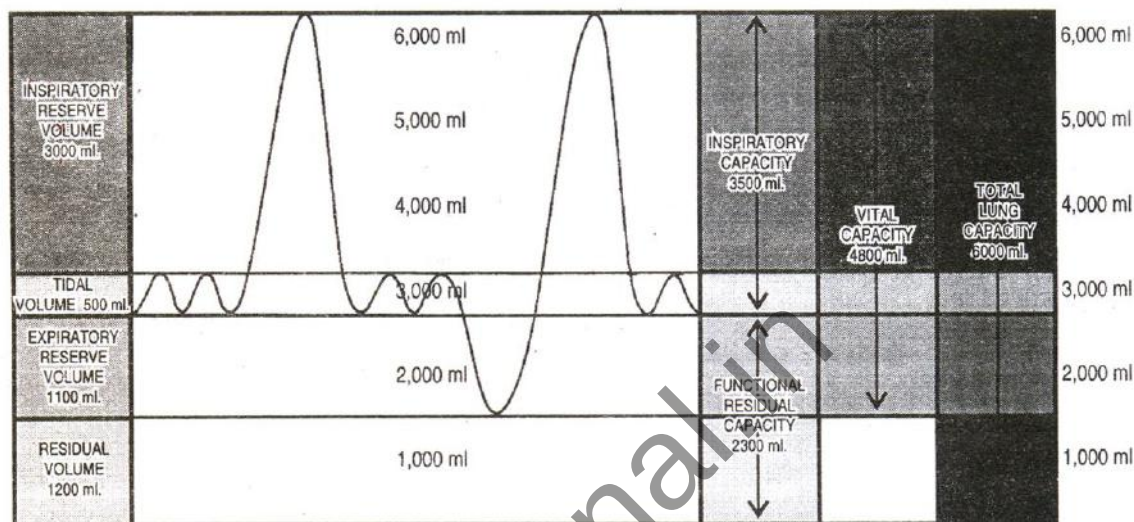
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- Dead volume
 - Dead space
 - Both A and B
 - Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- Omosis
 - Diffusion
 - Active transport
 - None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- Spherometer
 - Spirometer
 - Sphygmomanometer
 - Barometer
- Q.28** Air moves into the lungs when-
- Atmospheric pressure is less than pressure within the lungs
 - Atmospheric pressure is equal to the pressure within the lungs
 - Atmospheric pressure is greater than pressure within the lungs
 - None of these
- Q.29** Normal rate of breathing in man is-
- 20-30 times per minute
 - 12-14 times per minute
 - 5-10 times per minute
 - 40-50 times per minute
- Q.30** Choose the correct equation-
- Total capacity of lungs = Vital capacity + Residual air
 - Vital capacity of lungs = Tidal air + Complemental air
 - Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- Hypothalamus
 - Medulla oblongata
 - Cerebellum
 - Thalamus
- Q.32** Which of the following statements is correct-
- Inspiration is an active process
 - Expiration is an active process
 - Inspiration is a passive process
 - Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- Oxygen in trachea
 - Concentration of O_2
 - Diaphragm expansion
 - Concentration of CO_2
- Q.34** The breathing rate in a child is-
- Same as in an adult man
 - Less than in an adult man
 - More than in an adult man
 - None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- Inspiration
 - Normal respiration
 - Aspiration
 - Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- Backward and upward
 - Forward and upward
 - Backward and downward
 - Forward and downward
- Q.37** Tidal air in mammals is-
- Total air that can be drawn into lungs
 - Air that normally goes in and comes out of lungs during breathing
 - Air that is left in the lungs after normal expiration
 - Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box
 - (2) Vocal cord
 - (3) Trachea
 - (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue
 - (2) Larynx
 - (3) Trachea
 - (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million
 - (2) 450 million
 - (3) 750 million
 - (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney
 - (2) Envelop the lung
 - (3) Envelop the liver
 - (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi
 - (2) Tracheae
 - (3) Alveoli
 - (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis
 - (2) Tracheal valves
 - (3) Syrinx
 - (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three
 - (2) Four
 - (3) Two
 - (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid
 - (2) Larynx
 - (3) Trachea
 - (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries
 - (2) Alveoli
 - (3) Turbinates
 - (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc
 - (2) About 2000 cc
 - (3) About 4500 cc
 - (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease
 - (2) Stop
 - (3) Increase
 - (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia
 - (2) Anoxia
 - (3) Suffocation
 - (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis
 - (2) Asphyxia
 - (3) Hypoxia
 - (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis
 - (2) Hypoxia
 - (3) Pneumonia
 - (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia
 - (2) Bronchitis
 - (3) Asthma
 - (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a -
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with -
- (1) respiration
 - (2) breathing
 - (3) inspiration
 - (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured-
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2
 - (2) fall in level of CO_2
 - (3) rise of O_2 level
 - (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

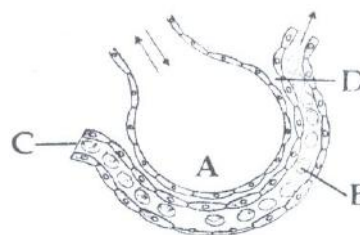
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															

DEFINITION ::

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION ::

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration ::

Direct respiration

- (i) In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.
- (ii) Exchange of gases occurs on the principle of diffusion, through moist body surface.
- (iii) Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, sponges, hydra, flatworm, roundworm etc.

Indirect respiration

- (i) In this type of respiration, there is no direct contact in between the body cells and respiratory medium.
- (ii) Indirect respiration is found in complex and higher form of organism.
- (iii) Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.
e.g. (a) Skin - Skin is respiratory organ in annelida and amphibians.
(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.
(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.
(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION ::

Aerobic respiration

- (i) Respiration which occurs in presence of oxygen is called aerobic respiration.
- (ii) The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 2880 \text{ KJ Energy}$$
- (iii) Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

A- External respiration

- (i) External respiration is also called **breathing** or **ventillation**.

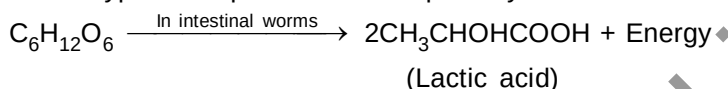
- (ii) It is gaseous exchange in between respiratory organ and outer environment.
e.g. Exchange of gases in between lungs and air.

B-Internal respiration

- (i) Internal respiration is also called **tissue respiration**.
(ii) It is the exchange of oxygen of blood and carbon dioxide of body cells through tissue fluid at the cellular level
(iii) It involves cellular respiration in which glucose is oxidised inside the mitochondria of cell to produce H_2O , CO_2 and energy.

Anaerobic respiration

- (i) Respiration which occurs in absence of oxygen is called anaerobic respiration, anaerobic respiration is also called **fermentation**.
(ii) It is found in bacteria, yeast, parasitic worms
(iii) In this type of respiration food is partially oxidised. It can be shown by following way.



Note :

Anaerobic respiration even takes place in certain particular body tissues of aerobes.

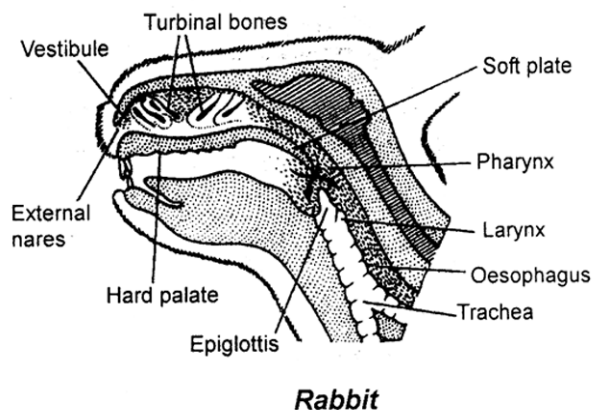
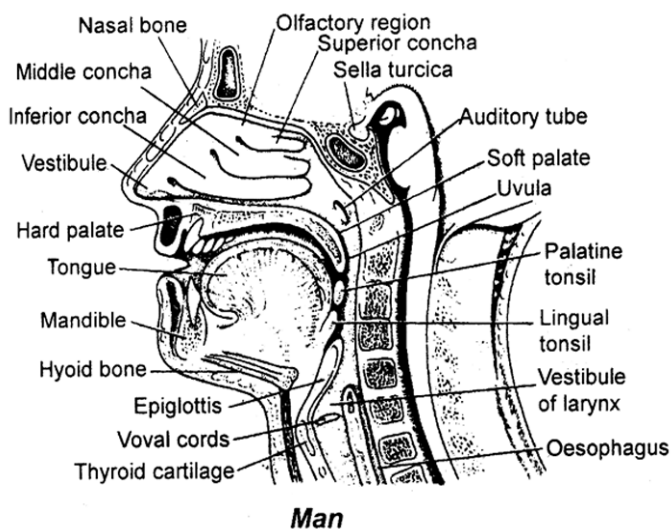
e.g. In skeletal muscles fibres, In mammalian RBC.

- (iv) In skeletal muscle fibres during vigorous exercise **glucose is metabolised into lactic acid**. The rapid formation and accumulation of lactic acid are responsible for muscle fatigue.
(v) In mammalian RBC anaerobic respiration is found, because no mitochondria is found in mammalian RBC.

MAMMALIAN (HUMAN) RESPIRATORY SYSTEM ::

Mammalian respiratory system is formed of following parts-

(1) Nostril	(2) Nasal chamber	(3) Internal nare	(4) Pharynx
(5) Laryngopharynx	(6) Larynx	(7) Vocal cord	(8) Trachea
(9) Primary bronchi	(10) Lungs		



Nostril

- (i) It is also called external nares.
- (ii) It is oval aperture of nose present at the lower end.

Note : Presence of two nares is called dirhynous stage.

Nasal chamber

Nasal septum (made of Hyaline cartilage) divides nasal cavity into two nasal chamber by the nasal septum. Each nasal chamber can be divided into three regions. These three parts are as follows -

(i) Vestibular part

It is smaller and anterior part, and is lined by hairy skin which acts as filter and prevents entry of dust particles.

(ii) Respiratory part

It is middle part and is lined by pseudo-stratified epithelium which acts as air conditioner and brings the inspired air at the body temperature.

(iii) Olfactory part

It is upper part of nasal chamber and is lined by olfactory epithelium called **schneiderian membrane**. It looks yellowish brown, This region acts as an organ of smell. Three bony ridges the superior, middle and inferior nasal conchae arises from the wall of each nasal chamber. The nasal conchae increases the surface area of nasal chamber for better air conditioning

Internal nares

There are posterior opening of nasal chambers that leads into nasopharynx.

Pharynx

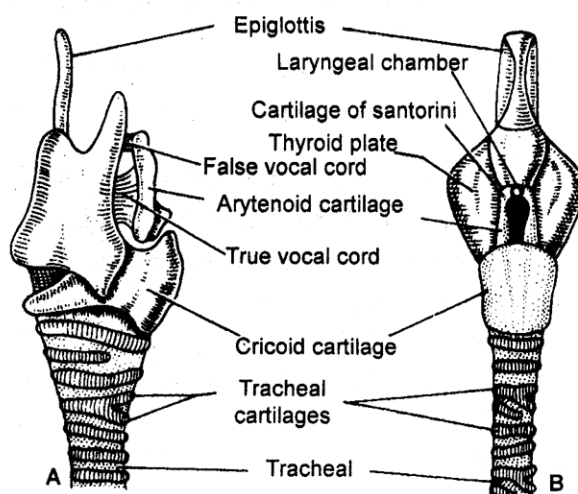
Pharynx comprises nasopharynx, oropharynx and laryngopharynx. The pharynx provides passage to both air and food.

Laryngopharynx

It is the lower part of pharynx and has a slit like aperture called **glottis**, which can be closed by a leaf like bilobed cartilage **epiglottis**, during swallowing of food bolus.

Larynx

- (i) It is also called **voice box** or **adam's apple** or **pomas adami**.
- (ii) After puberty it get more developed in males in comparison to female, because of this very reason, males have deeper voice



(iii) It is supported by four cartilage which prevent its collapsing these cartilage are as follows.

- Cricoid-1 – Thyroid-1 – Arytenoid-2 – Cartilage of santorini-2

(i) **Thyroid cartilage**

- It is single in number (Hyaline Cartilage).
- It is largest size and c shaped cartilage which supports anterior and lateral sides of upper part of the larynx.

(ii) **Cricoid cartilage**

- It is single in number. (Hyaline Cartilage)
- It is some what smaller, thicker and a complete ring or collar like cartilage around the larynx behind the thyroid cartilage.
- It is broad **dorsally** and narrow ventrally.

(iii) **Arytenoid cartilage**

- These are two pyramid shaped cartilage.(Hyaline cartilage)
- It is smallest cartilage which support posterior wall of upper part of larynx.

(iv) **Cartilage of Santorini**

Each arytenoid terminates in front in a Swollen knob called the cartilage of santorini.
(Elastin Cartilage)

Vocal cords

- In larynx, 2 pairs of vocal cord is found outer pair is **false vocal cord** whereas, inner pair is **true vocal cord** when air is forced through the larynx it cause vibration of true vocal cards and sound is produced.
- The pitch of the sound is determined by the tension of vocal cards, the greater the tension the higher the pitch.
- Vocal cards are modified mucous folds of larynx.

