Respirition In Plants

Syllabus

Respirition In Plants

Cell respirition

Name : _____ Contact No. _____

- **Anaerobic respiration -** This is incomplete oxidation.
  - When food is oxidized into alcohol or organic acids without use of oxygen.
    During it most of energy is lost in form of heat. It occurs in cytoplasm and only 2ATP are produced.

$$C_6H_{12}O_6 \xrightarrow[\text{cytoplasm}]{\text{Enzyme}} 2C_2H_5OH + 2CO_2 + 21KCal\ (2ATP)$$

  - Anaerobic respiration was first reported by Kostytchev.
  - Anaerobic respiration may takes place in bacteria, some lower parasitic animals (Ascaris, Taenia) plants, R.BCs. & muscles of human body. When oxygen is not available, then food is incompletely oxidised in to some organic compounds like ethanol, acetic acid, lactic acid.
  - In muscle cells & some bacteria, the energy is produced by breaking of glucose into lactic acid inside the cells.
  - The amount of energy released in anaerobic respiration is much less than aerobic respiration.
  - Fermentation is performed by some fungi & some bacteria (only by microbes) and is an extracellular process. 2 ATP are produced.

$$C_6H_{12}O_6 \xrightarrow[\text{Bact.}]{\text{Yeast}} 2C_2H_5OH + 2CO_2 + \text{Heat (2 ATP)}$$

  - Both anaerobic rspiration and fermentation are incomplete oxidations.
  - Inhibitory effect on respiration (anaerobic respiration) of oxygen is called **Pasteur effect**.
    (Anaerobic → Aerobic)

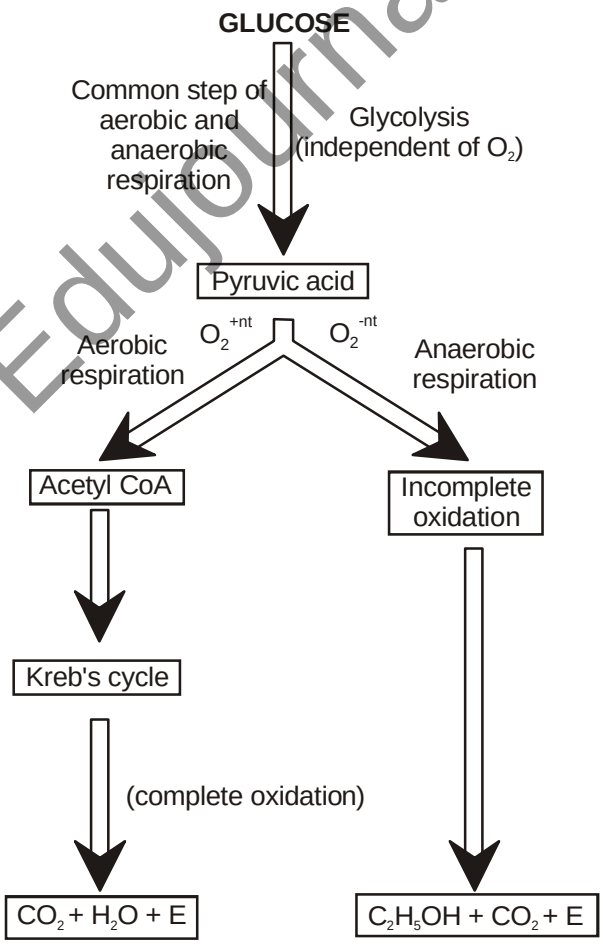
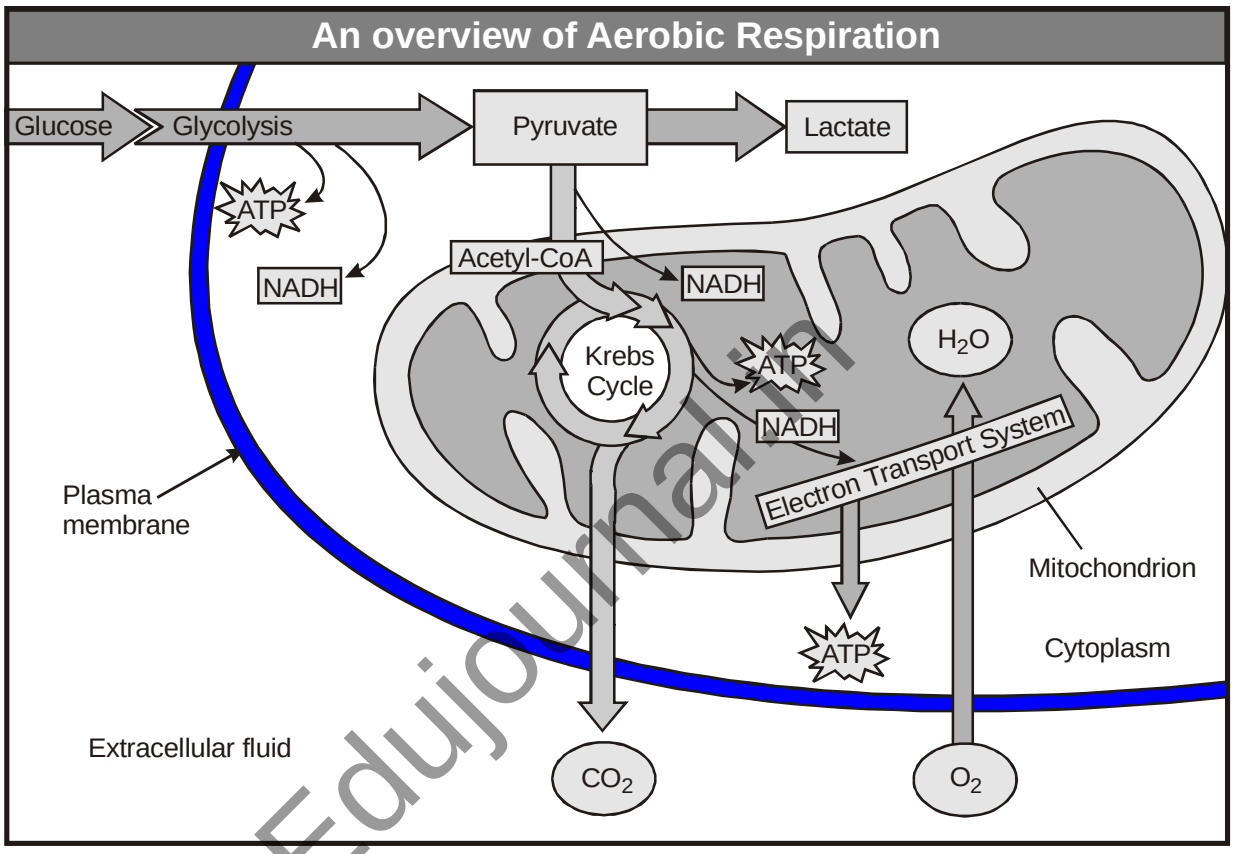


Fig : Aerobic and Anaerobic Respiration

- Initial steps of aerobic and anaerobic respiration are same i.e. Glucose is converted to pyruvic acid. Further fate of **pyruvic acid is dependent upon presence or absence of O_2**.
- There are **2 major** pathways of respiration.
  - Common Pathway
  - Pentose Phosphate Pathway (PPP)



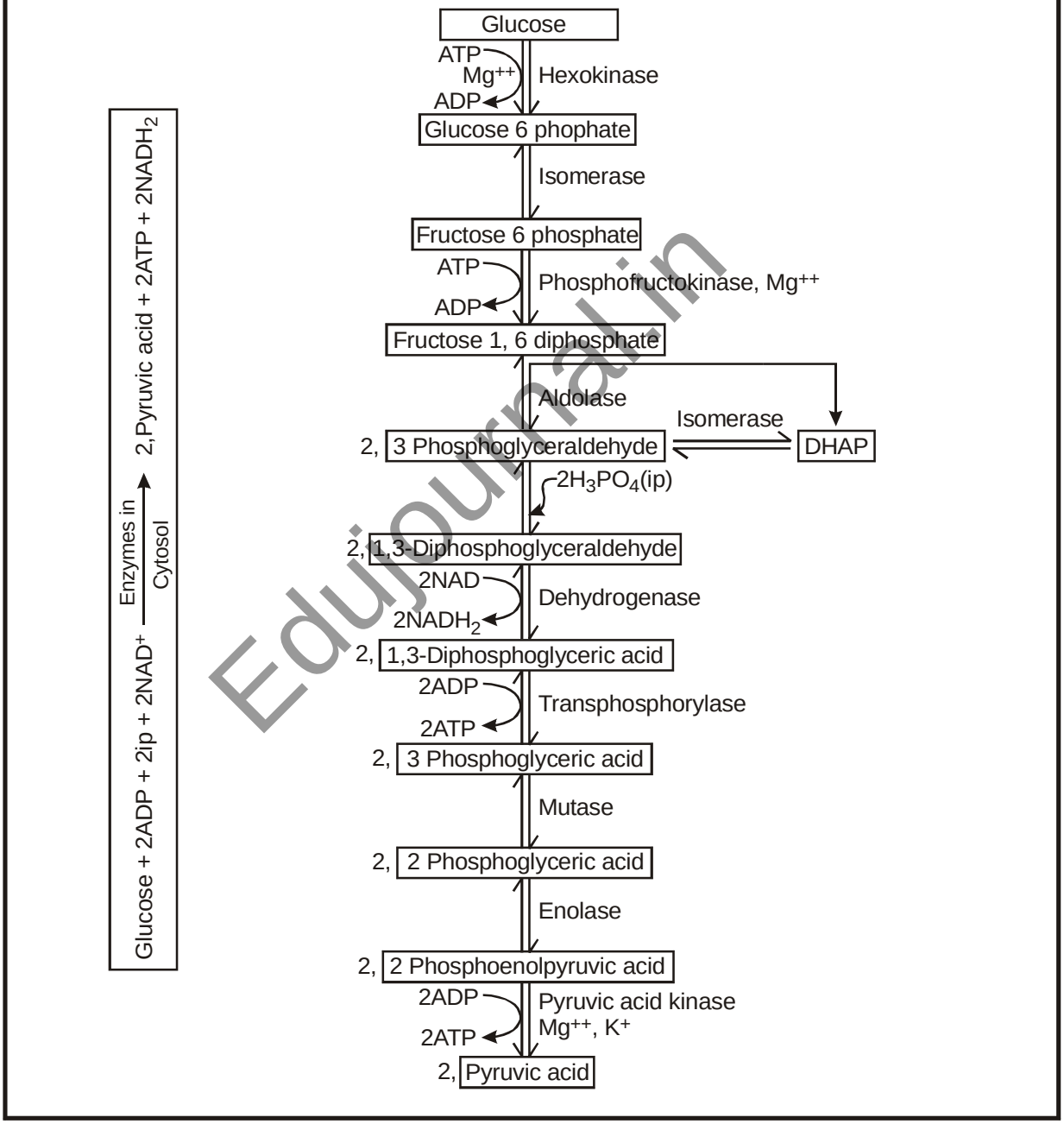
- **Common Pathway :**
  - It has **3 main** parts.
    - **Glycolysis**
    - **Krebs Cycle**
    - **Terminal Oxidation**