Note :

- Sound get converted into speech by Tongue. Movement of Tounge is controlled by Speech centre of the brain.
- Speech centre is not well developed in dumb persons.
- Voice of rabbit is called **Quacking**.
- False vocal cord remain absent in **Elephant**.
- True vocal cord remain absent in **Hippopotamus**.
- Voice apparatus of birds is called **syrix**.

Trachea (Wind pipe)

- It is long, tubular structure which runs downward through the neck in front of oesophagus.
- It is supported by 16-20 dorsally incomplete C-shaped cartilagenous tracheal ring, which prevents its collapsing.
- It is lined by pseudostartified ciliated epithelium with mucous secreting goblet cells.

Primary bronchi

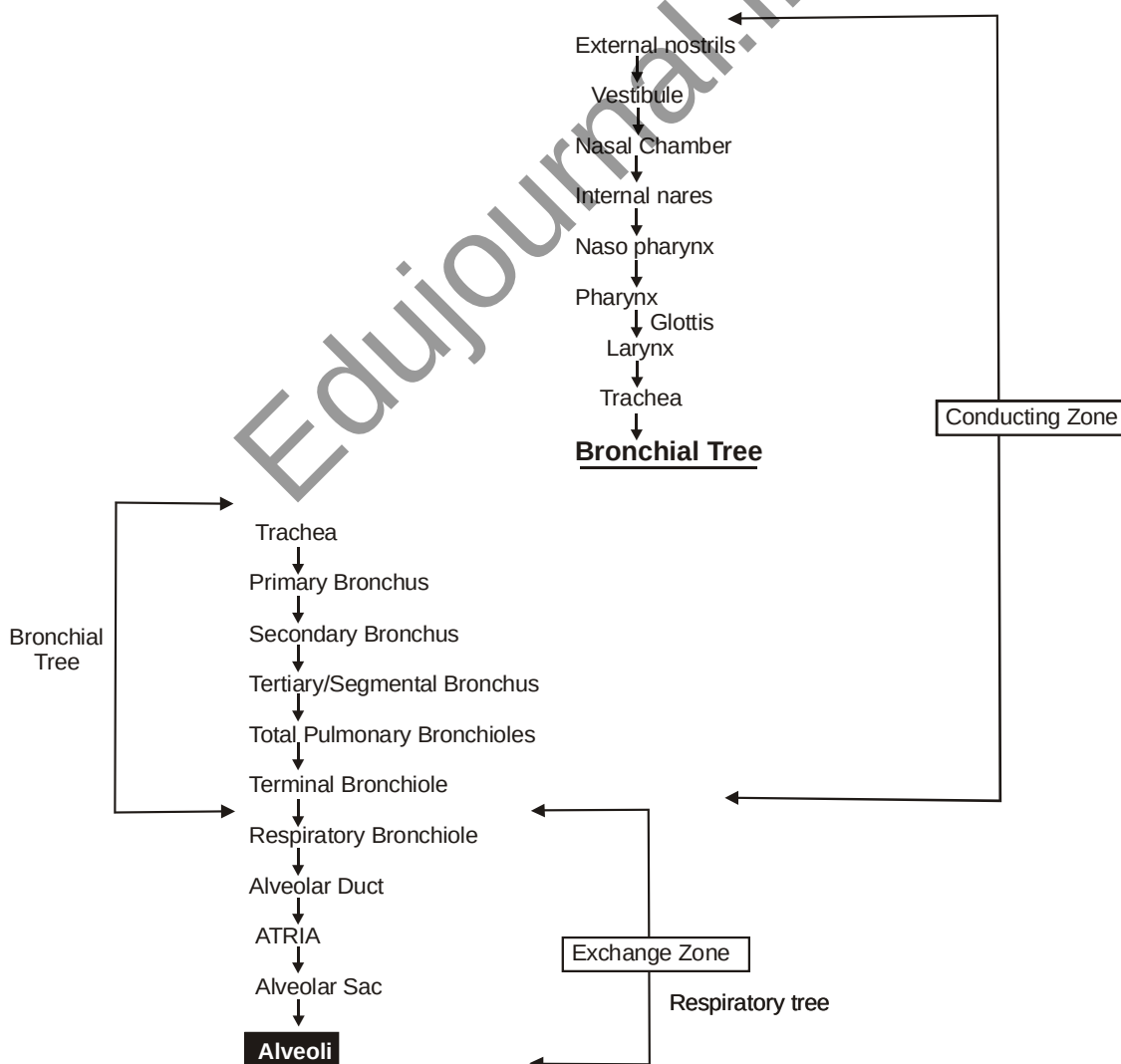
- These are one pair of small thin walled tubular structure formed by the division of trachea at the level of 5th thoracic vertebrae near the heart.

- The right bronchus (2.5 cm) is wider shorter and more vertically placed than the left bronchus.
- Like trachea primary bronchi are supported by cartilaginous rings.
- Each primary bronchus enters the lungs on its own side.

Bronchial tree (B.T.) & Respiratory Tree (R.T.)

- When trachea enters thoracic cavity, it divides into two branches called primary bronchus. Branches of primary bronchus up to terminal bronchioles make the **bronchial tree**.
- Terminal bronchioles divide to form respiratory bronchioles & branches of respiratory bronchioles make the **respiratory tree**.
- In bronchial tree, cartilage rings are present, while these are absent in respiratory tree.
- Gaseous exchange occurs in respiratory tree while it is absent in bronchial tree.
- Volume of air which is filled in B.T. is a part of **dead space volume**, which doesn't take part in gaseous exchange. (150 ml)

There are two zones.



Lungs

Position

Lungs are present in thoracic cavity on either side of heart.

Pleural membranes

- Each lung is enclosed with double membrane pleural membrane.
- The outer membrane is called **parietal pleura**. Whereas inner membrane is known as visceral pleura.
- In between two pleural membranes, hollow space is found which is called pleural cavity.
- Pleural cavity is filled with watery fluid called **pleural fluid**. Pleural fluid is secreted by pleural membrane.

Pleural fluid perform three function which are as follows-

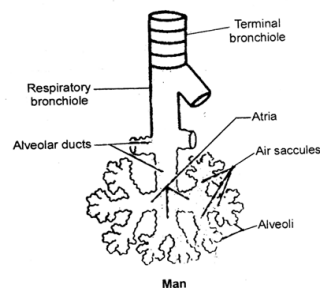
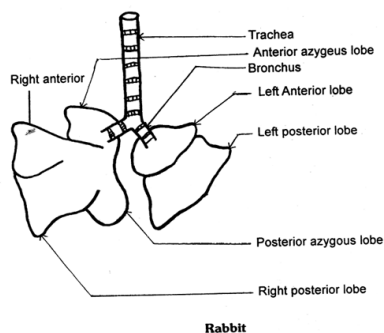
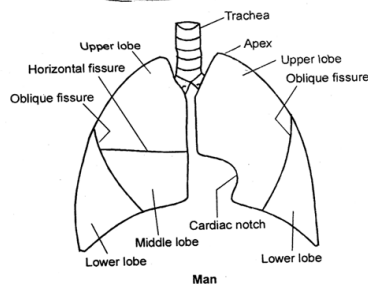
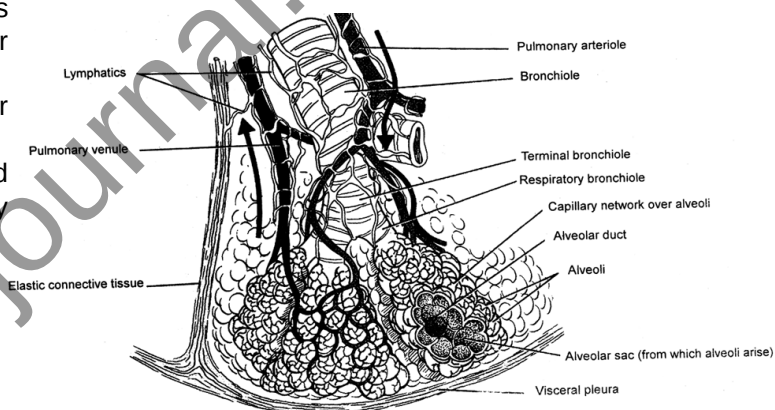
- (a) It allows free frictionless movement of lungs.
- (b) It protects the lungs from mechanical shock.
- (c) It prevents pleural membrane from sticking together.

Note :

Accumulation of fluid between the pleura is called pleural effusion or pleurisy. It happens because of bacterial infection and the person feel difficulty in breathing. due to the increased intrapleural pressure

External structure of lungs

- The lungs are spongy, soft, pinkish elastic organs.
- The most upper portion of each lungs is called the **apex** and the most lower portion is called the **base**.
- **Right lung** is slightly larger and broader in size.
- Each lung is a lobulated structure and is divided externally into the lobes by transverse and oblique grooves called **fissures**.



Lobes of lungs

(A) Lobes of lungs in man

- (i) Left lung is 2 lobed, upper superior lobe, and lower inferior lobe. (575 gm)
- (ii) Right lung is 3 lobed; upper superior lobe, middle lobe and lower inferior lobe. It is demarcated by transverse and oblique fissures. (625 gm)

(B) Lobes of lungs in rabbit

- (i) Right lung is 4 lobed, the right lobes are anterior and posterior azygous medianwards and right anterior and right posterior lobes outwards.
- (ii) Left lung is 2 lobed upper anterior and lower posterior lobe.

Alveoli : Each lobe is further divided into several lobules by septas of connective tissue. Each lobule is further divided into several air sacs ; and in the end, each air-sac is lastly divided into 3 or 4 alveolis ; which are also termed as the units of lungs.

Structural & functional unit of lungs is called **alveoli**

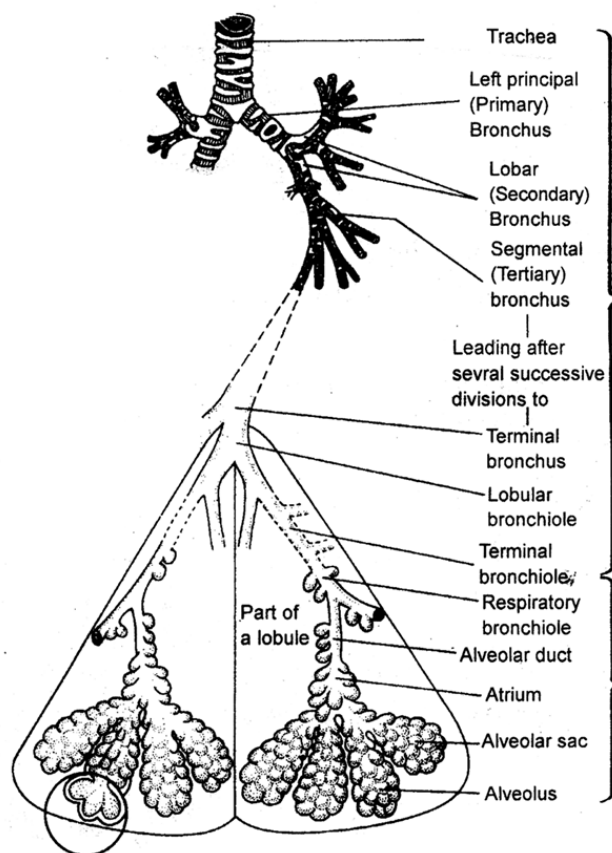
Approximately 300 million alveoli are present in Both lungs. Inner (Alveolar) surface area of both lungs is approximately 100 m^2 . Wall of alveoli consists of two layers, outer layer is composed of yellow fibrous C.T. Inner layer is composed of Simple Squamous Epithelium

- squamous cells are called as **pneumocytes**.
- most of these Pneumocytes help in gaseous exchanges while few pneumocytes which are larger in size (type II pneumocyte) secrete LECITHIN (Phospholipid) this acts as surfactant which prevents alveoli from remaining collapse by reducing its surface tension.

Alveoli internal surface is termed as the Respiratory surface. It is derived from the endoderm of the embryo. Rest whole lung is mesodermal. The middle part of alveoli wall is made up of connective tissue. It is richly supplied with blood capillaries, a dense network of blood capillaries is found in alveoli.

These blood capillaries come from pulmonary artery. Pulmonary artery divides into blood capillaries after reaching in lungs. These capillaries from a dense network in the walls of alveoli. All these capillaries combine to form pulmonary vein at the another end. These veins carries pure blood to the left auricle of the heart. There are small pores present in the walls of alveoli. These pores make diffusion of gases easy. These pores are called **pores of Kuhn**. It is the characteristic feature of mammalian lungs, that there is no central cavity, Mammalian lungs are **solid and spongy**.

Muscles are absent in the lungs of mammals. So the power of self-contraction and self-expansion is absent in these lungs. (Sucken lungs).



Internal structure of lungs

Thoracic cavity

- Thoracic cavity is like a cage, so also called thoracic cage.
- Thoracic cavity is combination of following structure.
 - (a) Vertebral column - Found on dorsal part of thoracic cavity.
 - (b) Sternum - Found on ventral part of thoracic cavity.
 - (c) Ribs - Found on lateral part of thoracic cavity.
 - (d) Diaphragm - Found on posterior part of the thoracic cavity.

Diaphragm

A muscular septum which is found only in mammals (and crocodile). Normal shape of it is dome like which divides body cavity in two parts upper thoracic cavity & lower abdominal cavity.

In it radial muscles are present. They originate from periphery and inserted in central region of diaphragm. By the contraction in these muscles, diaphragm become flattened in shape. So, volume of thoracic cavity increases. Therefore, diaphragm helps in inspiration.