4 GLYCOLYSIS

- Glycolysis was discovered by **Embden**, **Meyerhoff** and **Parnas** and hence it is called as **EMP pathway**.
- Glycolysis is **independent of O_2**, hence it is common in both **aerobic** and **anaerobic** conditions.
- Glycolysis is completed in **cytoplasm**.
- **Glucose** is substrate of glycolysis. Most of enzymes requires Mg as cofactor.
- The glycolysis is common phase for aerobic & anaerobic respirations both.
- Glycolysis involves a series of ten biochemical reactions in cytoplasm.
- In glycolysis, neither consumption of oxygen nor liberation of CO_2 take place.

- **Phosphofructokinase** and **Hexokinase are allosteric enzymes**. The steps catalysed by these enzymes are considerd as control point reactions of glycolysis.
- Ist & 3rd and last reaction of glycolysis are considered as irreversible reactions of glycolysis.
- Further oxidation of puruvic acid and $NADH_2$ after glycolysis in mitochondria requires oxygen. So the fate of pyruvic acid is decided by presence or absence of Oxygen.

Glycolysis / EMP Pathway



4 KREBS CYCLE / TRICARBOXYLIC ACID (TCA) CYCLE / CITRIC ACID CYCLE

- Krebs cycle was discovered by **Sir Hans Kreb** in 1937 in **pigeon muscles**.
- It is also called **citric acid cycle**, citric acid being the **first** product of krebs cycle.

⇒ Biochemical reactions in Krebs Cycle :

G $\underset{(2C)}{\text{Acetyl Co}-\text{A}} + \underset{(4C)}{\text{OAA}} \xleftrightarrow[\text{Synthese}]{\text{Citrate}} \underset{(TCA)}{\text{Citric acid}} + \text{Co}-\text{A}$

G $\text{Citricacid} \xleftrightarrow[Fe^{++}]{\text{Aconitase}} \underset{(6C)}{\text{Cisaconiticacid}} \longrightarrow \text{Isocitrate}$

G $\text{Isocitrate} + NAD^{+} \xleftrightarrow[\text{Dehydrogen ase}]{\text{Isocitric}} \underset{(6C)}{\text{Oxalosuccinic acid}} + NADH_2$

G $\underset{(6C)}{\text{Oxalosuccinic acid}} \xleftrightarrow[\text{Decarboxylase}]{Mn^{++}} \underset{(5C)}{\alpha\text{Ketoglutarate}} + Co_2$

G α Ketoglutaric acid $\xleftrightarrow[\text{TPP, LA } Mg^{++}\text{, CoA}]{\text{Dehydrogenase}}$ Succinyl Co A + CO_2 (4C)

NAD → $NADH_2$

(This reaction similar to link reaction)

G Succinyl Co A (4C) $\xleftrightarrow[GDP + ip \rightarrow GTP]{\text{Thiokinase}}$ Succinic acid + Co A (4C)

[Energy of thioester bond is released, which used in formation of GTP]

(GTP + ADP ⟶ GDP + ATP)

The GTP formed in this reaction, reacts with ADP to form ATP and GDP, as GTP adn ATP have approximatly same energy.

G Succinic acid (4C) $\xleftrightarrow[FAD \rightarrow FADH_2]{\text{Succinic dehydrogenase}}$ Fumaric acid (4C)

G Fumaric acid (4C) $\xleftrightarrow{\text{Fumarase}}$ Malic acid (4C)

G Malate (4C) $\xleftrightarrow[NAD \rightarrow NADH_2]{\text{dehydrogenase}}$ Oxaloacetic acid (Acceptor of Acetyl CoA) (4C)

4 TERMINAL OXIDATION

- It is combination of oxygen with electrons and protons released from reduced co-enzymes which produces water (metabolic water).
- Terminal oxidation consists of two processes
  - **Electron Transport System (ETS)**
  - **Oxidative Phosphorylation**

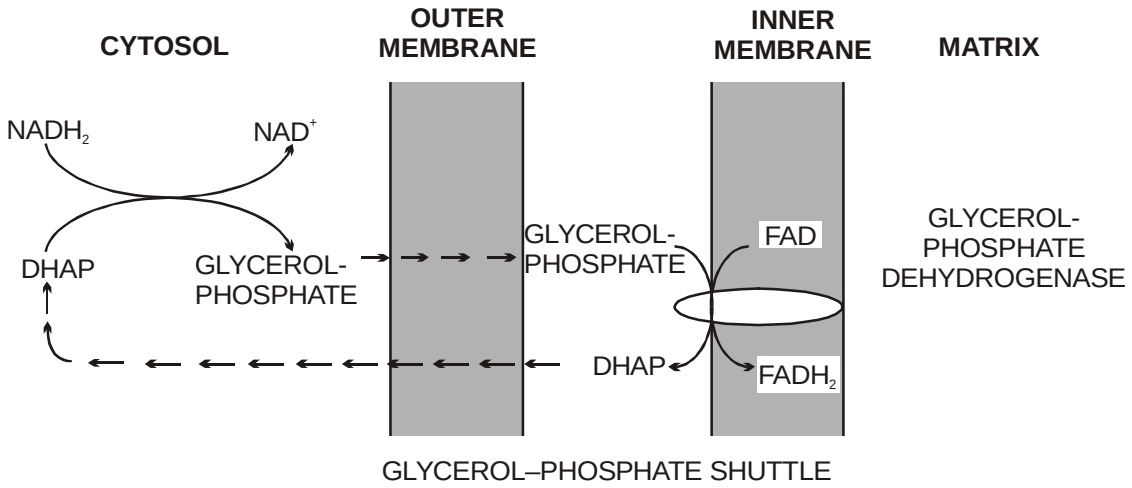
Electron Transport System (ETS) :

- $NADH_2$ & $FADH_2$ obtained from **glycolysis** and **Kreb's cycle** enter in electron transport chain and form water molecule by oxidation with the help of **molecular oxygen**.
- In this process, energy is released which is used for the synthesis of ATP.
- Transfer of electrons from $NADH_2$ or $FADH_2$ occurs through a chain of electron acceptors and donors arranged in a specific sequence.
- Electron transport chain is located in **inner mitochondrial membrane** in **Eukaryotes** and in inner side of **plasma membrane or in mesosome membrane in prokaryotes.**
- ETS (Respiratory chain) consists of four components
  - FP (flavoprotein) or FMN
  - Fe-S Protein
  - Co-Q
  - Cytochromes.
- Cytochromes are cyto.-b, cyto.-C_1 & cyto. C, cyto.-a & cyto a_3 (cyto a & a_3 – **Cu** containing)
- Now compounds of ETS are categories as follows :

Name of complexes	Components of ETS	Inhibitors
Complex-I	FMN-$NADH_2$ dehydrogenase	Rotenone & amytal
Complex-II	CoQ/UQ-$FADH_2$ dehydrogenase / Succinate dehydrogenase	
Complex-III	Cytochrome b-Cyto c_1	antimycin
Complex-IV	Cyto. a – Cyto. a_3	cyanide, CO
Complex-V	ATP synthase / ATPase	

- Two electron acceptors **coenzyme Q** or **ubiquinone** and **cytochrome** C can be easily separated from respiratory chain, therefore they are called **mobile carriers**. CoQ functions for e^- transport between complex I and III and cyto.C transports e^- between complex III and IV.
- Hydrogen is transferred from $NADH_2$ to FMN and NAD is obtained back from $NADH_2$. FMN forms $FMNH_2$.
- Two **protons** and **electrons** are released from $FMNH_2$. Two protons are transported out through membrane and two electrons are taken up by Fe-S protein.
- Terminal oxidation of reduced coenzyme $FADH_2$ also occurs at mitochondrial ETS. FADH2 gives its e^- & H^+ to CoQ and become FAD.
- During the ETS, **$NADH_2$** gives it's $2e^-$ / $2H^+$ to FMN in respiratory chain, thus **3 ATP** are generated, while **$FADH_2$** give it's $2e^-$ / $2H^+$ to CoQ hence only **2 ATP** are formed during the process of oxidative phosphorylation.