Intercostal muscles (ICM)

Space between two ribs is called intercostal space in which 2 types of muscles are present

– **External ICM. (EICM)**

– **Internal ICM. (IICM)**

EICM

They originate from dorsal part of upper rib & insert on ventral part of lower rib. By the contraction in this muscles, rib. and sternum shifts upward and outward. So they helps in inspiration.

IICM

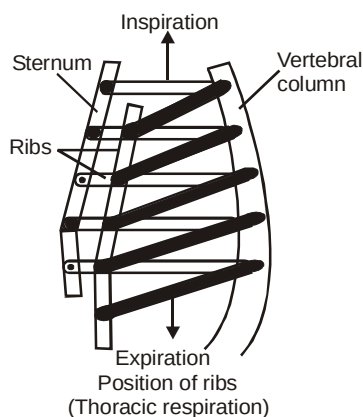
They originate from dorsal part of lower rib and insert in ventral part of upper rib. By the contraction in these muscles, ribs and sternum shifts downward and inward respectively, so it helps in forceful expiration which is a voluntary activity. So contraction of IICM is under the control of cerebrum.

MECHANISM OF RESPIRATION OR BREATHING ::

Mechanism of Breathing involves two phases

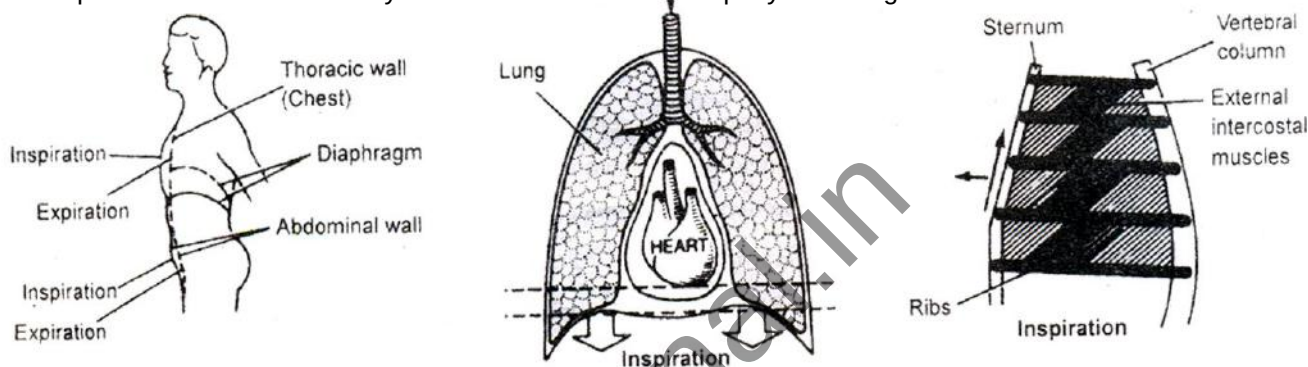
Inspiration

Expiration



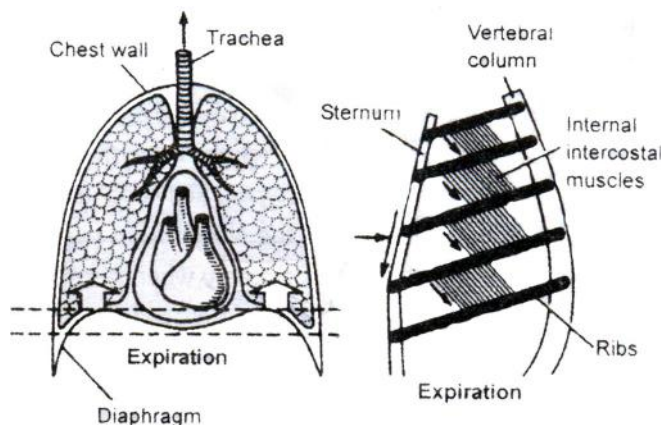
INSPIRATION ::

- It is a process by which fresh air enters the lungs, the intercostal muscles, diaphragm, and abdominal muscles play an important role.
- During inspiration, diaphragm becomes flat and gets lowered by the contraction of its radial muscle fibres, This increases vertical diameter of Thoracic cavity.
- Due to contraction of external intercostal muscles, ribs and sternum are pulled upward and outward and it also result in increase of transverse diameter of thoracic cavity.
- Due to increase in both diameters of thoracic cavity, intrapleural pressure falls causing decompression of lungs so lungs expand due to elastic recoil and air pressure within lungs decrease. The greater pressure outside the body now causes air to flow rapidly into lungs.



EXPIRATION ::

- It is a process by which the foul air (carbon dioxide) is expelled out from the lungs.
- It is passive process
- During expiration muscles fibres of the diaphragm relax, so diaphragm becomes convex towards thoracic cavity, it results in decrease vertical diameter of thoracic cavity.
- Due to relaxation of external intercostal muscles, ribs and sternum return back to their original position and this also results in decrease in transverse diameter of thoracic cavity.
- Due to decrease in both diameter of thoracic cage, intrapleural pressure increases, lungs are now compressed so pressure within lungs increase, the greater pressure within lungs force foul air from lungs to outside of body.



Forceful expiration

During forceful expiration as during exercise coughing and sneezing, abdominal muscles and internal intercostal muscles come into action which rapidly reduces volume of thoracic cavity. So, abdominal muscles and internal intercostal muscles are called expiratory muscles.

REGULATION OF BREATHING ::

Breathing is an **involuntary process** and is **controlled by medulla oblongata**, but it can be made voluntary for a short while, during this period it is **controlled by cerebrum**, those involuntary process which can be made voluntary are called **Reflex action**.

Breathing is regulated by two controls

Nervous control

Chemical control

NERVOUS CONTROL ::

The respiratory rhythm is controlled by the nervous system. The rate of respiration can be enhanced as per demand of the body during strainous physical exercises. A number of groups of neurons are located bilaterally in the medulla oblongata control the respiration, these are called **respiratory centres**. Three groups of respiratory centres have been indentified, namely : dorsal respiratory groups, ventral respiratory group and pneumotaxic centre

The **dorsal respiratory group** is present in the dorsal portion of medulla oblongata. The signals from these neurons generate the basic respiratory rhythm. The nervous signal released from this group is transmitted to the diaphragm, which is the primary inspiratory muscles & EICM.

The **ventral respiratory group** of neurons are located anterolateral to the dorsal respiratory group During normal respiration, this remains inactive and even does not play any role.

In this enhanced respiratory drive, the respiratory signal of this group contributes to fulfil the demand by regulating both inspiration and expiration. Few of the neurons of this group control inspiration, while few other control expiration, thus regulating both. The **pneumotaxic centre** is located dorsally in

the upper pons. It transmits signals to the inspiratory area. Primarily, it controls the switch off point of inspiration. When this signal is strong (high frequency), the inspiration lasts for a shorter duration and lungs are filled partially. During weak pneumotaxic signal, inspiration lasts for a longer duration resulting into complete filling of lungs. The strong signal (high frequency) causes increased rate of breathing, because duration inspiration as well as expiration, is shortened. The concentration of CO_2 and H^+ cause increased strength of inspiratory, as well as expiratory signal. However, oxygen has no such direct effect.

Heiring breuer reflex arch :

In the walls of terminal bronchioles and atria stretch receptors are present, Which are normally inactive but they become active when the lungs are excessively inflated due to failure of switch off of inspiration. The heiring breuer reflex arch now becomes activated and sends inhibitory signals to the inspiratory centre to switch off inspiration. This prevents the alveoli from over stretching and bursting. Thus Heiring Breuer reflex arch is a protective reflex which works only when normal mechanism of switch off of inspiration does not work timely due to any reason.

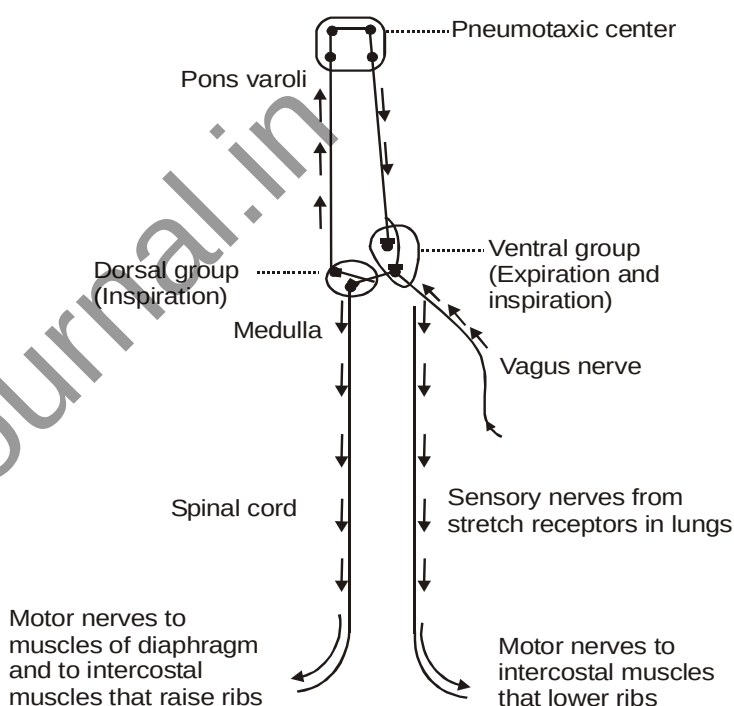


Diagram showing nervous control of breathing

CHEMICAL CONTROL ::

Effect of CO₂

- Chemoreceptors are found in the **carotid bodies** (located in the wall of carotid arteries) and in the **aortic bodies** (located in the wall of aorta).
- These chemoreceptors are stimulated by an increase in carbon dioxide concentration and by an increase in hydrogen ion concentration (pH) in the arterial blood.
- Increased CO₂ concentration lowers the pH resulting in **acidosis**. These chemoreceptors send signals to inspiratory and expiratory centres, thus rate of breathing is increased.

Note :

Activity and function of respiratory centre also get affected by body temperature and blood pressure. In case of increased blood pressure or increased body temperature the breathing rate also increases.

EXCHANGE OF GASES ::

- Ledwig at first described exchange of gases in blood.
- Exchange of gases occurs in lungs and body tissue.

Exchange of gases in lungs

- Exchange of gases in lungs is also called pulmonary gas exchange.
- In the lungs exchange of gases takes place between the air in the alveoli and the blood in the capillaries around the alveoli.
- In this exchange of gases blood takes up oxygen from the alveolar air and releases CO₂ to the alveolar air.

Uptake of oxygen (O₂) by pulmonary blood

The pO₂ (partial pressure of oxygen) of the alveolar air is 104 mm Hg and PO₂ of blood in alveolar capillaries is 40 mm Hg. Due to pO₂ differences of 64 mm Hg between air and blood. Oxygen diffuses rapidly from the alveolar air into the blood of alveolar capillaries raising PO₂ of blood to about 95 to 104 mm Hg.

Uptake of CO₂ by the air

The pCO₂ of the venous blood entering the pulmonary capillaries is 46 mm Hg while that of the alveolar air is 40 mm Hg. Therefore CO₂ diffuses from the blood of alveolar capillaries into the alveolar air till the pCO₂ of blood falls to 40 mm Hg.

Exchange of gases in tissue

- The oxygenated blood is sent from the pulmonary blood capillaries to the heart. The heart distributes this oxygenated blood to various body parts and tissues through arteries. The arteries divide to form arterioles which further divide to form capillaries.
- In tissues exchange of gases occurs between the blood and the tissue cells. The exchange occurs through tissue fluid that surrounds the tissue cells.
- The blood reaching the tissue capillaries has PO₂ of 95 to 104 mmHg and PCO₂ of 40 mmHg. The tissue cell has lower pO₂ and higher pCO₂. Due to pO₂ and pCO₂ difference between blood and tissue cell, oxygen separates from oxyhaemoglobin and diffuses from the blood into the tissue fluid and finally into the tissue cells. CO₂ diffuses from tissue cell into the tissue fluid and

finally into the blood present in the tissue **capillaries**, as a result of this, the blood becomes deoxygenated. The deoxygenated blood returns to right side of the heart that sends it to lungs for reoxygenation.

- (iv) In inspired air oxygen is 19.6% whereas in expired air oxygen is 15.7%, hence, **nearly 4% oxygen comes in from air to blood, similarly in inspired air CO₂ is 0.04%**. Whereas in expired air CO₂ is 3.6% hence nearly **3.56% CO₂ comes out from blood into air**.

Table of partial pressures and percentage concentrations (in brackets) of gases in various airs

Gas	Atmospheric air	Inspired (= humidified air)	Functional residual alveolar air	Expired air
N ₂	597.0(78.62%)	563.4(74.09%)	569.0(74.9)	566.0(74.5%)
O ₂	159.0(20.84%)	149.3(19.67%)	104.0(13.6%)	120.0(15.7%)
CO ₂	0.3(0.04%)	0.3(0.04%)	40.0(5.3%)	27.0(3.6%)
H ₂ O	3.7(0.5%)	47.0(6.2%)	47.0(6.2%)	47.0(6.2%)
	760.0(100%)	760.0(100%)	760.0(100%)	760.0(100%)

Partial Pressure	Alveolar air	Pulmonary Arterial Blood	Pulmonary Venous Blood
PO ₂	104 mm Hg	40 mm Hg	95 - 104 mm Hg
PCO ₂	40 mm Hg	45 - 46 mm Hg	40 mm Hg

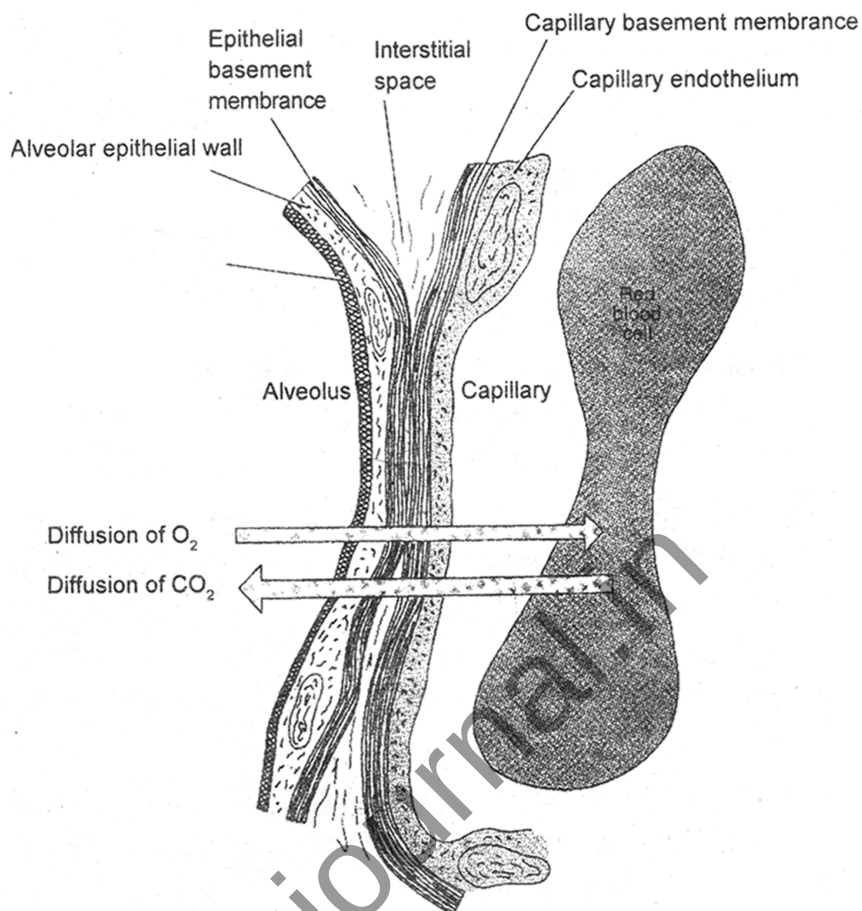
TRANSPORT OF GASES IN BLOOD ::

Blood carries oxygen from lungs to the heart and from the heart to various cells and tissue.

The blood also brings CO₂ from cells and tissue to the heart, from heart to lungs, for expiration.

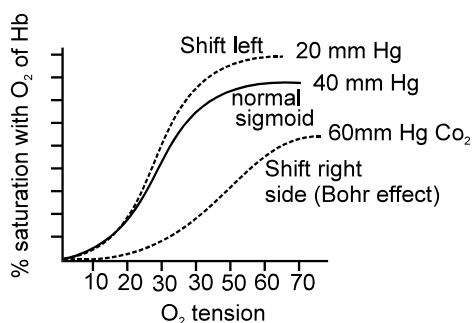
TRANSPORT OF OXYGEN ::

As much oxygen comes in the blood from air, approximately 3% of it dissolves in the blood plasma. Remaining 97% oxygen combines with haemoglobin to form oxyhaemoglobin. One molecule of haemoglobin combines with 4 molecules of oxygen. Haemoglobin is made up of 4 units. Every unit of it, reacts with one molecule of oxygen. 1 gm haemoglobin can combine with a maximum of 1.34 ml of oxygen and 100 ml blood carries about 15 gm haemoglobin so 100 ml blood transports approximately 20 ml of oxygen. Oxygen does not oxidise haemoglobin. Formation of oxyhaemoglobin is a process of oxygenation. The valency of iron is 2 in oxyhaemoglobin. Some gases (eg. Ozone SO₃, NO, NO₂ etc.) oxidise haemoglobin. This oxidised haemoglobin is called Methaemoglobin. This is a colourless compound. This type of gases are environmental pollutant. At the time, oxyhaemoglobin reaches upto the tissues it dissociates. O₂ freed it goes into the tissue fluid from blood. In place of it, CO₂ from tissue fluid comes into blood. Gaseous exchange between blood and tissue is called internal respiration. It is also done by simple diffusion. In a conduction cycle blood gives its 25% O₂ to tissues. The rate of saturation of haemoglobin with O₂ is directly proportional to concentration of oxygen as with a rise in pO₂ the affinity between O₂ and Hb also increases.



Oxygen dissociation curve

- (i) The relationship between the saturation of haemoglobin and oxygen tension is studied by examination of dissociation curve of oxyhaemoglobin.
- (ii) Oxygen dissociation curve is **sigmoid**. It is also called oxygen equilibrium curve.
- (iii) At normal condition it is sigmoid & normal.
- (iv) With increase in concentration of CO_2 in tissues curve shifts towards right side and % of O_2 in Hb decreases due to more dissociation of oxyhaemoglobin.
- (v) By decrease in conc. of CO_2 in tissues curve shifts towards left side and % of O_2 in Hb becomes more due to low dissociation of oxyhaemoglobin.
- (iv) p_{50} is the partial pressure of O_2 at which Hb is 50% saturated with O_2 . Its normal value is 30 mmHg.



Factors affecting oxygen dissociation curve

- (a) **Temperature** - Oxygen dissociation curve turns to right side with increase in temperature.
- (b) **pCO₂** - Oxygen dissociation curve turns to right side and oxygen binding capacity of haemoglobin is lowered with increase in pCO₂.
- (c) **pH** - Oxygen dissociation curve turns to right side with decrease in pH. Moreover dissociation of oxyhaemoglobin will increase when pH of blood falls or H⁺ concentration of blood rises.
- (d) **Fetal Haemoglobin** - Pressure of Fetal Hb shifts the curve towards left. Because fetal Hb has a higher degree of affinity with oxygen than normal haemoglobin.

Bohr effect

- (i) Bohr effect is the effect of CO₂ on **oxyhaemoglobin**.
- (ii) Dissociation of oxyhaemoglobin is directly proportional to blood pCO₂. Because with a rise in pCO₂ the affinity between oxygen & haemoglobin decreases.

Haldane effect

According to Haldane effect the **oxyhaemoglobin** behaves like strong acid and causes dissociation of CO₂ from its carrier compounds.

TRANSPORT OF CARBON DIOXIDE ::

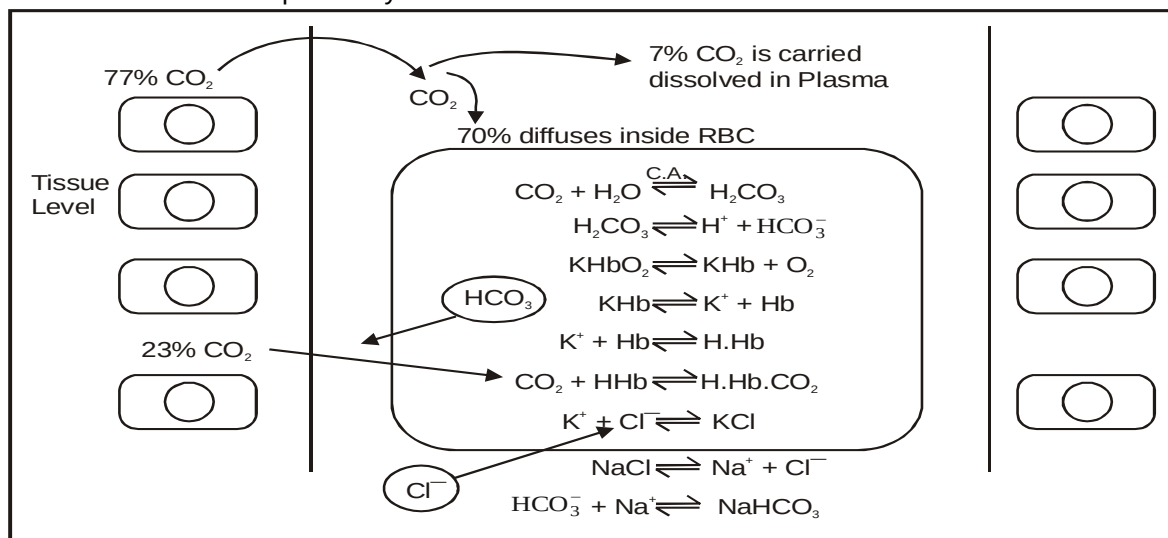
During oxidation of food CO₂, water and energy are produced. From the cells carbon dioxide in gaseous state diffuses out of the cells into the capillaries. From capillaries it is transported by 3-ways.

1. As a dissolved gas

A very small amount of CO₂ about 5% to 7% dissolves in the plasma and is carried as a physical solution to the lungs.

2. As bicarbonates

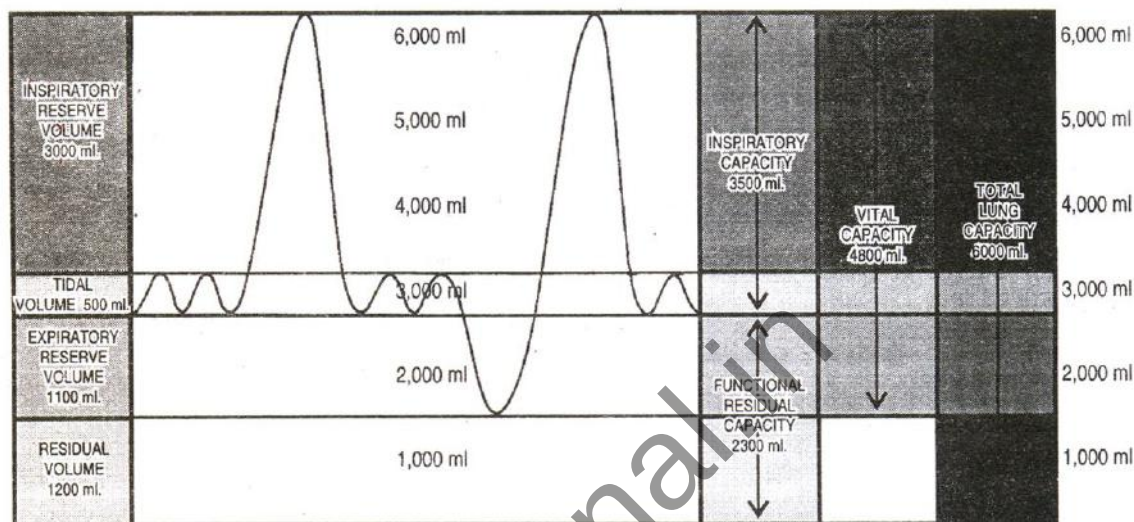
- (i) About 70% of CO₂ enters the erythrocytes where it reacts with water to form **carbonic acid** in the presence of an enzyme called the **carbonic anhydrase**.
- (ii) In erythrocytes most of the **carbonic acid** rapidly dissociates to form bicarbonate and hydrogen ion.
- (iii) Bicarbonate ion passes out from the erythrocytes into the plasma. This causes significant difference in ionic balance between ions in the plasma and those inside the erythrocytes. To restore the ionic balance the chloride ion diffuses from the plasma into the erythrocytes. This movement of chloride ions is called **chloride shift or Hamburger's phenomenon** reported by **Hamburger in 1918**. The chloride shift maintains an acid base equilibrium of pH 7.4 for the blood and electrical balance between erythrocytes and plasma.
- (iv) Some of the bicarbonate is carried in erythrocytes while most of bicarbonate is released into plasma and carried or transported by it



3. As carbamino haemoglobin

About 23% of CO_2 is transported as carbamino haemoglobin which is formed by the **reversible combination** of CO_2 with amino group of globin part of the haemoglobin.

PULMONARY CAPACITY (SPIROMETRY) ::



1. Tidal volume

- G Volume of air inspired or expired with each normal breath (in voluntarily) is called tidal volume.
- G In normal person tidal volume is **500 ml**.

2. Inspiratory reserve volume (IRV) or complimentary air volume

- G It is the extra volume of air which can be inspired by deepest forced inhalation beyond tidal volume.
- G It is about 3000 ml

3. Inspiratory capacity

- G It is total volume of air that can be inhaled forcefully after a normal exhalation.

$$\begin{aligned} \text{IC} &= \text{TV} + \text{IRV} \\ &= 500 + 3000 \\ &= 3500 \text{ mL.} \end{aligned}$$

4. Expiratory reserve volume (ERV)

- G It is extra amount of air that can be expired forcibly after a normal expiration. It is about 1100 ml.

5. Residual volume (RV)

- G It is volume of air which remains still in the lungs even after the most forceful expiration. It is about 1200 ml.

6. Functional residual volume (FRV)

- G It is the amount of air that normally remains inside lungs after a normal expiration.
- G It is equal to the sum of expiratory reserve volume and the residual volume.

$$\text{E.R.V.} + \text{R.V.} = \text{FRC}$$

- G It is about 2300 ml

7. Vital capacity of lung (V.C)

G It is the maximum amount of air that can be expelled from the lungs by forced exhalation after a deepest forced inhalation. It is equal to sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$\begin{aligned} \text{V. C.} &= \text{TV} + \text{IRV} + \text{ERV} \\ &= 500 + 3000 + 1100 \\ &= 4600 \text{ ml} \end{aligned}$$

Vital capacity is higher in mountain dwellers, athletes, young person and men.