Glycerol Phosphate Shuttle :



Glycerol–Phosphate Shuttle Scheme

- It is **less efficient** and present in **skeletal** muscles and **brain cells** or most **eukaryotic** cells.
- In this $NADH_2$ transfers electrons to FAD of mitochondria.
- **Dihydroxyacetone phosphate** (DHAP) and $NADH_2$ react to form Glycerol-Phosphate in cytoplasm.
- Glycerol-Phosphate goes to outer surface of inner membrane of mitochondria, where it reacts with FAD to form $FADH_2$ and DHAP.
- $FADH_2$ enters the electron system to form 2 ATP. DHAP gets transferred to **cytosol**.
- In the presence of this **shuttle**, **36 ATP are produced from one glucose molecule**. **(2 Glycolytic $NADH_2$ = 4 ATP)**

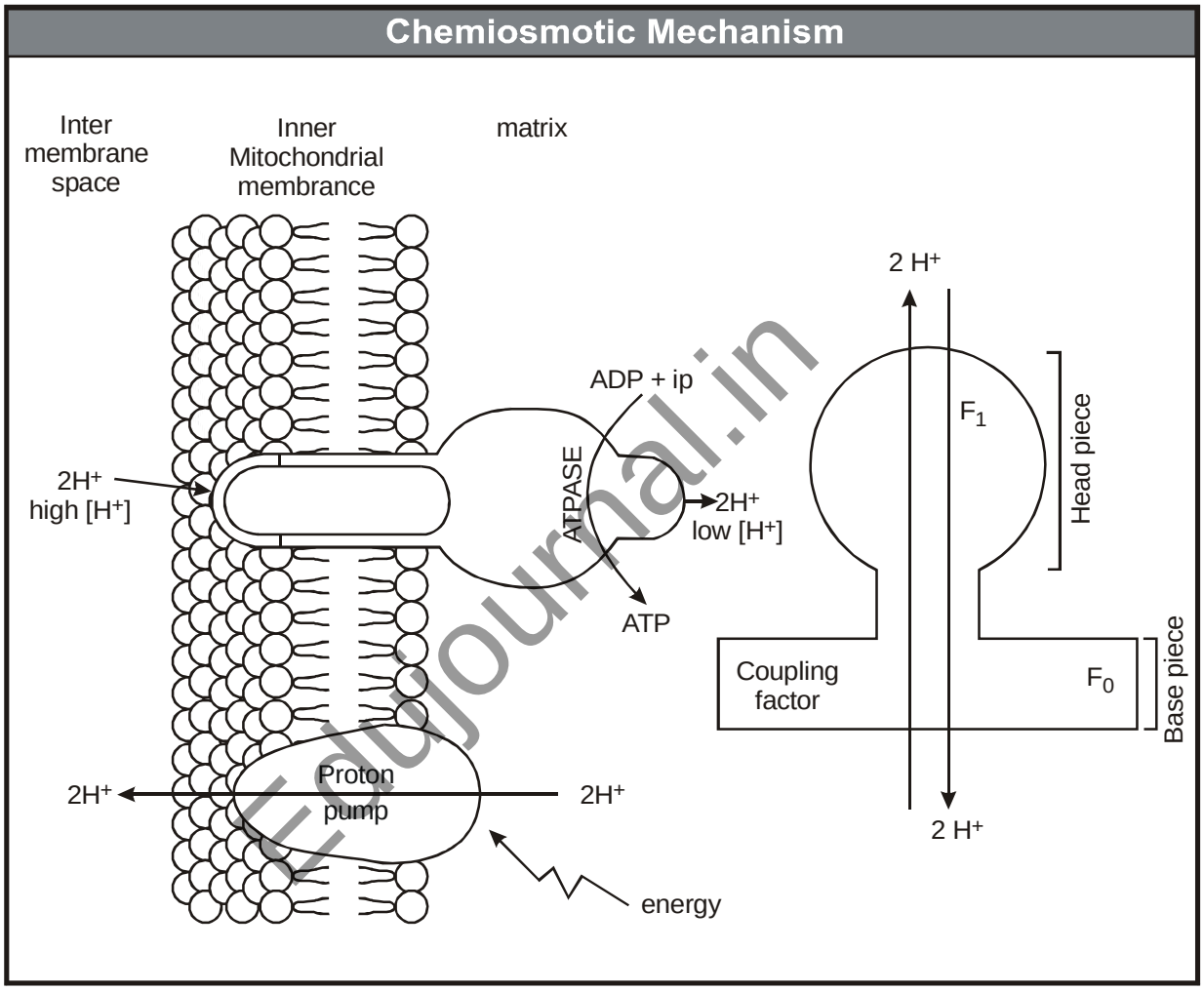
Note : When which shuttle will be functional, depends on the tissue and the species.

4 OXIDATIVE PHOSPHORYLATION AND CHEMIOSMOTIC THEORY

- **By P.Mitchell**
- The synthesis of energy rich ATP molecules with the help of energy librated by **oxidation** of reduced coenzyme produced during respiration is called **Oxidative Phosphorylation**.
- The protons which are expelled out from inner mitochondrial membrane during electron transport, produce proton gradient (ΔpH) and membrane potential in the external environment.
- This creates **proton motive force**. This is utilized in the formation of ATP.
- ATP synthesis is explained by **chemiosmotic theory.**
- **Oxidative phosphorylation** occurs on **F_1–F_0 particles** (oxysomes or elementary particles) which are located on inner mitochondrial membrane.
- **ATPase activity** is found in **F_1 (head)** which is protruded towards matrix of the mitochondria. **F_0 (base)** which is embedded in inner membrane has **proton channels**.
- ATPase becomes active only when **proton gradient** develops.
- Passage of $2e^-$ from $NADH_2$ pushes out three pairs of protons to outer chamber of mitochondria causing **proton gradient** and **membrane potential**. These collectively create **proton motive force (pmf)**.
- pmf cause protons to move back only passing through F_0, as inner membrane is impermeable for H^+.
- Energy is released during transfer of protons to the matrix passing through F_1 which is used for ATP formation. Formation of ATP from ADP is induced by the enzyme **ATP synthase (ATPase) present in F_1**.

Chemiosmosis during oxidative phosphorylation :

- ATP synthesis during oxidative phosphorylation & Photophosphorylation is explained by Chemi-osmotic theory of P.Mitchell 1978. According to this theory energy liberated during ETS, is used in creation of proton gradient (pH gradient) & membrane potential which constitutes proton motive force (pmf) due to this formation of ATP takes place in F_1 particle of oxysome.

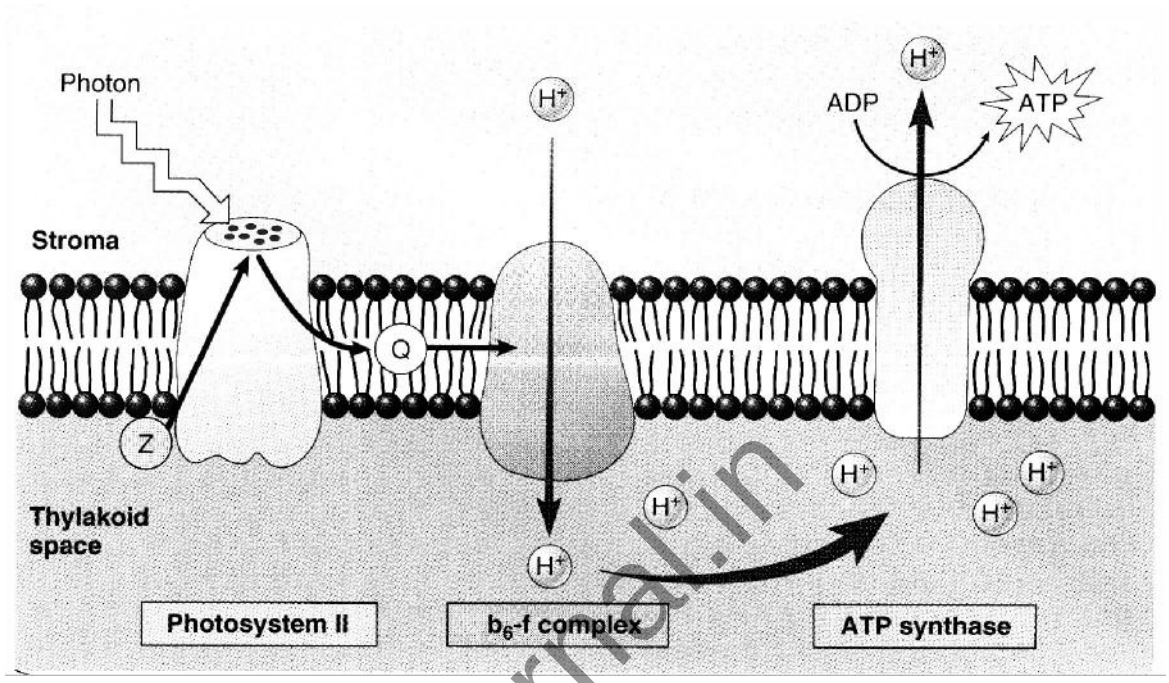


- Coupling factor : ATP formation requires H+ transport. These H+ only passes through the proton tunnel or **coupling** factor or **F_0 particle** in mitochondrial membrane, and bacterial membrane
- The process of eldcron transport and oxidative phosphorylation in mitochondria is tightly coupled. Some chemicals like 2,4 Dinitrophenol (2, 4 DNP) and oligomycin acts as **uncouplers** for this process.

Chemiosmosis during photophosphorylation :

- The synthesis of ATP is coupled with electron transport system and creation of proton gradient across the membrane during photophosphorylation and oxidative phosphorlaion. Both are same but the difference is that during oxidative phosphorylation high H^+ ion concentration at intermembrane space/ perimitochondrial space and low H^+ concentration in mitochondrial matrix. While during photophosphorylation High H+ conc. inside the thylakoid lumen (due to photolysis of water at thylakoid lumen) and low H+ ion conc. in stroma.