8. Total lung capacity (TLC)

G It is the total amount of air that can be present in the lungs after a maximum inhalation effort.

$$\begin{aligned} \text{TLC} &= \text{VC} + \text{RV} \quad \text{OR} \quad \text{TV} + \text{IRV} + \text{ERV} + \text{RV} \\ &= 5\text{-}6 \text{ liter (Average 5800 ml)} \end{aligned}$$

SOME DISORDERS OF RESPIRATORY SYSTEM ::

1. Laryngitis

It is an inflammation of larynx.

2. Pharyngitis

It is an inflammation of pharynx.

3. Bronchitis

It is inflammation of bronchi.

4. Pneumonia

In pneumonia fluid and white blood corpuscles accumulates in the lung tissue due to infection.

5. Hypoxia

It is an insufficiency of oxygen reaching the tissue of the body or in other words it is a condition of oxygen shortage in the tissue. Hypoxia is of two types

Artificial hypoxia -

It results from shortage of oxygen in the air as at height over 2400 m altitude.

Anaemic hypoxia -

It is due to reduced oxygen carrying capacity of the blood due to anaemia.

6. Asphyxia (Suffocation)

It is oxygen deficiency and CO_2 accumulation in body tissues which results to death.

7. Emphysema

The air pollutants or cigarette smoke that causes chronic bronchitis may also lead to breakdown the alveoli of lungs reducing the surface area of gaseous exchange.

8. Asthma

It is an allergic attack of breathlessness associated with bronchial spasm.

9. Anoxia

It is a state during which respiratory centre is inhibited resulting in lack of O_2 delivery to tissues.

10. Cyanide poisoning (Histotoxic anaemia)

Causing inactivation of cytochrome oxidase enzyme of mitochondria leading to asphyxia & death

11. CO poisoning

Carbon monoxide affinity for haemoglobin is about 300 times more than O_2 . It forms a stable carboxy haemoglobin (cherry red in colour) hence decreasing oxygen carrying capacity of Hb

ADDITIONAL USEFUL INFORMATION ::

- (i) Cessation of breathing is called **Apnoea**.
- (ii) Normal (involuntary) breathing is called **Eupnoea**.
- (iii) Decreased breathing rate is called **Hypopnoea**.
- (iv) Increased breathing rate is called **Hyperpnoea**.
- (v) Difficulty in breathing is called **Dyspnoea**.
- (vi) Due to deficiency of oxyhaemoglobin skin turns bluish in colour this condition is called **Cyanosis**.
- (vii) Prolong involuntary inspiration due to fall in tension of O_2 in blood is called **Yawning**.
- (viii) Sharp inspiratory sound due involuntary contractions in diaphragm is called **Hiccup**.
- (ix) **Cough** - Forceful expiration to expell an irritant in throat .
- (x) **Sneeze**-Reflex action ; stimulation takes place through the olfactory epithelium of nasal chamber. Air is expelled out through the mouth & nose both.
- (xi) Haemoglobin of foetus has high affinity for oxygen than mother's haemoglobin.
- (xiii) Cerebrum initiates impulses for voluntary muscles for forced breathing.
- (xiv) Amount of air exchange in breathing can be measured with a **Respirometer**. Ganong's respirometer is generally used.
- (xv) The partial pressure of O_2 which 50% haemoglobin of blood is saturated with oxygen is called p50 value.

EFFECTS OF HIGH ALTITUDES ON RESPIRATORY SYSTEM ::

As we ascend upwards an mountains above 8000 ft from sea level , the atmosphere become thinner and O_2 fall. This causes decrease in Oxygenation of blood with rise in altitude and symptoms like breathlessness, headache, dizziness, irritability , nausea, vomiting, mental fatigue and bluish tinge on the skin & lips .This is known as mountain sickness.

A condition of prolonged hypoxia in renal tissue causes Kidney to release a hormone erythropoietin which stimulates R.B.C production in bone marrow. Hence longer stays at high altitude result in increased R.B.C. count of blood (polycythemia) and this also increases the Haemoglobin concentration in blood.

EFFECTS OF DEPTH ON RESPIRATORY SYSTEM OR DECOMPRESSION SICKNESS ::

When a diver descends to great depth , his body is subjected to high pressure caused by water to prevent the collapse of lungs he breathes compressed air. Under compression, N_2 gets dissolve in blood and body fats. This cause the diver to lose his strength and work capacity and feels drowsy. When the diver is suddenly lifted out of water N_2 forms bubbles in blood & tissues due to fall in pressure. Bubbles may block the blood vessels (Air embolism) and produce serious shortness of breath , itching , local pain , dizziness, paralysis and mental derangement.

EXERCISE # 1

- Q.1** Even when there is no air in it, human trachea does not collapse due to presence of -
(1) Chitinous rings (2) Bony rings
(3) Cartilaginous rings (4) Turgid pressure
- Q.2** Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(1) Have rich supply of blood vessels and lymph ducts
(2) Are suited for diffusion of gases
(3) Have ciliated epithelium
(4) Provide a large surface area
- Q.3** The mode of respiration in rabbit is -
(1) Mucosal (2) Pulmonary
(3) Cutaneous (4) Tracheal
- Q.4** The structure which does not contribute to the breathing in mammals is -
(1) Diaphragm
(2) Larynx
(3) Intercostal muscles
(4) Ribs
- Q.5** C - shaped cartilaginous rings supporting the trachea are made of -
(1) Fibrous cartilage
(2) Elastic cartilage
(3) Calcified cartilage
(4) Hyaline cartilage
- Q.6** Which of the following is the smallest structure in the lung of rabbit.
(1) Tracheae (2) Alveoli
(3) Bronchioles (4) Hilum
- Q.7** Rate of breathing in an adult human is -
(1) 25 - 30/min (2) 20-25/min
(3) 14-18/min (4) 10-12/min
- Q.8** If the diaphragm of a rabbit is perforated, the breathing is -
(1) Not affected (2) Increased
(3) Decreased (4) Stopped
- Q.9** Glottis is opening in the floor of -
(1) Trachea
(2) Diaphragm
(3) Bucco- pharyngeal cavity
(4) None of the above
- Q.10** In mammals ventilation movements of lungs are governed by -
(1) Diaphragm and intercostal muscles
(2) Diaphragm
(3) Intercostal muscles
(4) Muscular wall of lungs
- Q.11** Which type of respiration appeared first in the primitive organism and why
(1) Aerobic respiration as no harmful waste products are formed
(2) Anaerobic respiration because small organism can only do it
(3) Anaerobic respiration as there was no O₂
(4) Aerobic respiration as it releases more energy
- Q.12** One of the following is a difference between pulmonary respiration of frog and human -
(1) Respiration occurs due to pressure gradient
(2) Diaphragm and ribs play role in respiration
(3) Lungs are respiratory organs
(4) None of the above

- Q.13** Oxyhaemoglobin is an unstable compound because -
 (1) One molecule of haemoglobin combines with four molecules of oxygen
 (2) There is a chemical bonding between oxygen and haemoglobin
 (3) There is a physical bonding between oxygen and haemoglobin
 (4) Haemoglobin is a complex pigmented protein
- Q.14** Percentage of O_2 present in inhaled air in man is about -
 (1) 43% (2) 78% (3) 21% (4) 1%
- Q.15** The cartilage present in the larynx of rabbit are -
 (1) Thyroid, cricoid, palatine
 (2) Thyroid, cricoid, ethmoid
 (3) Thyroid, cricoid, epiglottis
 (4) Thyroid, cricoid, arytenoid
- Q.16** Food does not normally enter the trachea because during swallowing of food-
 (1) The circular muscles at the end of trachea contract and close its opening
 (2) The cartilage called arytenoids lie between the larynx and the glottis
 (3) The nodule called cartilage of Santorini plug the larynx
 (4) The epiglottis and tongue cover the glottis
- Q.17** If O_2 concentration in tissue was almost as high as at the respiratory surface -
 (1) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
 (2) CO_2 will interfere the O_2 transport
 (3) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
 (4) Haemoglobin would combine with more O_2 at respiratory surface
- Q.18** A person with high fever may be breathing faster than normal. This faster breathing may be due to -
 (1) Loss of appetite
 (2) Mental worry of patient
 (3) High temperature of the body
 (4) Additional requirement of O_2 for germs
- Q.19** Cilia of trachea transfer -
 (1) Air into pharynx
 (2) Air into larynx
 (3) Mucous into lungs
 (4) Mucous into pharynx
- Q.20** Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
 (1) Bicarbonate tension (2) CO_2 tension
 (3) Carbonate tension (4) O_2 tension
- Q.21** In a normal man the transport of O_2 and CO_2 properly, the blood is-
 (1) Slightly alkaline (2) Slightly acidic
 (3) Strongly acidic (4) Strongly alkaline
- Q.22** The normal shape of diaphragm is-
 (1) Spherical (2) Cone-like
 (3) Flat (4) Dome-like
- Q.23** Largest cartilage in the form of a broad ring incomplete posteriorly is-
 (1) Thyroid
 (2) Cartilage of santorini
 (3) Cricoid
 (4) Arytenoids
- Q.24** Which of the following statement correctly defines "Bohr effects"-
 (1) Rise in P_{CO_2} with a decrease in CO_2 concentration
 (2) Rise in P_{CO_2} with an increase in O_2 concentration
 (3) Rise in P_{CO_2} with an increase in pH
 (4) Rise in P_{CO_2} with a decrease in pH

- Q.25** Amount of air that remains always trapped in respiratory passage is called-
- Dead volume
 - Dead space
 - Both A and B
 - Used air volume
- Q.26** Exchange of gases between alveolar air and alveolar capillaries occur by-
- Omosis
 - Diffusion
 - Active transport
 - None of these
- Q.27** Amount of air exchanged in breathing can be measured with a-
- Spherometer
 - Spirometer
 - Sphygmomanometer
 - Barometer
- Q.28** Air moves into the lungs when-
- Atmospheric pressure is less than pressure within the lungs
 - Atmospheric pressure is equal to the pressure within the lungs
 - Atmospheric pressure is greater than pressure within the lungs
 - None of these
- Q.29** Normal rate of breathing in man is-
- 20-30 times per minute
 - 12-14 times per minute
 - 5-10 times per minute
 - 40-50 times per minute
- Q.30** Choose the correct equation-
- Total capacity of lungs = Vital capacity + Residual air
 - Vital capacity of lungs = Tidal air + Complemental air
 - Total capacity of lungs = Tidal air + Complemental air + Supplemental air
 - Total capacity of lungs = Vital capacity + Tidal air
- Q.31** Breathing rate in mammals is controlled by a part of the brain called-
- Hypothalamus
 - Medulla oblongata
 - Cerebellum
 - Thalamus
- Q.32** Which of the following statements is correct-
- Inspiration is an active process
 - Expiration is an active process
 - Inspiration is a passive process
 - Both expiration and inspiration are passive processes
- Q.33** Rate of breathing is directly affected by-
- Oxygen in trachea
 - Concentration of O_2
 - Diaphragm expansion
 - Concentration of CO_2
- Q.34** The breathing rate in a child is-
- Same as in an adult man
 - Less than in an adult man
 - More than in an adult man
 - None of the above
- Q.35** The contraction of internal intercostal muscles in man causes-
- Inspiration
 - Normal respiration
 - Aspiration
 - Forced expiration
- Q.36** During inspiration in mammals, the sternum moves-
- Backward and upward
 - Forward and upward
 - Backward and downward
 - Forward and downward
- Q.37** Tidal air in mammals is-
- Total air that can be drawn into lungs
 - Air that normally goes in and comes out of lungs during breathing
 - Air that is left in the lungs after normal expiration
 - Air that can be expelled out from lungs forcibly after normal expiration

- Q.38** Intercostal muscles in man extend between its-
(1) Neck and shoulder
(2) Thorax and abdomen
(3) Thoracic ribs
(4) Cervical ribs
- Q.39** The amount of air breathe in and out with the greatest possible efforts is called-
(1) Tidal volume (2) Residual volume
(3) Lungs volume (4) Vital capacity
- Q.40** The maximum amount of air that our lung can normally hold is-
(1) Vital capacity
(2) Pulmonary capacity
(3) Tidal capacity
(4) Total lung capacity
- Q.41** The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(1) The tissue can absorb O_2 from oxyhaemoglobin
(2) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(3) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(4) Oxyhaemoglobin undergoes reduction
- Q.42** Which of the following increases the oxygen affinity of Hb-
(1) High body temperature
(2) Low pCO_2
(3) High blood pH
(4) Both B and C
- Q.43** The chemical formula of oxyhaemoglobin is-
(1) $Hb(O_2)_4$ (2) $Hb(O_3)_4$
(3) $H_2B_2O_4$ (4) $H_3B_2O_8$
- Q.44** Haemoglobin has least affinity for-
(1) Carbon dioxide
(2) Carbon monoxide
(3) Oxygen
(4) Same affinity for all above
- Q.45** When a frog is completely submerged in water it can respire only through-
(1) Lungs
(2) Skin
(3) Branchial chamber
(4) Buccopharyngeal cavity
- Q.46** Respiratory mechanism is controlled by-
(1) Sympathetic nervous system
(2) Central nervous system
(3) Autonomic nervous system
(4) Parasympathetic nervous system
- Q.47** Carbon monoxide combines with haemoglobin to form-
(1) Carboxyhaemoglobin
(2) Oxyhaemoglobin
(3) Carbaminohaemoglobin
(4) None
- Q.48** The percentage of haemoglobin saturated with oxygen will increase if-
(1) The arterial pH is decreased
(2) The arterial pO_2 is increased
(3) The haemoglobin concentration is increased
(4) The temperature is increased
- Q.49** Major fraction of CO_2 released during cellular respiration is transported in blood to the lungs in the form of-
(1) HCO_3^-
(2) H_2CO_3
(3) As free CO_2
(4) In combination with $HBCO_2$
- Q.50** Which mammal lacks true vocal cords-
(1) Hippopotamus (2) Man
(3) Elephant (4) Monkey
- Q.51** True organ of sound production in birds is-
(1) Sound box (2) Vocal sac
(3) Syrinx (4) Larynx