Chemoiosmosis in a chloroplast



4 BIOENERGETICS OF RESPIRATION - (1 MOL. OF GLUCOSE)

- This is a theoretical calculation based on some assumptions.
- EMP-Pathway -
  - ATP formed at substrate level phosphorylation ⇒ 4 ATP
  - ATP produced via ETS ($2NADH_2$) ⇒ 4/6 ATP
  - ATP consumed in glycolysis ⇒ 2 ATP

  10 ATP – 2 ATP = $\boxed{6/8\ ATP}$

  Gross – Expenditure = Net or Total gain

  Direct Gain = 2 ATP
- Link reaction or Gateway reaction -

  $2NADH_2$ = $\boxed{6\ ATP}$ (via ETS)
- Kreb's Cycle -
  - ATP produced at substrate level phosphorylation ⇒ 2GTP / 2ATP
  - ATP produced via ETS $\begin{bmatrix} 6NADH_2 \rightarrow 18ATP \\ 2FADH_2 \rightarrow 4ATP \end{bmatrix}$

    $\boxed{24\ ATP}$

    Total→ $\boxed{36/38\ ATP}$

Pentose Phosphate pathway can be summarized as :

- 6 Glucose-6-P + 12 NADP $\longrightarrow$ 6 CO_2 + 12 $NADPH_2$ + 5 Glucose-6-P

or

- Glucose-6-P + 12 NADP $\longrightarrow$ 6CO_2 + 12 $NADPH_2$

Significance of PPP / HMP shunt :

- This pathway **produces reducing power $NADPH_2$** for the various biosynthetic pathways, other than photosynthesis like **fats synthesis, starch synthesis, hormone synthesis and chlorophyll synthesis.**
- An intermediate **erythrose-P (4C)** of this pathway is precursor of **shikimic acid**, which goes **synthesis of aromatic compounds and amino acids.**
- This cycle provides pentose sugars **Ribose-p** for synthesis of nucleotides, nucleosides, ATP and GTP.
- A five carbon intermediate **Ribulose-5-phosphate** may used as CO_2 acceptor in green cells.
- Intermediates like **PGAL** and **fructose-6-phosphate** of this pathway may link with glycolytic reactions.

4 OTHER METHODS OF RESPIRATION

Respiration of Fats :

- It occurs **during germination of fatty seeds** and in plants when carbohydrates reserve declines.
- Fats are hydrolysed in presence of **enzymes lipase** to yield **fatty acid and glycerol**.

Oxidation of Glycerol :

- Glycerol reacts with ATP in presence of **glycerol kinase** to form **glycerol-3-PO_4**, which is then oxidised in presence of glycerol phosphate dehydrogenase and NAD to form **dihydroxy acetone phosphate** (DHAP). DHAP enters into glycolysis.

$$\text{Glycerol + ATP} \xrightarrow{\text{Kinase}} \text{Glycerol-3-PO}_4$$

$$\text{Glycerol-3-PO}_4 + \text{NAD} \xrightarrow{\text{Dehydrogenase}} \text{DHAP/PGAL + NADH}_2$$

Oxidation of Fatty Acids (β–oxidation) :

- It takes place **in mitochondria and glyoxysomes**.
- It involves sequential **removal of 2C in the form of acetyl CoA** molecules from the carboxyl end of the fatty acid.
- Each turn of β–oxidation generates one $FADH_2$, one $NADH_2$ and one acetyl CoA molecule. So each turn of β–oxidation generates 5 ATP molecules.
- Complete oxidation of one mole of acetyl CoA in TCA results in production of 12 ATP molecules, CO_2 and H_2O.

Palmitic acid (16 C)
(1 mole)

7 turns of β–oxidation ↓ 5 ATP per turn

= 35 ATP – 2 ATP (consumed in first turn) = 33 ATP

8 mole of Acetyl CoA

TCA cycle ↓ 12 ATP per cycle = 96 ATP

16 mole CO_2 + 16 mole H_2O Total = 129 ATP

Acetic Acid Fermentation :

- It is a **fermentation process** which requires atmospheric oxygen.
- Ethyl alcohol is oxidized into **acetic acid** by the activity of **acetic acid bacteria** (Acetobacter aceti).

$$C_6H_{12}O_6 \xrightarrow{\text{yeast}} 2C_2H_5OH + 2CO_2$$

$$2\ C_2H_5OH + O_2 \xrightarrow{\text{Acetobacteraceti}} CH_3COOH + H_2O$$

Acetic acid

Butyric Acid Fermentation :

- **Pyruvic** acid is converted to **butyric** acid by the activity of **anaerobic bacteria**. Eg. Bacillus butyricus, Clostridium butyricum.
- CO_2 is liberated during such fermentation.

Pyruvic acid $\xrightarrow{\downarrow CO_2}$ Acetoacetic acid $\longrightarrow$ Butyric acid.

4 RESPIRATORY QUOTIENT

- The ratio of volume of CO_2 released to the volume of O_2 absorbed in respiration is called **respiratory quotient** (RQ) or **respiratory ratio**.

$$RQ = \frac{\text{Vol. of } CO_2 \text{ released}}{\text{Vol. of } O_2 \text{ absorbed}}$$

- Value of RQ measured by **Ganong's respirometer**.
- Value of RQ varies from one **substrate** to another.
- RQ gives the idea of nature of substrate being respired in a particular tissue.

R.Q. value equal to unity (RQ = 1) :

- When carbohydrates are the respiratory substrate, as in green leaves, flowers, fruits, germinating seeds of cereals etc.

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$$

RQ = 6 / 6 = 1

RQ value less than unity (RQ < 1) :

Fats as respiratory substrate

- When fats are respiratory substrate RQ is **less than one** because **fats are poorer in oxygen** and hence require more oxygen for their oxidation. Eg. : **germinating seeds of peanuts**, **mustard**, **sunflower**, **castor** etc.

$$2\ C_{51}H_{98}O_6 + 145O_2 \longrightarrow 102\ CO_2 + 98H_2O$$

Tripalmitin

RQ = 102/145 = 0.7

Proteins as respiratory substrate –

- RQ value for proteins is also **less than one**. Value of RQ is between 0.8 and 0.9. Eg : germinating seeds of gram, pea, bean etc.

- The inhibition of anaerobic respiration by O_2 concentration is called as **Pasteur's effect**.
- The minimum amount of oxygen, at which aerobic respiration takes place & anaerobic respiration become extinct is called as **extinction point**.
- Oxygen conc^n at which both aerobic & anaerobic respiration take place simultaneously is called as **transition point**.

Carbondioxide :

- Increase in CO_2 concentration reduces respiration. Consequently inhibits the **germination of many seeds** and rate of growth falls down.

Water :

- Proper hydration of respiring cells is must because decrease in water content, **decreases respiratory rate** as water is **necessary for the activity of enzymes**.
- **Dry seeds** having 8–12% of water, have negligible respiratory rate but as the seeds **imbibe** water the respiration increases.
- **The rate of respiration of seeds increases with increase of water** because water causes hydrolysis and so enzyme activity increases. Oxygen also enters the seed through water.

Light :

- Light has no direct effect.
- Under suitable light, **rate of photosynthesis** is optimun which supplies respiratory substrate at a moderate rate and hence **indirectly affects respiration**.

Injury :

- Injury or **wounds causes increase in respiration** because healing of wound needs more meristmatic activity of cells which needs more energy provided by increased rate of respiration.
- After some time the rate of respiration returns to normal.

Mineral Salts :

- If the plants are transferred from water to adequate salt solution, then **rate of respiration** increases. This process is known as **salt respiration**.

Hormones :

- IAA, GA & cytokinin increase the respiration rate.
- The rapid increase in rate of respiration during ripening of fruits and senscence of leaves and plant organs is called as "**Climacteric respiration**". The rate is decrease after sometime.

  It is due to production of **ethylene** hormone.

Inhibitors :

- CN, azides, DNP (Dinitrophenol) CO, rotenone, antimycin, amytal, etc inhibit the respiration.
- **Heavy metals** like lead and zinc **inhibit respiration** by inactivating respiratory enzymes.

- ATP discovered by Lohman, while importance of ATP in metabolism by Lipman.
- 1 gram of fat equals to 9.8 K.Cal.

  Proteins = 4.8 K.Cal.

  Carbohydrate = 4.4 K.Cal (Old 3.8 K.Cal)

  (Fat is energy rich respiratory substrate)
- Almost all enzymatic reactions are reversible type.
- Cytochromes are Iron-porphyrin protein discoverd by MacMunn (Termed by Keilin)
- When respiratroy substrate is **fats** or **proteins**, then **level of Hg rises in Ganong's respirometer**, because more O_2 absorbed than CO_2 released, If respiratory substrate is **organic acids** than **Hg level will fall**.
- In bacteria site of ETS is **mesosome.**
- Respiration efficiency :

  1 glucose = 686 K cal.

  $$38 \text{ ATP} \times 7.6 \text{ K cal} = \frac{288 \text{ kcal}}{686} \times 100 = 42\%$$

  Thus efficiency of aerobic respiration is 42% ±.
- For the complete oxidation of one glucose if, option 38 or 36 ATP are not given, then the answer goes to 32 or 30 ATP.
- Bichemical difference between Aerbic, Anoerobic respiration and fementation.
  - **Aerobic Respiration** → The electron ejected by oxidation of organic ompound is terminally accepted by external componant to organic compound or inorganic compound which is **oxygen**.
  - **Anaerobic Respiratio**n → The electron ejected by oxidation of organic compound is terminally accepted by external component to organic ompound or inorganic compound other than oxygen **NO_2^-, NO_3^-, SO_4^{-2}**, **N_2** etc.
  - **Fementation** → The electron ejected by oxidation of organic compound is terminally accepted by intermal component to organic compound or organic compund **C_2H_5OH**, **Lactic Acid**, etc
- During fermentation and anaerobic respiration only 2 ATP and $2NADH_2$ are produced during glycolysis. The $2NADH_2$ produced terminally **reduce the organic compound in fermentation** and **inorganic compound, in anaerobic respiration** and energy lost in form of heat **as mitochondrial ETS not occurs.**

EXERCISE-I

Q.1 What is the importance of respiration in organisms ?

(1) It provides oxygen to plant

(2) It liberates energy

(3) It liberates CO_2

(4) All of the above

Q.2 Energy obtained by a cell from catabolic reaction is stored immediatlety in the form of-

(1) Pyruvic acid (2) Glucose

(3) ATP (4) DNA

Q.3 Which component of ETS is mobile, e^- carrier ?

(1) UQ (CO-Q) (2) Cyto a

(3) Cyto - b (4) Cyto - f

Q.4 Which of the following is the source of respiration ?

(1) Stored food (2) RNA

(3) DNA (4) ATP

Q.5 R.Q. is less than one at the time of respiration of -

(1) Starch (2) Sugarcane

(3) Glucose (4) Ground nut

Q.6 Number ATP produced from one pyruvic acid during conversion to actyl Co-A-

(1) 6 (2) 3 (3) 12 (4) 15

Q.7 In succulent plants R.Q. is less than one because of

(1) Complete oxidation

(2) Complete reduction

(3) Incomplete reduction

(4) Incomplete oxidation

Q.8 The link between Glycolysis and Krebs cycle is

(1) Citric acid

(2) Malic acid

(3) Fumaric acid

(4) Acetyl co-enzyme-A

Q.9 Aerobic respiration of glucose produces energy -

(1) 637 K.cal (2) 640 K.cal

(3) 686 K.cal (4) 693 K.cal

Q.10 Succinyl Co-A is related to -

(1) Krebs cycle

(2) Calvin cycle

(3) Glycolate cycle

(4) HMP-cycle

Q.11 According to chemisomotic theory of P.Mitchell (1978), ATPs are synthesised on membrance due to the -

(1) Proton gradient

(2) Electron gradient

(3) Osmosis

(4) From H_2SO_4

Q.12 A reducton of NADP to $NADPH_2$ is associted with-

(1) EMP-pathway

(2) HMP-shunt

(3) Calvin cycle

(4) Glycolysis

Q.13 Cut surface of fruit and vgetable often become dark because -

(1) Dirty knife makes it dark

(2) Oxidation of tannic acid in the presence of trace of iron from the knife makes it dark

(3) Dust of the air makes it dark

(4) None of the above

Q.14 An example of competitive inhibition of an enzyme is the inhibition of :

(1) Succinic dehydrogenase by malonic acid

(2) Cytochrome oxidase by cyanide

(3) Hexokinas by glucose-6 phosphate

(4) Carbonic anhydrase by carbon-dioxide

Q.15 In hexose monophosphate shunt the number of CO_2 molecules evolved is-

(1) Same as in glyclysis

(2) Less than glycolysis

(3) More than glycolsis

(4) Much less than glycolysis

Q.16 Conversion of pyuvic acid into ethyl alcohol is mediated by -

(1) Phosphatase

(2) Dehydrogenase

(3) Decarboxylase & dehydrogenase

(4) Catalase

Q.17 The commonest living, which can respire in the absence of O_2 is -

(1) Fish (2) Yeast

(3) Potato (4) Chorella

Q.18 The formation of Acetyl Co-A from pyuvic acid is the result of its -

(1) Reduction

(2) Dehydration

(3) Phosphorylation

(4) Oxidative decarboxylation

Q.19 Which of the following is link between carbohydrate and fat metabolism ?

(1) CO_2

(2) Acetyl Co-A

(3) Pyruvic acid

(4) Citric acid

Q.20 Pyruvate dehydrogenase complex is used in converting-

(1) Pyuvate to glucose

(2) Glucose to pyruvate

(3) Pyruvic acid to lactic acid

(4) Pyruvate to acetyl Co-A

Q.21 The first compound of TCA cycle is -

(1) Oxalo succinic acid

(2) Oxalo acetic acid

(3) Citric acid

(4) Cis aconitic acid

Q.22 End product of glycolysis is-

(1) Citirc acid

(2) Glyceraldeyde

(3) Phosphoglyceraldehyde

(4) Pyruvic acid

Q.23 First reaction in pentose phosphate pathway is -

(1) Oxidation of glucose-6-phosphate

(2) 6-Phosphogluconic acid

(3) Ribose-5-phosphate

(4) Fructose-5-phosphate

Q.24 Oxidation of one molecule of glucose in aerobic respiration result in the formation of-

(1) 36 ATP molecules

(2) 40 ATP moleules

(3) 3 ATP molecules

(4) 15 ATP molecules

Q.25 In the electron transport chain during terminal oxidation, the cytochrome, which donated electrons to O_2 is ?

(1) Cytochrome-b

(2) Cyto-C

(3) Cyto-a_3

(4) Cyto-f

Q.26 Number of oxygen atoms required for aerobic oxidation of one pyruvate-

(1) 5 (2) 8

(3) 10 (4) 12

Q.27 Alternate name of Krebs cycle is -

(1) Glyoxylate cycle

(2) Glycolate cycle

(3) Citric acid cycle

(4) EMP Pathway

Q.28 Respiration in plants

(1) Occurs only during day

(2) Results in the formation of vitamins

(3) Is characteristic of all living cells

(4) Often requires CO_2

Q.29 In plants energy is produced during the process of -
(1) Photosynthesis
(2) Transpiration
(3) Respiration
(4) Water abosrption

Q.30 A very important feature of respiration is that
(1) It liberates energy
(2) It provides O_2
(3) Utilize CO_2
(4) Synthesize complex compounds

Q.31 Complete oxidation of 1 gm mol of glucose gives rise to -
(1) 6860000 cals (2) 686000 cals
(3) 68600 cals (4) 6860 cals

Q.32 The cell orgnelle in, which aerobic respiration occurs -
(1) Ribosome
(2) Mitochondria
(3) Lysosmes
(4) Chloroplast

Q.33 For the purpose of respiration in plants
(1) Light is necessary
(2) CO_2 is necessary
(3) O_2 is necessary
(4) Chlorophyll is necessary

Q.34 The end products of respiration in plants are
(1) CO_2, H_2O and energy
(2) Starch and O_2
(3) Sugar and oxygen
(4) H_2O and energy

Q.35 The incomplete breakdown of sugars in anaerobic respiration resulat in the formation of -
(1) Fructose and water
(2) Glucose and carbon dioxide
(3) Alcohol and CO_2
(4) Water and CO_2

Q.36 Carbon dioxide is liberated during -
(1) Phtosynthesis (2) Transpiration
(3) Acent of sap (4) Respiration

Q.37 Common immediate source of energy in cellular acticity is -
(1) glucose (2) aldohexose
(3) ATP (4) NAD

Q.38 Energy obtined by a cell from catabolic reaction is stored immediataly in the form of
(1) Glucose (2) Pyruvic acid
(3) ADP (4) ATP

Q.39 A.T.P. is
(1) A hormone
(2) A protiein
(3) An enzyume which brings about oxidation
(4) A molecule which contain high energy bond

Q.40 In anaerobic respiration seeds respirs -
(1) In presence of O_2
(2) In presence of CO_2
(3) In absence of O_2
(4) In absence of CO_2

Q.41 The following is required both by the process of respiration and phtosynthesis -
(1) Carbohydrates
(2) Sunlight
(3) Chlorophyll
(4) Cytochromes

Q.42 The net gain of ATP molecules in glycolysis is -
(1) Zero (2) Two
(3) Four (4) Eight

Q.43 Cytochromes are concerned with -
(1) Protein synthesis
(2) Cellular digestion
(3) Cell division
(4) Cell-respiration

Q.44 How is respiration affected on the basis of protoplasm activity ?

(1) Rate of respiration in seed is found low

(2) In dormant organs, rate of respiration is low

(3) Rate of respiration is high in meristematic cells

(4) All the above

Q.45 Number of every cytochrome molecule require for transfer of $2e^-$ in ETS :

(1) 2 (2) 4

(3) 1 (4) 10

Q.46 Kreb's cycle takes place in -

(1) Vesicles of E.R

(2) Mitochiondrial matrix

(3) Dictyosomes

(4) Lysosomes

Q.47 The respiration in germinating seeds produces energy, which can be delflected in the form of -

(1) water (2) O_2

(3) Heat (4) CO_2

Q.48 In respiration pyruvic acid is -

(1) Formed only when oxygen is available

(2) One of product of krebs cycle

(3) Broken down into Acetyl Co-A and CO_2

(4) a result of protein break down

Q.49 Most of the energy of the carbohydrates is released by oxidation when -

(1) Pyruvic acid is converted into CO_2 and H_2O

(2) Pyuvic acid is converted into acetyl Co-A

(3) Sugar is converted into pyruvic acid

(4) Glucose is converted into alcohol and CO_2

Q.50 Glycolysis takes place in -

(1) Cytoplasm

(2) Chloroplast

(3) Ribosome

(4) Mitochondria

Q.51 The universal hydrogen acceptor is -

(1) NAD (2) ATP

(3) Co-A (4) FMN

Q.52 The end product of fermentation when sugar are used as raw materials are -

(1) Alcohol and CO_2

(2) Alcohol, Pyruvate

(3) CO_2

(4) Alcohol

Q.53 Iron-porphyrin protein complex occurs in -

(1) phytochrome (2) cytochrome

(3) chlorophyll (4) both (1) and (3)

Q.54 Fermentation is conducted by

(1) All bacteria

(2) All fungi

(3) Some fungi and some bacteria

(4) All microorganism

Q.55 In the process of respiration in plants 180 gm of Glucose plus192 gm of oxygen produce -

(1) 132 gm of CO_2 , 54 gm of H_2O & 483 Kcal.E

(2) 264 gm of CO_2 , 108 gm of H_2O & 686 Kcal.E

(3) 200 gm of C_2H_5OH, 72 gm of H_2O & 21 Kcal.E

(4) None

Q.56 Respiratory enzymes are localised in -

(1) Ribosomes (2) Chloroplast

(3) Mitochondria (4) None of the above

Q.57 Respiration is an -

(1) Exothermic process

(2) Endothermic process

(3) Anabolic process

(4) None of these

Q.58 In Opuntia during night the R.Q. will be -

(1) 1 (2) less than 1

(3) More than 1 (4) 0

Q.59 Number of ATP molecules formed during aerobic respiration in break down of one glucose molecule via malate aspartate shuttle -