- Q.52** Expiration involves-
- (1) Contraction of diaphragm muscles
 - (2) Contraction of intercostal muscles
 - (3) Relaxation of diaphragm and intercostal muscles
 - (4) Contraction of diaphragm and intercostal muscles
- Q.53** During inspiration, air passes into lungs due to-
- (1) Fall in pressure inside the lungs
 - (2) Increased volume of thoracic cavity
 - (3) Muscular expansion of lungs
 - (4) Increase in volume of thoracic cavity and fall in lung pressure
- Q.54** Tidal volume in human beings is-
- (1) 1500 ml
 - (2) 500 ml
 - (3) 4.5 lt.
 - (4) 1000 ml
- Q.55** In human beings, CO_2 concentration the inspired and expired air is respectively-
- (1) 0.04 % and 4.0 %
 - (2) 0.03 % and 5.3 %
 - (3) 0.4 % and 5.0 %
 - (4) 0.04 % to 3.0 %
- Q.56** Oxygen dissociation curve of myoglobin is-
- (1) Hyperbolic
 - (2) Linear
 - (3) Sigmoid
 - (4) Hypobolic
- Q.57** Pneumotaxic centre is associated with-
- (1) Movement
 - (2) Closure of glottis
 - (3) Respiration
 - (4) Breathing
- Q.58** Which of the following structures, increases the respiratory surface of lungs in rabbit-
- (1) Atrium
 - (2) Bronchioles
 - (3) Alveolar ducts
 - (4) Alveoli
- Q.59** In mammals, the tracheal cartilaginous rings are-
- (1) Complete rings
 - (2) Incomplete rings
 - (3) Incomplete dorsally
 - (4) Incomplete laterally
- Q.60** Choose the wrong statement-
- (1) Respiratory pigments are coloured pigments
 - (2) Respiratory pigments are the coloured proteins which contain a metallic ion
 - (3) Respiratory pigments have special affinity for respiratory gases
 - (4) None of the above
- Q.61** What are the functions that are performed by the nasal cavity when air passes through it-
- (1) Air is warmed
 - (2) Air is filtered
 - (3) Air is humified
 - (4) All are true
- Q.62** Dead space air is-
- (1) The amount of air remaining in the alveoli
 - (2) The amount of air taken in and out
 - (3) The air left in the bronchial tree
 - (4) The amount of air left behind in lungs at the end of deep expiration
- Q.63** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the blood plasma
 - (2) Mainly in the erythrocytes
 - (3) Mainly in the interstitial fluid
 - (4) Equally well in all the three
- Q.64** The function of surfactant is/are-
- (1) Facilitating lungs expansion
 - (2) To reduce the surface tension on the alveoli
 - (3) Maintaining the stable size of the alveoli
 - (4) All the above
- Q.65** The diffusion of CO_2 across the alveolar membrane is 20 times faster than that of O_2 because-
- (1) CO_2 is actively transferred
 - (2) The alveolar area available for CO_2 diffusion is larger
 - (3) CO_2 is more soluble in H_2O than O_2 which enables it to pass the membrane more rapidly
 - (4) The CO_2 pressure gradient is larger

- Q.66** Emphysema is a condition in which-
- (1) Lot of fluid in the lungs
 - (2) Lungs have less air
 - (3) The walls separating the alveoli break
 - (4) Respiratory centre is inhibited
- Q.67** When some food particle enters the windpipe instead of oesophagus it is expelled by the process of-
- (1) Hiccuping
 - (2) Coughing
 - (3) Sneezing
 - (4) Yawning
- Q.68** All are the respiratory diseases except-
- (1) Asthma
 - (2) Encephalitis
 - (3) Bronchitis
 - (4) Pneumonia
- Q.69** Low oxygen tension in the blood causes-
- (1) Coughing
 - (2) Yawning
 - (3) Hiccuping
 - (4) Sneezing
- Q.70** Hypoxia is the condition in which less oxygen becomes available to the tissues. This may be due to-
- (1) Less RBCs in blood
 - (2) More CO_2 in the air
 - (3) Lesser oxygen in the blood
 - (4) All the above
- Q.71** One reason for emphysema is-
- (1) Liquor consumption
 - (2) Drug addiction
 - (3) Heavy exercise
 - (4) Smoking
- Q.72** Asthma is caused due to-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.73** Hypercapnia means excess of in body fluids-
- (1) Calcium
 - (2) Potassium
 - (3) Oxygen
 - (4) Carbon dioxide
- Q.74** When partial pressure of CO_2 (pCO_2) rises, the oxygen dissociation curve of haemoglobin at 37°C will-
- (1) Shift towards left
 - (2) Remain unchanged
 - (3) Shift towards right
 - (4) Become irregular
- Q.75** Under a given oxygen concentration in blood, dissociation of oxyhaemoglobin will increase if-
- (1) pH of blood rises
 - (2) pH of blood falls
 - (3) Free fatty acid concentration in blood falls
 - (4) CO_2 concentration in blood falls
- Q.76** Dissociation curve is connected with-
- (1) Oxygen
 - (2) Oxyhaemoglobin
 - (3) Carbonic anhydrase
 - (4) Carbon dioxide
- Q.77** Dissociation of oxyhaemoglobin can be promoted by-
- (1) Low pCO_2
 - (2) High pCO_2
 - (3) High blood pH
 - (4) Low body temperature
- Q.78** An increase in the P_{50} of an oxyhaemoglobin curve would result from a decrease in-
- (1) Metabolism
 - (2) Temperature
 - (3) pH
 - (4) Oxygen
- Q.79** Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes, because-
- (1) More sunshine is available
 - (2) Air clean and unpolluted
 - (3) Air is less dense
 - (4) Vegetation gives out more O_2

- Q.80** When man inhales air containing normal concentration of O_2 but also carbon monoxide, he suffers from suffocation because -
- (1) Haemoglobin combines with CO instead of with O_2 and product cannot dissociate
 - (2) CO affects the nerve of the lungs
 - (3) CO reacts with O_2 reducing percentage O_2 in the air
 - (4) CO affects the diaphragm and intercostal muscles
- Q.81** If a person, living at sea level, migrates to about 8000 feet high hill, his blood after about fifteen days will-
- (1) Have fewer WBCs
 - (2) Increase in volume
 - (3) Have more plasma
 - (4) Have greater number of RBCs and more haemoglobin
- Q.82** In an accident, a man dies immediately although there was no injury to brain, kidney, stomach and heart. The probable cause of death may be-
- (1) Digestion stopped
 - (2) Diaphragm got punctured
 - (3) Coagulation of RBC
 - (4) Larynx got punctured
- Q.83** Breathing differs from respiration by-
- (1) Breathing refers to respiration in human beings whereas respiration occurs in rest of the animals and plants
 - (2) Breathing refers to chest movements due to inhalation of O_2 and exhalation of carbon dioxide whereas respiration refers to gaseous exchange
 - (3) Both are same and there is no difference
 - (4) None of these
- Q.84** During respiration CO_2 is transported in the forms of-
- (1) Dissolved in plasma
 - (2) $KHCO_3$
 - (3) Sodium carbonate
 - (4) Partly dissolved in plasma and partly in the form of sodium and potassium bicarbonate
- Q.85** The most important function of diaphragm of the mammals is-
- (1) To protect lungs
 - (2) To aid in respiration
 - (3) To aid in ventilation or breathing
 - (4) To divide the body cavity into compartment
- Q.86** In vertebrates O_2 is transported by the blood as follows-
- (1) Association with globin
 - (2) Only haemoglobin
 - (3) Dissolved in plasma
 - (4) Both 2 and 3
- Q.87** Lung originated from-
- (1) Ectoderm
 - (2) Mesoderm
 - (3) Endoderm
 - (4) Endoderm & Mesoderm
- Q.88** The respiratory centre leading to faster breathing is on account of-
- (1) Venous blood entering the respiratory centre
 - (2) Arterial blood entering the respiratory centre
 - (3) Venous blood leaving the respiratory centre
 - (4) Arterial blood leaving the respiratory centre
- Q.89** Mountain sickness is due to-
- (1) Stimulation of the nervous system at higher altitude
 - (2) Muscular fatigueness
 - (3) O_2 is decreased progressively with the rise in altitude so fall in O_2 of the blood produces this symptoms
 - (4) All of the above
- Q.90** 'Chloride shift' is the term given to-
- (1) The movement of Cl^- into and out of RBC and plasma
 - (2) Breakdown of acid of gastric juice
 - (3) Neutralization of acidity by chloride ions
 - (4) Increased concentration of chloride ions

- Q.91** Breathing rate is lowered during eating because-
- (1) Swallowing and breathing cannot go together at the same time
 - (2) Lungs are compressed as stomach enlarges
 - (3) Our lungs do not get enough supply of blood
 - (4) More energy is required during eating
- Q.92** Rate and depth of respiration shall increase when-
- (1) Oxygen concentration increases
 - (2) HCO_3 concentration increases
 - (3) HCO_3 concentration decreases
 - (4) CO_2 concentration increase
- Q.93** Which of the following statement best summarises the relationship between respiratory rate and body size in related animals-
- (1) Smaller the animal lower the respiratory rate
 - (2) Size and respiratory rate are not related in any orderly fashion
 - (3) Smaller the animal higher the respiratory rate
 - (4) None of these
- Q.94** The vital capacity of the lungs signifies the volume of air-
- (1) Breathed out with forcible expiration
 - (2) Breathed in with forcible inspiration
 - (3) With deep inspiration and forcible expiration
 - (4) Breathed in during normal inspiration
- Q.95** The medullary inspiratory centre is always under the direct-
- (1) Chemical control
 - (2) Nervous control
 - (3) Physical control
 - (4) All of the above
- Q.96** Cyanosis is-
- (1) Difficult or heavy breathing
 - (2) Excess of carbon dioxide in the body fluids
 - (3) Skin turning blue due to excessive amount of deoxygenated haemoglobin in the skin blood vessels
 - (4) Lack of oxygen in body fluids
- Q.97** Which of the following nerves is present in diaphragm-
- (1) Phrenic nerve
 - (2) Intercostal nerve
 - (3) Vagus nerve
 - (4) Optic nerve
- Q.98** Which of the following can cause suffocation-
- (1) Lack of surfactant in fluids lining the alveoli
 - (2) Blockage of small bronchi with mucous
 - (3) Obstruction of a major bronchus
 - (4) All the above
- Q.99** Alveolar surfactant is-
- (1) Protein
 - (2) Lipopolysaccharide
 - (3) Lipoprotein
 - (4) Polysaccharide
- Q.100** Lack of breathing is-
- (1) Apnoea
 - (2) Asphyxia
 - (3) Eupnoea
 - (4) Dyspnoea
- Q.101** Volume of air remaining in lungs after maximum expiratory effort is
- (1) Tidal volume
 - (2) Vital capacity
 - (3) Total lung capacity
 - (4) Residual volume
- Q.102** The residual volume of human being is about-
- (1) 1200 ml
 - (2) 3600 ml
 - (3) 4800 ml
 - (4) 2400 ml

- Q.103** The most characteristic feature of haemoglobin is-
- (1) Its red colour
 - (2) Its ability to combine reversibly with oxygen
 - (3) Presence of basic protein globin
 - (4) Presence of iron
- Q.104** Which of the following statement is true-
- (1) 11 pairs of intercostal muscles are found in both, rabbit and man
 - (2) In man 12 pairs of intercostal muscles are found. Whereas in rabbit 11 pairs of intercostal muscles are found
 - (3) 12 pairs of intercostal muscles are found in both, rabbit and man
 - (4) In man 11 pair of intercostal muscles are found whereas in rabbit 12 pairs of intercostal muscles are found
- Q.105** Most of the carbon dioxide produced in a tissue enters the RBCs by-
- (1) Osmosis
 - (2) Active transport
 - (3) Diffusion
 - (4) All of the above
- Q.106** Which of the following shows maximum solubility in blood plasma-
- (1) Carbon dioxide
 - (2) Carbon monoxide
 - (3) Oxygen
 - (4) Nitrogen
- Q.107** Which of the following gases makes the most stable combination with the haemoglobin of RBCs-
- (1) CO (2) CO₂ (3) O₂ (4) N
- Q.108** Cellular respiration in rabbit occurs in-
- (1) Cells lining the lung cavities
 - (2) Cells lining the gut
 - (3) Cells contained in blood
 - (4) All live cells of body
- Q.109** Painful breathing is called-
- (1) Eupnoea (2) Hypopnoea
 - (3) Apnoea (4) Dyspnoea
- Q.110** During inspiration, the diaphragm-
- (1) Relaxes (2) Contracts
 - (3) Expands (4) No change
- Q.111** Asthma is a respiratory disease caused by-
- (1) Infection of lungs
 - (2) Bleeding into pleural cavity
 - (3) Spasm in bronchial muscles
 - (4) Infection of trachea
- Q.112** Respiration is a-
- (1) Catabolic process
 - (2) Physiological catabolic process
 - (3) Anabolic process
 - (4) None of these
- Q.113** Direct respiration occurs in-
- (1) Human beings (2) Prawn
 - (3) Insects (4) Fish
- Q.114** Which one of the following helps in air conditioning-
- (1) Nostrils (2) Pharynx
 - (3) Alveoli (4) Nasal chamber
- Q.115** In larynx smallest cartilage is-
- (1) Arytenoid (2) Cricoid
 - (3) Tracheal ring (4) Thyroid
- Q.116** Sound is produced by vibration of vocal cord located in the-
- (1) Larynx (2) Trachea
 - (3) Bronchioles (4) 2 & 3 both are
- Q.117** False vocal cord remain absent in-
- (1) Elephant (2) Rabbit
 - (3) Birds (4) Monkey