(1) 38 (2) 18

(3) 28 (4) 4

Q.60 During respiration pyruvic acid is formed by -
(1) Glycolysis (2) Kreb's cycle
(3) TCA cycle (4) None of the above

Q.61 Enzyme involved in alcoholic fermentation -
(1) Pyruvate decarboxylse
(2) Lactate dehydrogenase
(3) Hexoisomerase
(4) Both decarboxylase and dehydrogenase

Q.62 Kreb's cycle is -
(1) Aerobic respiration
(2) Photosynthesis
(3) Transpiration
(4) Anaerobic respiration

Q.63 The organism in which kreb's cycle does not occur in mitochondria is -
(1) Yeast
(2) E.coil
(3) Ulothrix
(4) Molds

Q.64 Citric acid is produced in
(1) Bacterial episome
(2) Kreb's cycle
(3) Calvin cycle
(4) Calvin + HSK cycle

Q.65 How many times CO_2 released in aerobic respiration -
(1) One or two (2) Three
(3) Six (4) Twelve

Q.66 Raw material for respiration is -
(1) Glucose & O_2
(2) Glucose & CO_2
(3) Glucose & Carbon
(4) Glucose & sucrose

Q.67 Slow respiring plant or plants tissues are -
(1) Promeristem
(2) Cambium
(3) Leaf primordia & young plant
(4) Adult plants & matured tissues

Q.68 The tissue of highest respiratory activity is -
(1) Meristem (2) Ground tissue
(3) Phloem (4) Mechanical tissue

Q.69 Respiratory quotient is expressed as -
(1) O_2/CO_2 (2) CO_2/O_2
(3) O_2/H_2O (4) CO_2-O_2

Q.70 What causes R.Q. to vary
(1) Respiratory Substrate
(2) Light & O_2
(3) Respiratory Product
(4) Temperature

Q.71 The first preferred respiratory substrate is -
(1) Glucose (2) Fats
(3) Protein (4) Polypeptide

Q.72 Respiration results into -
(1) Gain in weight
(2) Loss in weight
(3) No change in weight
(4) Loss of ATP

Q.73 Respiration occurs in -
(1) All living cells both in lights & dark
(2) Non green cells only in light
(3) Non green cells in light and dark
(4) All living cells in light only

Q.74 The value of RQ at compensation point is -
(1) One (2) More than one
(3) Less than one (4) Inifinite

Q.75 The value of RQ at compensation point is -
(1) Unity (2) Two
(3) >1 (4) Zero

Q.76 The value of RQ of starved cell is -
(1) Zero (2) Less than one
(3) 1 (4) infinite

Q.77 RQ of an activley phtosynthesizing tissue is-
(1) Unity (2) < 1
(3) > 1 (4) Zero

Q.78 R.Q. of germinating ground nut & castor seed is -

(1) 1 (2) < 1

(3) >1 (4) 0

Q.79 The value of RQ of a ripening fatty seed is-

(1) < 1 (2) > 1

(3) zero (4) Unity

Q.80 When the evolution of CO_2 is more than the intake of O_2 the respired substrate should be-

(1) Fatty acid

(2) orgainc acid

(3) Glucose

(4) Polysaccharides

Q.81 The value of R.Q. of a succulent plant at night is -

(1) unity (2) >1

(3) Zero (4) Infinite

Q.82 Protoplasmic proteins are used as a respiratory substrate only when -

(1) Carbohydrates are absent

(2) Fats are absent

(3) Both 1 & 2 are absent

(4) Fats & carbohydrates are abundant

Q.83 The term ''Protoplasmic respiratory'' is used when the respiratory substrate is -

(1) Carbohydrates

(2) Portein

(3) Organic acid

(4) Lipid

Q.84 The term ''Floating respiration'' is used when the respiratory substrate is -

(1) Carbohydrates (2) Fats

(3) Both 1 and 2 (4) Protein

Q.85 Respiration may take place -

(1) In the presence of O_2

(2) In the absence of O_2

(3) In the presence or absence of O_2

(4) In the presence of CO_2

Q.86 Apparatus used to measure respiratory quotient -

(1) Potometer

(2) Auxanometer

(3) Respirometer

(4) Warburg's apparatus

Q.87 Glycolysis involves the conversion of -

(1) Protein into glucose

(2) Glucose into fructose

(3) Starch into glucose

(4) Glucose into pyruvic acid

Q.88 The end product of glycolysis is -

(1) Glycolate & ethanol

(2) Glyoxylic acid & CO_2

(3) Glucose or hexose units

(4) Pyruvate

Q.89 The common phase between aerobic & anaerobic respiration is -

(1) TCA cycle (2) Kreb's cycle

(3) Glycolysis (4) Photo respiration

Q.90 Which of the follwing scientist discovered the conventional path of glycolysis -

(1) Embeden, Myerhof and Parnas

(2) Emerson, Hoffman and Peterson

(3) Embeden, Morrison and Pitcher

(4) Warburg, Dickens and Horecker

Q.91 What is active glucose -

(1) FAD glucose

(2) NAD glucose

(3) Glucose-6-P

(4) Glycerophosphate

Q.92 The enzyme which converts glucose to glucose 6-phosphate-

(1) Phosphorylase

(2) Gluco-phosphorylase

(3) Hexokinase

(4) Phospho glucomutase

Q.93 Glycolysis give rise to -

(1) 8ATP, 2$NADH_2$, 2 Pyruvate

(2) 2ATP, 2CoA, 2$NADH_2$

(3) 2ATP, 2$NADH_2$, 2 Pyruate

(4) 2ATP, 2 acetate, 2$NADPH_2$

Q.94 The inhibitory effect of the presence of O_2 on anaerobic respiration is termed -

(1) Warburg effect (2) Pasteur effect

(3) Emerson's effect (4) Oxygen effect

Q.95 During glycolysis the mineral needed as an enzyme activator is -

(1) Mn^{++} (2) Fe^{++}

(3) Ca^{++} (4) Mg^{++}

Q.96 Green plants kept in light produce ATP from the glucose. This process is -

(1) Photophosphroylation

(2) Hill reaction

(3) Oxidative phosphorylation

(4) β-oxidation

Q.97 Anaerobic respiration was reported for the first time by -

(1) Pasteur (2) Kostychev

(3) Klein (4) Pfeffer

Q.98 Which of the follwing ETS complex is inhibited by cyanide -

(1) Complex II (2) Complex V

(3) Complex IV (4) Comlex III

Q.99 Final e^- acceptor of mitochondria is -

(1) Pyruvate (2) NADP

(3) O_2 (4) OAA

Q.100 The number of ATP molecules produced from one Kreb's cycle are -

(1) 15 (2) 30

(3) 38 (4) 40

Q.101 How many molecules of ATP are produced per molecule of $FADH_2$ oxidised -

(1) One (2) Two

(3) Three (4) four

Q.102 Which of the following cytochrome donated electron to oxygen -

(1) cyto.-a_1 (2) cyto.-a_3

(3) cyto.-b (4) cyto.-c

Q.103 The amount of energy given by one ATP molecule is -

(1) 67 K cal (2) 6.7 K cal

(3) 7.6 K cal (4) 75 K cal

Q.104 How many ATP molecules produced from the complete oxidation of a molecule of active acetate or acetyl Co-A -

(1) 38 ATP (2) 15 ATP

(3) 12 ATP (4) 4 ATP

Q.105 How many ATP equivalents are produced by the oxidation of succinate into fumarate -

(1) 1 ATP (2) 2 ATP

(3) 3 ATP (4) 4 ATP

Q.106 The product of aerobic respiration of glucose is -

(1) CO_2 + H_2O + ATP

(2) CO_2 + Pyruvic acid

(3) CO_2 + ethyl alcohol

(4) CO_2 + Pyruvic acid + citric acid

Q.107 Product formed by the activity of malic dehydrogenase is -

(1) Fumaric acid (2) Malic acid

(3) Oxaloacetic acid (4) Succinc acid

Q.108 Which of the following is 5-carbon compound of Kreb's cycle -

(1) Citric acid

(2) Furmaric acid

(3) Oxalosuccinic acid

(4) α-Ketoglutaric acid

Q.109 Energy for ATP synthesis is obtained from -

(1) Oxygen ion gradient

(2) Heavy water grdient

(3) Uranium ion gradient

(4) Hydrogen ion gradient

Q.110 Mitochonderia is the site of -
(1) CO production
(2) Cell division
(3) The release of energy during respiration
(4) None of the above

Q.111 Substrate level ATP molecules during complete oxidation of 1 molecule of glucose-
(1) 8 ATP (2) 6 ATP
(3) 4 ATP (4) 2 ATP

Q.112 How many ATP generates in aerobic respiration via glycerol phosphate shuttle in eukaryotes ?
(1) 38 ATP (2) 36 ATP
(3) 40 ATP (4) 80 ATP

Q.113 How many ATP generates in aerobic respiration of eukaryotic cell ?
(1) 28 ATP (2) 36 ATP
(3) 20 ATP (4) 40 ATP

Q.114 Respiration differs from burning in which of the following ?
(1) Energy released in respiration
(2) Oxidation of substance occurs
(3) Enzymes are involved
(4) All the above

Q.115 Energy produced per gram is highest in -
(1) Starch (2) Sucrose
(3) Protein (4) Lipid

Q.116 Site of Kreb's-cycle in respiration & ATP synthesis is -
(1) Mitochondrial stroma
(2) Matrix & oxysome
(3) Cytoplasm
(4) None of the above

Q.117 Minimum respiration rate found in -
(1) Leaves (2) Stem
(3) Parenchyma (4) Seeds

Q.118 Cyanide resistant respiration is found in -
(1) Homo sapiens (2) Brassica
(3) Spinacea (4) Bacteria

Q.119 Ganong's respirometer used for -
(1) Respiration measuring
(2) R.Q. measuring
(3) Transpiration measuring
(4) All of the above

Q.120 Direct gain of ATP from one mole of glucose during glycolysis or EMP pathaway -
(1) 2 ATP (2) 6 ATP
(3) 36 ATP (4) 38 ATP

Q.121 In glycolysis of aerobic respiration the ATP synthesized are -
(1) 2 ATP (2) 6 ATP
(3) 8 ATP (4) 30 ATP

Q.122 $FADH_2$ Produced in Kreb's-cycle from -
(1) Isocitrate (2) α-ketoglutarate
(3) succinate (4) malate

Q.123 Which 5-carbon organic acid of TCA-cycle is key compound in N_2 -metabolism ?
(1) Cirtric acid
(2) Fumaric acid
(3) Oxalosuccinic acid
(4) α-ketoglutaric acid

Q.124 1 mole of glucose when oxidised through EMP & TCA-cycle would yield -
(1) 30 ATP gross
(2) 40 ATP net
(3) 36 or 38 ATP net
(4) 38 ATP only

Q.125 When 100% carbon is oxidised to CO_2 the efficiency of such a respiration is ?
(1) 40% (2) 60%
(3) 80% (4) 100%

Q.126 What is true for Kreb's cycle ?
(1) GTP/ATP is formed
(2) 2 Decarboxylation
(3) Acetyl Co-A acceptor is O.A.A .
(4) All the above

Q.127 β-oxidation takes place in -
(1) Cell Membrane
(2) Mitochondrial Membrane
(3) Oxysomes Head
(4) Perimitochondrial space

Q.128 Warburg-Dickens pathaway is -
(1) PPP (2) TCA-cycle
(3) EMP pathway (4) None

Q.129 Which enzyme break downs the fructose-1, 6-Disphosphate ?
(1) Hexokinase (2) Phosphatase
(3) Aldolase (4) None

Q.130 How much energy equal to ATP will be produced by HMP shunt ?
(1) 40 ATP (2) 38 ATP
(3) 35 ATP (4) 8 ATP

Q.131 Link between glycolysis & TCA cycle is -
(1) Pyruvic acid (2) Acetyl Co-A
(3) Citric acid (4) None

Q.132 Aceptor of acetyl Co-A in Kreb's-cycle is -
(1) Malic acid (2) Fumaric acid
(3) α-ketoglutric acid (4) Oxalo acetic acid

Q.133 Enzyme alternate oxidase is inhibited by :
(1) NADP
(2) SHAM (Salicy hydroxamic acid)
(3) m-CLAM (m-chloro-benzhydroxamic acid)
(4) 2 & 3

Q.134 When 2-pyruvic acids froms two lactic acid by aneaerobic respiration then ?
(1) One ATP is lost (2) 3 ATP is lost
(3) 6 ATP is lost (4) None

Q.135 During oxidative phosphorylation follwoing provides energy for the ATP formation -
(1) Co-A
(2) NADPH
(3) Efflux of proton to PMS
(4) Pyruvic acid

Q.136 Anaerbic respiration takes place in - **[MP PMT 2002]**
(1) Ribosome (2) Nucleus
(3) Cytoplasm (4) Vacuole

Q.137 What is the energy coin of a cell ? **[MP PMT 2002]**
(1) DNA (2) RNA
(3) ATP (4) Minerals

Q.138 The process of oxidative phosphorylation takes place in - **[MP PMT 2002]**
(1) Mitochondria (2) Chloroplasts
(3) Ribosomes (4) Cytoplasm

Q.139 R.Q. of which diet is less than unit ? **[RPMT 2002]**
(1) Carbohydrate (2) Fats
(3) Organic acid (4) Sugar

Q.140 Pyruvic acid is the end product of which process ? **[RPMT 2002]**
(1) Kreb's cycle
(2) Calvin cycle
(3) Pentose phosphate pathway
(4) Glycolysis

Q.141 1 molecule glucose + 6 molecule of O_2 and 38 ADP combined to form 12 H_2O, 6 CO_2 and- **[RPMT 2002]**
(1) 38 molecules of ATP
(2) 28 ATP
(3) 38 ADP
(4) 28 ADP

Q.142 Number of ATP obtained at the end of Kreb's cycle - **[RPMT 2002]**
(1) 2 ATP (2) 4 ATP
(3) 8 ATP (4) 38 ATP

Q.143 During the formation of bread, it becomes porous due to release of CO_2 by the action of - **[CPMT 2002]**
(1) Yeast (2) Bacterial
(3) Virus (4) Protozoans

Q.144 How many ATP molecules produced by aerobic oxidation of one molecule of glucose ?
[CPMT 2002]
(1) 2 (2) 4 (3) 38 (4) 34

Q.145 Energy required for start of biochemical reaction is -
(1) Potential energy (2) Entropy
(3) Activation enegy (4) Kinetic energy

Q.146 R.Q. of maturing fatty seeds will be -
(1) 1 (2) More than one
(3) 0 (4) 0.7

Q.147 Anaerobic degradation of proteins by microbes is known as -
(1) Putreification (2) Degradation
(3) Decomposition (4) None

Q.148 In which one of the following do the two names refer to one and the same thing -
CPMT 2003]
(1) Kreb's cycle and calvin cycle
(2) Tricarboxylic acid cycle and citric acid cycle
(3) Citric and cycle and Calvin cycle
(4) Tricarboxylic acid cycle and urea cycle

Q.149 In alcohol fermentation - **[CPMT 2003]**
(1) Triose phosphate is the electron donor, while acetaldehyde is the electron accceptor
(2) Triose phosphate is the electron donor, while pyruvic acid is the electron acceptor
(3) There is no electron donor
(4) Oxygen is the electron acceptor

Q.150 In glycolysis, during oxidation electrons are removed by - **[CPMT 2004]**
(1) Molecular oxygen (2) ATP
(3) Glyceraldehyde (4) NAD^+

Q.151 Aerobic respiration is how many times useful than anaerobic respiration - **[RPMT 2004]**
(1) 2 (2) 8
(3) 19 (4) 38

Q.152 For retting of jute, the fermenting microbe used is - **[AIPMT 2005]**
(1) Helicobactor pylori
(2) Methophilic bacteria
(3) Streptococcus lactin
(4) Butyric acid bacteria

Q.153 During which stage in the complete oxidation of glucose are the greatest number of ATp molecules formed form ADP ? **[AIPMT 2005]**
(1) Conversion of pyruric acid to acetyl Co A
(2) Electron transport chain
(3) Glycolysis
(4) Krebs cycle

Q.154 The deficiencies of micronutrients, not only affects growth of plants, but also vital functions such as photosynthetic and mitochondrial electron flow. Among the list given below, which group of three elements shall affact most, both photosynthetic and mitochodrial electron transport -
[AIPMT 2005]
(1) Cu, Mn Fe (2) Co, Ni, Mo
(3) Mn Co, Ca (4) Ca, K, Na

Q.155 Chemiosmotic theory of ATP synthesis in the chloroplast and mitochondria is based on -
[AIPMT 2005]
(1) Proton gradient
(2) Accumulation of K ions
(3) Accumulation of Na ions
(4) Membrane potential

Q.156 Respiration is which type of process-
[RPMT 2005]
(1) Catabolic
(2) Metabolic
(3) Anabolic
(4) None

Q.157 R.Q. is represented by- **[RPMT 2005]**
(1) O_2/CO_2 (2) CO_2/O_2
(3) $V_2/V_2–V_1$ (4) O_2 taken in

Q.158 Which is the site of Kreb's cycle -
(1) Chloroplast **[RPMT 2005]**
(2) Golgibody
(3) Mitochondria
(4) Endophasmic reticulum

Q.159 Curing of tea leaves is broght about by the actiivty of - **[AIPMT 2006]**
(1) viruses
(2) fungi
(3) bacteria
(4) mycorrhiza

Q.160 Which of the following statements regarding mitochondrial membrane is NOT correct ? **[AIPMT 2006]**
(1) The inner membrance is highly convoluted forming a series of infolding
(2) The outer membrane resembles a sieve
(3) The outer membrance is permeable to all kinds of molecules
(4) The enzymes of the electron transfer chain are embedded in the outer membrane.

Q.161 How many ATP molecules could maximally be generated from one molecule of glucose, if the complete oxidation of one mole of glucose to CO_2 and H_2O yields 686 kcal and the useful chemical energy
available in the high energy phosphate bond of one mole of ATP is 12 Kcal ? **[AIPMT 2006]**
(1) 57 (2) 1
(3) 2 (4) 30

Q.162 The overall goal of glycolysis, Krebs cycle and the electron transport system is the formation of - **[AIPMT 2007]**
(1) Nucleic acids
(2) ATP in small stepwise units
(3) ATP in one large oxidation reaction
(4) Sugars

Q.163 All enzymes of TCA cycle are located in th mitochondroial martix except one which is located in inner mitochondrial membrane in eukaryotes and in cytosol in prokaryotes. This enzyme is - **[AIPMT 2007]**
(1) Succinate dehydrogenase
(2) Lactate dehydrogenase
(3) Isocitrate dehydrogenase
(4) Malate dehydrogenase

Q.164 Which one of the following mamalian cells are not capable of metabolising glucose to carbondioxide aerobically ? **[AIPMT 2007]**
(1) Red blood cells
(2) White blood cells
(3) Unstriated muscle cells
(4) Liver cells

Q.165 A competitive inhibitor of succinc dehydrogenase is - **[AIPMT 2008]**
(1) $\propto$-ketoglutarate (2) Malate
(3) Malonate (4) Oxaloacetate

Q.166 The chemisomotic coupling hypothesis of oxidative phosphorylation proposes that adenosine triphosphate (ATP) is formed because - **[AIPMT 2008]**
(1) A proton gradient forms across the inner membrane
(2) There is a change in the permeabity of the inner mitochondrial membrane towrds adenosine diphosphate (ADP)
(3) High energy bonds are formed in mitochondrial proteins
(4) ADP is pumped out of the matrix into the intermembrane space

Q.167 The energy-relesing process in which the substrate is oxidised without an external electron acceptor is called - **[AIPMT 2008]**
(1) Aerobic respiration
(2) Glycolysis
(3) Fermentation
(4) Photorespiration

Q.168 In germinating seeds fatty acids are degraded exclusively in the - **[AIPMT 2008]**

(1) Peroxisomes

(2) Mitochondria

(3) Proplastids

(4) Glyoxysomes

Q.169 How is the energy present in food released during biological oxidation ?