- Q.118** Larynx is also called-
- (1) Voice box
 - (2) Vocal cord
 - (3) Trachea
 - (4) None of these
- Q.119** Sound get converted into speech by-
- (1) Tongue
 - (2) Larynx
 - (3) Trachea
 - (4) None of these
- Q.120** In both lungs of human how many alveoli are found-
- (1) 300 million
 - (2) 450 million
 - (3) 750 million
 - (4) 1000 million
- Q.121** Pleura are double membrane sacs which-
- (1) Envelop the kidney
 - (2) Envelop the lung
 - (3) Envelop the liver
 - (4) Envelop the heart
- Q.122** Lungs have a large number of narrow tubes called -
- (1) Bronchi
 - (2) Tracheae
 - (3) Alveoli
 - (4) Bronchioles
- Q.123** Opening of larynx into pharynx is guarded by-
- (1) Epiglottis
 - (2) Tracheal valves
 - (3) Syrinx
 - (4) All of above
- Q.124** The number of lobes in the right lung of rabbit is-
- (1) Three
 - (2) Four
 - (3) Two
 - (4) Five
- Q.125** Adams' apple corresponds to -
- (1) Thyroid
 - (2) Larynx
 - (3) Trachea
 - (4) Epiglottis
- Q.126** Which of the following factor is most necessary for a respiratory surface -
- (1) Thickness
 - (2) Moistness
 - (3) Large respiratory surface
 - (4) Rich blood supply
- Q.127** The process of respiration is concerned with-
- (1) Intake of O_2
 - (2) Liberation of O_2
 - (3) Liberation of energy
 - (4) Liberation of CO_2
- Q.128** The nasal cavity is divided by a central septum and several projections called-
- (1) Tributaries
 - (2) Alveoli
 - (3) Turbinates
 - (4) None of these
- Q.129** Which structure in mammals does not help in respiration-
- (1) Ribs
 - (2) Abdominal muscles
 - (3) Larynx
 - (4) Diaphragm
- Q.130** Inspiration would not occur if the -
- (1) Diaphragm is lowered
 - (2) Diaphragm is elevated
 - (3) Ribs are elevated
 - (4) Ribs are elevated and diaphragm is lowered
- Q.131** Exchange of gases between the blood and the tissue of the body is called-
- (1) Internal respiration
 - (2) Cellular respiration
 - (3) External respiration
 - (4) None of these
- Q.132** The reaction of CO_2 with H_2O to form carbonic acid occurs-
- (1) Mainly in the erythrocytes
 - (2) Mainly in the blood plasma
 - (3) Mainly in the interstitial fluid
 - (4) All of these
- Q.133** Which structure are end part of the branch of trachea and take part in the exchange of gases -
- (1) Terminal tracheoles
 - (2) Tracheoles
 - (3) Alveoli
 - (4) Air sacs

- Q.134** When the affinity of O_2 and CO_2 for haemoglobin is compared, it is -
 (1) More for O_2
 (2) More for CO_2
 (3) Equal for both
 (4) Have no affinity at all
- Q.135** During respiration if the volume of thoracic cavity of rabbit is maximum, then
 (1) Expiration is impossible
 (2) Inspiration is impossible
 (3) Both are impossible
 (4) None of the above
- Q.136** Blood contains CO_2 in which of the following forms-
 (1) $NaHCO_3$ (2) Carbonic acid
 (3) $Hb-CO_2$ (4) $Hb-CO_2$ and CO
- Q.137** Quite breathing is often referred to as-
 (1) Respiration
 (2) Thoracic breathing
 (3) Abdominal breathing
 (4) Inspiration
- Q.138** Bohr effect is-
 (1) The effect of CO_2 on haemoglobin
 (2) The effect of CO_2 on oxyhaemoglobin
 (3) The effect of O_2 on haemoglobin
 (4) The effect of CO_2 on RBCs
- Q.139** If the thoracic wall but not the lungs in man are punctured-
 (1) The breathing rate will decrease
 (2) The breathing rate will increase
 (3) The lungs get inflated
 (4) He will die as the lungs are collapsed
- Q.140** Which of the following structures, increases the respiratory surface of lungs in rabbit-
 (1) Atrium (2) Bronchioles
 (3) Alveolar ducts (4) Alveoli
- Q.141** Concentration of carbonic acid does not increase in blood due to the presence of-
 (1) Na^+ (2) K^+
 (3) Ca^{++} (4) Mg^{++}
- Q.142** Chloride shift is essential for the transport of-
 (1) Oxygen (2) Carbon dioxide
 (3) Both (1) and (2) (4) Nitrogen
- Q.143** The process in which chloride ions pass into red blood corpuscles and bicarbonate ions pass out from red blood corpuscles is called as-
 (1) Chloride shift
 (2) Enzyme shift
 (3) Biological combustion
 (4) Respiration quotient
- Q.144** Which of the following activity does not take place during pulmonary respiration-
 (1) Movement of buccal cavity
 (2) Contraction and relaxation of sternohyal and pterohyal muscles
 (3) Successive opening and closing of mouth and external nostrils
 (4) No activity takes place
- Q.145** Residual volume in the lungs of a normal human is-
 (1) 500 ml (2) 3-4.5 litres
 (3) 1000 ml (4) 1200 ml
- Q.146** Vital capacity is higher in-
 (1) Young person (2) Mountain dwellers
 (3) Athletes (4) All of these
- Q.147** The largest quantity of air that can be expired after a maximal inspiratory effort is-
 (1) Residual volume (2) Lung volume
 (3) Tidal volume (4) Vital capacity

- Q.148** The volume of air breathed out during a normal respiration is called-
- (1) Tidal air
 - (2) Inspiratory reserve volume
 - (3) Expiratory reserve volume
 - (4) Vital capacity
- Q.149** What is the total vital capacity of man -
- (1) About 2200 cc (2) About 2000 cc
 - (3) About 4500 cc (4) About 5500 cc
- Q.150** If the CO_2 concentration in the blood increases, the breathing shall -
- (1) Decrease (2) Stop
 - (3) Increase (4) No affect
- Q.151** The state during which the respiratory centre is inhibited is termed as-
- (1) Asphyxia (2) Anoxia
 - (3) Suffocation (4) Chocking
- Q.152** Inflammation of the lung covering causing severe chest pain is-
- (1) Pleuritis (2) Asphyxia
 - (3) Hypoxia (4) None of these
- Q.153** Inflammation of larynx is called-
- (1) Laryngitis (2) Hypoxia
 - (3) Pneumonia (4) Asthma
- Q.154** Reduction in respiratory surface of the lung due to break down of partition in the alveoli is known as-
- (1) Asphyxia (2) Bronchitis
 - (3) Asthma (4) Emphysema
- Q.155** Amount of air exchanged in breathing can be measured with a –
- (1) Spherometer
 - (2) Barometer
 - (3) Spirometer
 - (4) Sphygmomanometer
- Q.156** Pneumatic and inhibitory centres are associated with –
- (1) respiration (2) breathing
 - (3) inspiration (4) expiration
- Q.157** If the thoracic wall but not lungs is punctured–
- (1) the lungs get inflated
 - (2) the man dies as the lungs get collapsed
 - (3) the breathing rate decreases
 - (4) the breathing rate increases
- Q.158** The cartilages upon which the vocal cords are attached are
- (1) the thyroid and arytenoid cartilages
 - (2) the thyroid and cricoid cartilages
 - (3) the cuneiform and cricoid cartilages
 - (4) the thyroid and corniculate cartilages
- Q.159** One of the following is a difference between pulmonary respiration of frog and human
- (1) diaphragm and ribs play role in respiration
 - (2) lungs are respiratory organs
 - (3) respiration occurs due to pressure gradient capacity
 - (4) none of these
- Q.160** Asphyxia occurs due to
- (1) rise in level of CO_2 (2) fall in level of CO_2
 - (3) rise of O_2 level (4) fall in O_2 level
- Q.161** Peripheral chemoreceptors are located in
- (1) lung tissue
 - (2) the pons and medulla oblongata
 - (3) aortic and carotid bodies
 - (4) the myocardium
- Q.162** Factors determining the extent to which O_2 will combine with haemoglobin are
- (1) PCO_2 in blood
 - (2) body temperature
 - (3) blood H^+ concentration
 - (4) all of the preceding

- Q.163** In mammals ventilation movements of lungs are governed by–
 (1) muscular wall of lungs
 (2) intercostal muscles
 (3) diaphragm
 (4) diaphragm and intercostal muscles
- Q.164** During inspiration, air passes into lungs due to
 (1) increase in volume of thoracic cavity and fall in lung pressure
 (2) fall in pressure inside the lungs
 (3) increased volume of thoracic cavity
 (4) muscular expansion of lungs
- Q.165** Expiratory muscles contract at the time of
 (1) deep inspiration
 (2) normal inspiration and expiration
 (3) forceful expiration
 (4) normal expiration
- Q.166** People living at sea level have around 5 million RBCs per cubic millimeter of their blood whereas those living at an altitude of 5400 meters have around 8 million. This is because at high altitude–
 (1) people get pollution-free air to breath and more oxygen is available
 (2) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
 (3) there is more UV radiation which enhances RBC production
 (4) people eat more nutritive food, therefore, more RBCs are formed
- Q.167** Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing usually high content of
 (1) Carbon disulphide
 (2) Chloroform
 (3) Carbon dioxide
 (4) Carbon monoxide
- Q.168** When 1500 mL air is in the lungs, it is called
 (1) vital capacity
 (2) tidal volume
 (3) residual volume
 (4) inspiratory reserve volume
- Q.169** The affinity of CO for Hb is – times more than oxygen
 (1) 2 times (2) 20 times
 (3) 300 times (4) 1000 times
- Q.170** Mammalian lungs have an enormous number of minute alveoli (air sacs). This it to allow–
 (1) more space for increasing the volume of inspired air
 (2) more surface area for diffusion of gases
 (3) more spongy texture for keeping lung in proper shape
 (4) more nerve supply to keep the lungs working
- Q.171** CO is more harmful pollutant because it–
 (1) has more affinity for haemoglobin
 (2) reacts quickly with UV radiations
 (3) has less affinity for Hb
 (4) cannot compete with oxygen
- Q.172** In a frog, if a hole is punched in the floor of its buccal cavity, then the frog will not die as–
 (1) he can breath
 (2) pulmonary respiration occurs
 (3) buccal respiration does not stop
 (4) respiration other than lungs will continue
- Q.173** Diffusion of oxygen along the respiratory surface occurs because–
 (1) P_{CO_2} is more in alveoli than blood
 (2) P_{O_2} is more in alveoli than blood
 (3) P_{CO_2} is more in blood than alveoli
 (4) P_{O_2} is more in blood than in tissues

Q.174 Vital capacity of lungs is–

- (1) Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV) + Tidal Volume (TV) + Residual Volume (RV)
- (2) IRV + ERV + TV
- (3) IRV + ERV
- (4) IRV + ERV + TV – RV

Q.175 Residual air can be traced in–

- (1) alveoli (2) bronchi
- (3) nasal chambers (4) trachea

Q.176 Dissociation curve shifts to the right when–

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decreases
- (4) Cl⁻ concentration increases

Q.177 Body tissues obtain O₂ from oxyhaemoglobin because of its dissociation caused by–

- (1) low O₂ concentration
- (2) high CO₂ concentration
- (3) low CO₂ concentration
- (4) low O₂ and high CO₂ concentration

Q.178 In which form iron is present in haemoglobin–

- (1) Ionic (2) Unionic
- (3) Fe²⁺ (4) Fe³⁺

Q.179 Oxyhaemoglobin is an unstable compound because

- (1) O₂ and haemoglobin reaction depends upon partial pressure
- (2) haemoglobin is a conjugated protein
- (3) haemoglobin is contained within RBC
- (4) one haemoglobin binds with four molecules of O₂

Q.180 Hamburger phenomenon is associated with–

- (1) transport of oxygen
- (2) transport of CO₂
- (3) haemoglobin is contained within RBC
- (4) transport of CO

Q.181 The alveolar epithelium in the lung is –

[C.B.S.E. 1990, B.H.U. 1996]

- (1) Nonciliated columnar
- (2) Nonciliated squamous
- (3) Ciliated columnar
- (4) Ciliated squamous

Q.182 Respiratory centre is situated in–

[C.B.S.E. 1999]

- (1) Cerebellum (2) Medulla oblongata
- (3) Hypothalamus (4) Cerebrum

Q.183 Air is breathed through–

[Pb. P.M.T. 1999 C.B.S.E. 1994]

- (1) Trachea → lungs → larynx → pharynx → alveoli
- (2) Nose → larynx → pharynx → bronchus → alveoli → bronchioles
- (3) Nostrils → Pharynx → larynx → trachea → bronchi → bronchioles → alveoli
- (4) Nose → mouth → lungs

Q.184 Carbonic anhydrase is mostly active in –

[C.E.T. Chd. 2000, Manipal 2001]

- (1) RBC (2) WBC
- (3) Blood Plasma (4) Blood Platelets

Q.185 At high altitude, RBC of human blood will –

[C.B.S.E. 1995, Pb. P.M.T. 1999]

- (1) Increase in number
- (2) Decrease in number
- (3) Decrease in size
- (4) Increase in size

Q.186 About 1200 ml of air left in lungs is called–

[C.B.S.E. 1996]

- (1) Tidal volume
- (2) Inspiratory reserve volume
- (3) Residual volume
- (4) Vital capacity

Q.187 Which one protects the lungs—

[B.H.U. 1996]

- (1) Rib (2) Vertebral column
(3) Sternum (4) All above

Q.188 Which one has the lowest value —

[B.H.U. 1996]

- (1) Tidal volume
(2) Vital capacity
(3) Inspiratory reserve volume
(4) Expiratory reserve volume

Q.189 Amount of oxygen present in one gram of haemoglobin is—

[A.I.I.M.S. 1997, Har, PMT 2000]

- (1) 20 ml (2) 1.34 ml
(3) 13.4 ml (4) None of these

Q.190 Compound soluble in water which does not impede oxygen transportation is—

[A.I.I.M.S. 1997]

- (1) SO_2 (2) SO_3
(3) CO (4) NO

Q.191 In lungs air is separated from venous blood by —

[C.B.S.E. 1997]

- (1) Squamous epithelium + tunica externa of blood vessel
(2) Squamous epithelium + endothelium of blood vessel
(3) Transitional epithelium + tunica media of blood vessel
(4) Columnar epithelium + 3 layered wall of blood vessel

Q.192 In carbon monoxide poisoning there is—

[A.F.M.C. 1997]

- (1) Increase in carbon dioxide concentration
(2) Decrease in oxygen availability
(3) Decrease in free haemoglobin
(4) None of these

Q.193 Exchange of gases in lung alveoli occurs through —

[C.B.S.E. 1998]

- (1) Active transport
(2) Osmosis
(3) Simple diffusion
(4) Passive transport

Q.194 Vocal cords occur in—

[M.P. P.M.T. 1999]

- (1) Pharynx (2) Larynx
(3) Glottis (4) Bronchial tube

Q.195 Match the columns—

[Karnataka 1999]

	Column I		Column II
(a)	Larynx	(p)	Lid of larynx
(b)	Trachea	(q)	Air sacs
(c)	Alveoli	(r)	Voice box
(d)	Epiglottis	(s)	Wind pipe
		(t)	Common passage

- (1) a-r, b-s, c-q, d-p
(2) a-t, b-s, c-p, d-q
(3) a-r, b-s, c-q, d-t
(4) a-r, b-t, c-q, d-p

Q.196 Adam's Apple represents—

[Pb. P.M.T. 2000]

- (1) Arytenoid cartilage of larynx
(2) Cricoid cartilage of larynx
(3) Thyroid cartilage of larynx
(4) All the above

Q.197 Hiccough (Hiccup) is due to activity of—

[Manipal 2001]

- (1) Intercostal muscle
(2) Food in air tract
(3) Diaphragm
(4) Inadequate oxygen in environment

Q.198 respiratory centre of brain is stimulated by–

[A.I.I.M.S 2000]

- (1) Carbon dioxide content in venous blood
- (2) Carbon dioxide content in arterial blood
- (3) Oxygen content in venous blood
- (4) Oxygen content in arterial blood

Q.199 Carbon dioxide entering erythrocytes reacts with water to form carbonic acid. The enzyme is–

[H.P.P.M.T. 2001]

- (1) Carbonic anhydrase
- (2) Carboxypeptidase
- (3) Hydrolase
- (4) Oxidoreductase

Q.200 Arytenoid cartilage is found in–

[B.H.U. 2000]

(1) Hyoid	(2) Sternum
(3) Larynx	(4) Nose

Q.201 Dissociation of oxyhaemoglobin occurs in tissues due to –

[J.I.P.M.E.R. 2002]

(1) High P_{O_2}	(2) Low P_{O_2}
(3) Equal P_{O_2}	(4) Irrespective of P_{O_2}

Q.202 At the time of expiration, diaphragm becomes–

[Karnataka 2003]

(1) Oblique	(2) Normal
(3) Flattened	(4) Dome-shaped

Q.203 Exchange of bicarbonates and chloride ions between RBC and plasma is called–

[CBSE 1999]

- (1) Chloride shift
- (2) Bohr's effect
- (3) Haldane's effect
- (4) Intra cellular respiration

Q.204 When CO_2 concentration in blood increase breathing becomes–

[CBSE 2004]

- (1) There is no effect on breathing
- (2) Slow and deep

(3) Faster

(4) Shallower and slow

Q.205 In which part of lungs gaseous exchange takes place in Rabbit–

[RPMT 2001]

- (1) Trachea & alveolar duct
- (2) Trachea & bronchi
- (3) Alveolar duct & alveoli
- (4) Alveoli & Trachea

Q.206 If CO_2 concentration increase in blood then breathing will–

[RPMT 2003]

- (1) Increases
- (2) Decrease
- (3) Stop
- (4) Remain unchanged

Q.207 Heiring breuer reflex related to–

[RPMT 2003]

- (1) Effect of pH on respiratory centre
- (2) Effect of CO_2 on respiratory centre
- (3) Effect of nerves on respiratory centre
- (4) Effect of temp. on respiratory centre

Q.208 Toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen–

[RPMT 2003]

(1) 2 times	(2) 20 time
(3) 200 times	(4) 300 times

Q.209 Tracheal rins in rabbit are–

[RPMT 2004]

- (1) Complete
- (2) Incomplete
- (3) Dorsally incomplete
- (4) Lateral incomplete

STATE PMT EXAMS EXERCISE

- Q.1** Lungs ventilation movements is due to—
[Uttaranchal PMT 2004]
(1) Costal muscle and diaphragm
(2) Costal muscle
(3) Diaphragm
(4) Wall of the lungs
- Q.2** During hibernation period, frog's respiration is —
[Uttaranchal PMT 2005]
(1) cutaneous (2) pulmonary
(3) pharyngeal (4) buccopharyngeal
- Q.3** In alveolar air, the partial pressure of CO_2 is—
[West Bengal JEE 2007]
(1) 40 mm of Hg (2) 42 mm of Hg
(3) 44 mm of Hg (4) 46 mm of Hg
- Q.4** In lung, maximu gaseous exchange is due to—
[Jharkhand 2006]
(1) Simple diffusion
(2) Active transport
(3) Passive transport
(4) fascilitated diffusion
- Q.5** Respiratory centre in brain occurs in—
[Jharkhand]
(1) Medulla oblongata (2) Cerebellm
(3) Hypothalamus (4) Pericardium
- Q.6** CO_2 is transported mainly by—
[Bihar 2005]
(1) plasma
(2) carbonic acid
(3) bicarbonate
(4) carboxyhaemoglobin
- Q.7** By which mechanism, oxygen is transported from lungs to cells—
[Bihar 2005]
(1) Diffusion
(2) Fascilitated diffusion
(3) Transpiration
(4) Osmosis
- Q.8** Repiratory pigment or oxygen carrier in frog's blood is —
[Bihar 2002]
(1) haemocyanin (2) haemoglobin
(3) haemazoin (4) lymphocytes
- Q.9** Why is CO poisonous for man—
[Bihar 2006]
(1) CO affects the nerves of the lungs
(2) CO affects the diaphragm and intercostal muscles
(3) CO reacts with oxygen reducing percentage of O_2 in air
(4) haemoglobin combines with CO instead O_2 and the product cannot dissociate
- Q.10** One haemoglobin carries how many molecules of O_2 —
[UP CPMT 2002]
(1) 4 (2) 2
(3) 6 (4) 8
- Q.11** Respiratory centre is present in—
[UP CPMT 2002]
(1) Cerebellum (2) Cerebrum
(3) Medulla oblongata (4) hypothalamus
- Q.12** After deep inspiration, capacity of maximum expiration of lung is called—
[UP CPMT 2004]
(1) Total lung capacity
(2) Functional residual capicity
(3) Vital capacity
(4) Inspiratory capacity

Q.13 Ascent of high mountains may cause altitude sickness in men. Prime cause of this is—
[UP CPMT 2005]

- (1) Excess of CO₂ in blood
- (2) Decreased efficiency of haemoglobin
- (3) Decreased partial pressure of oxygen
- (4) Decreased proportion of oxygen in air

Q.14 Pneumotaxic centre is present in—
[UP CPMT 2007]

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla oblongata
- (4) Pons varolii

Q.15 Hamburger shift is also known as—
[MP PMT 2007]

- (1) bicarbonate shift
- (2) chloride shift
- (3) Potassium shift
- (4) All of these

Q.16 Haemoglobin shows maximum affinity with—
[MP PMT 2005]

- (1) Carbon monoxide
- (2) Carbon dioxide
- (3) Oxygen
- (4) Ammonia

Q.17 Dissociation curve shifts to the right when—
[MP PMT 2002]

- (1) CO₂ concentration decreases
- (2) CO₂ concentration increases
- (3) O₂ concentration decrease
- (4) Cl⁻ concentration increases

Q.18 The epithelium of bronchioles is—
[MP PMT 2002]

- (1) Pseudostratified and columnar
- (2) Squamous and sensory
- (3) Pseudostratified and sensory
- (4) Cuboidal and columnar

Q.19 If a man from sea coast goes to Everest peak then
[MP PMT 2002]

- (1) His breathing and heart beat will increase
- (2) His breathing and heart beat will decrease
- (3) His respiratory rate will decrease
- (4) His heart beat will decrease

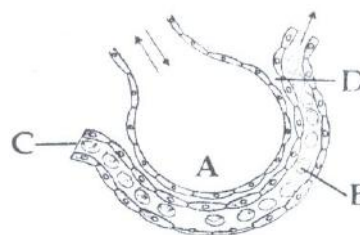
Q.20 A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O₂ :
[AIPMT 2011]

- (1) helps in releasing more O₂ to the epithelial tissues
- (2) acts as a reserve during muscular exercise
- (3) raises the pCO₂ of blood to 75 mm of Hg
- (4) is enough to keep oxyhaemoglobin saturation at 96%

Q.21 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
[AIPMT 2011]

(1) Tongue	(2) Epiglottis
(3) Diaphragm	(4) Neck

Q.22 The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function,
[AIPMT 2011]



Options :

- (1) **B** : red blood cell – transport of CO₂ mainly
- (2) **C** : arterial capillary – passes oxygen to tissues
- (3) **A** : alveolar cavity – main site of exchange of respiratory gases
- (4) **D** : Capillary wall – exchange of O₂ and CO₂ takes place here

Q.23 Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as :

[AIPMT MAINS 2011]

- (1) carbamino-haemoglobin in RBCs
- (2) bicarbonate in blood plasma and RBCs
- (3) Free CO_2 in blood plasma
- (4) 70% carbamino-haemoglobin and 30% as bicarbonate

Q.24 Which one of the following is a possibility for most of us in regard to breathing , by making a conscious effort ? [AIPMT MAINS 2011]

- (1) The lungs can be made fully empty by forcefully breathings out all air from them
- (2) One can breathe out air totally without oxygen
- (3) One can breathe out air through Eustachian tubes by closing both the nose and the mouth.
- (4) one can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.

ANSWER KEY

EXERCISE # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	2	2	4	2	3	4	3	1	3	2	3	3	4	4	1	3	4	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	4	1	4	2	2	2	3	2	1	2	1	4	3	4	2	2	3	4	4
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	4	1	1	2	2	1	2	1	1	3	3	4	2	1	1	4	4	3	4
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	3	2	4	3	3	2	2	2	4	4	3	4	3	2	2	2	3	3	1
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	4	2	2	4	3	4	4	2	3	1	1	4	3	3	2	3	1	4	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	4	1	2	1	3	1	1	4	4	2	3	2	3	4	1	1	1	1	1	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	2	4	1	2	2	2	3	3	3	2	1	1	3	1	1	1	3	2	4	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	2	1	3	4	4	4	1	3	3	2	1	1	4	3	2	2	1	1	1
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	3	4	4	1	3	2	4	3	3	2	1	4	2	2	1	2	4	3	1	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	2	2	3	1	1	3	4	1	2	1	2	3	3	2	1	3	3	2	1	3
Ques.	201	202	203	204	205	206	207	208	209											
Ans.	2	4	1	3	3	1	3	4	3											

STATE PMT EXAMS EXERCISE

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	1	1	1	1	1	3	1	2	4	1	3	3	3	4	2	1	2	2	1	
Ques.	20	21	22	23	24															
Ans.	2	2	3	2	4															