(1) In one step, quickly

(2) In two steps, slowly

(3) In different steps, slowly

(4) In different steps, quickly

Q.170 During biological oxidation in which form energy is temporarily stored –

(1) In the form of Glucose

(2) In the form of Pyruvic acid

(3) In the form of ATP

(4) All the above

Q.171 Which of these is a high energy molecule ?

(1) GTP (2) CTP

(3) TTP (4) All the above

Q.172 ATP is formed in –

(1) Respiration

(2) Photosynthesis

(3) Photophosphorylation

(4) All the above

Q.173 ATP is called the –

(1) Cellular furnace

(2) Energy centre of the cell

(3) Biological energy currency

(4) Energy depositing molecule

Q.174 What is wrong about respiration ?

(1) It does not occur in cell

(2) Oxidation occurs without the use of enzymes

(3) Energy is released in one step quickly

(4) All the above

Q.175 Which statement about respiration is correct ?

(1) All energy is released in the form of heat

(2) Oxydations occurs with use of enzyme

(3) Energy released in single step

(4) All the above

Q.176 What is the product of aerobic respiration ?

(1) CO_2 (2) H_2O

(3) Energy (4) All the above

Q.177 It is equally found in aerobic as well as anaerobic respiration ?

(1) Glycolysis (2) Kreb's Cycle

(3) Both of above (4) ETS

Q.178 What happens in fermentation ?

(1) Incomplete oxidation of Glucose

(2) Complete oxidation of Glucose

(3) Both of the above

(4) None of the above

Q.179 What are the reasons for less frequent fermentation ?

(1) Due to less energy production, the energy supply is less

(2) Due to more use of respiratory substrate, it is not available for growth and other process

(3) The excess of final and intermediate products of fermentation produce toxicity

(4) All the above

Q.180 What is the other name of glycolysis

(1) HMP pathway (2) EMP pathway

(3) PPP (4) All the above

Q.181 What is formed at the end of first step of phosphorylation of glycolysis ?

(1) Glucose 6-PO_4

(2) Fructose 6-PO_4

(3) Fructose 1-6 diPO_4

(4) Any of the above

Q.182 Phosphorylation of glucose occurs by –

(1) H_3PO_4 (2) ATP

(3) Any of the above (4) None of the above

Q.183 What is formed by the breakdown of Fructose 1-6 diphosphate in glycolysis ?

(1) PGAL

(2) DHAP

(3) Both of above

(4) PGA

Q.184 When is $NADH_2$ formed in glycolysis ?

(1) During the formation of DiHAP from PGAL

(2) During the formation of 1-3 DiPGAL from PGAL

(3) During the formation of 1-3 DiPGA from 1-3 DiPGAL

(4) During the formation of PeP from PGA

Q.185 When is ATP formed in glycolysis ?

(1) During the formation of 3-PGA from 1-3 DiPGA

(2) During the formation of Pyruvic acid from PEP

(3) Both of above

(4) None of the above

Q.186 How many molecules of pyruvic acid are formed in glycolysis ?

(1) One (2) Two (3) Three (4) Four

Q.187 The products of glycolysis are –

(1) Pyruvic acid (2) 2 $NADH_2$

(3) 2 ATP (4) All the above

Q.188 What is the total gain in terms of ATP in glycolysis ?

(1) Six (2) Four (3) Eight (4) Ten

Q.189 How many ATPs are stored in anaerobic respiration ?

(1) Two (2) Four (3) Six (4) Eight

Q.190 What is formed during exercising in skeletal muscles ?

(1) Pyruvic acid

(2) Lactic acid

(3) Ethyl alcohol

(4) Acetone

Q.191 Why the animals feel fatigue during exercise ?

(1) Due to accumulation of malic acid

(2) Due to accumulation of lactic acid

(3) Due to accumulation of pyruvic acid

(4) Due to all the above

Q.192 What is there in Pyruvic dehydrogenase complex ?

(1) Pyruvic decarboxylase with TPP Mg^{++}

(2) COA

(3) Lipoic acid

(4) All the above

Q.193 What is the other name for Kreb's Cycle ?

(1) TCA Cycle (2) DCA Cycle

(3) Both of above (4) None of the above

Q.194 Which is the 6 carbon compound in Kreb's cycle ?

(1) Citric/Isocitric acid (2) Aconitic acid
(3) Oxalosuccinic acid (4) All the above

Q.195 What is formed besides succinic acid during its formation in Kreb's Cycle ?

(1) ADP (2) GTP

(3) $NADH_2$ (4) $FADH_2$

Q.196 Which is the 4-carbon compound found in Kreb's cycle ?

(1) Succinic acid (2) Fumaric acid

(3) Malic acid (4) All the above

Q.197 What else is formed during formation of Fumaric acid from succinic acid ?

(1) $FADH_2$ (2) $NADH_2$

(3) $NADPH_2$ (4) None of these

Q.198 How many $FADH_2$ are formed from one pyruvic acid molecule ?

(1) One (2) Two

(3) Three (4) Four

Q.199 How many $NADH_2$ are formed from one glucose molecule ?

(1) Four (2) Five (3) Eight (4) Ten

Q.200 How many $FADH_2$ are formed in one Kreb's cycle ?

(1) One (2) Two (3) Three (4) Four

Q.201 How many $FADH_2$ are formed from one glucose molecule ?

(1) One (2) Two (3) Three (4) Four

Q.202 Where the reaction of Kreb's cycle occur ?

(1) Cytoplasm

(2) Mitochondrial matrix

(3) Mitochondrial cristae

(4) F_1 particles of mitochondia

Q.203 How many ATP are obtained from $NADH_2$?

(1) One (2) Two (3) Three (4) Four

Q.204 How many ATP are obtained from $FADH_2$?

(1) One (2) Two (3) Three (4) Four

Q.205 $NADH_2$ to ATP synthesis occurs through –

(1) ETS (2) PPP

(3) EMP (4) HMP

Q.206 Which complex is formed by FMN $NADH_2$, Dehydrogenase,?

(1) Complex–I (2) Complex–II

(3) Complex–III (4) All the above

Q.207 Which substances are found in complex II of ETS ?

(1) FMN $NADH_2$, dehydrogenase

(2) Co-Q $FADH_2$, Dehydrogenase

(3) Both of above

(4) None of above

Q.208 Which complex is formed by Cyt.a_3 and Cyt.a of ETS ?

(1) Complex–I (2) Complex–II

(3) Complex–III (4) Complex–IV

Q.209 Where is ATPase complex found ?

(1) On cristae of mitochondria

(2) In matrix of mitochondria

(3) In oxysomes present on cristae of mitochondria

(4) On F_0 particles of mitochondria

Q.210 Which electron acceptors can easily be separated from respiratory chain ?

(1) Co-Q (2) Cyt-c

(3) Both of above (4) Fe-S Protein

Q.211 Which are called mobile carriers of respiratory chain ?

(1) Co-Q

(2) Cyt-c

(3) Both of above

(4) None of the above

Q.212 Which acts as mobile carrier between complex-III and complex-IV ?

(1) Fe-S (2) Co-Q

(3) Cyt-C (4) None of these

Q.213 Hydrogen is transferred from $FADH_2$ to –

(1) NAD (2) FMN

(3) Co-Q (4) NADP

Q.214 Hydrogen is transferred from $NADH_2$ to –

(1) FAD (2) FMN

(3) Co-Q (4) Fe-S

Q.215 Who discovered chemiosmosis ?

(1) Mitchell

(2) Warburg & Dickens

(3) Raecker

(4) Krebs

Q.216 From which place H^+ protons enter matrix from outside of inner membrane of mitochondria ?

(1) Any part of the membrane

(2) Through elementary particles/oxysomes of membrane

(3) From terminal end of cristae

(4) None of the above

Q.217 Which part of elementary particle is completely embedded in the membrane ?

(1) F_0 (2) F_1

(3) Both of above (4) None of these

Q.218 By transfer of how many protons, one ATP is formed ?

(1) $1H^+$ (2) $2H^+$

(3) $3H^+$ (4) $4H^+$

Q.219 How many pairs of protons are released in respiratory chain by one $NADH_2$?

(1) One pair (2) Two pairs

(3) Three pairs (4) Four pairs

Q.220 What is the method of formation of ATP in mitochondria ?

(1) Osmosis

(2) Chemiosmosis

(3) Chemiphosphorylation

(4) Osmophosphorylation

Q.221 Phosphorylation at substrate level is found in-

(1) Glycolysis

(2) Kreb's cycle

(3) Both (1) and (2)

(4) None of the above

Q.222 Which is called phosphorylative proton coupling ?

(1) Formation of ADP

(2) Formation of ATP by energy present in $NADH_2$, $FADH_2$ through respiratory chain

(3) Formation of ATP at substrate level

(4) All the above

Q.223 Who resists terminal oxidation of respiratory chain ?

(1) CO (2) KCN

(3) Both (1) and (2)

(4) None of these

Q.224 Where is PPP (Pentose Phosphate pathway) performed in cell ?

(1) In mitochondrial matrix

(2) In cytoplasm

(3) In mitochondrial membrane

(4) None of the above

Q.225 PPP is related to –

(1) Glycolysis (2) Kreb's cycle

(3) Respiration (4) Photosynthesis

Q.226 PPP is an alternative of –

(1) Anaerobic respiration

(2) Fermentation

(3) Aerobic respiration

(4) All the above

Q.227 What is the significance of PPP ?

(1) It provides reductive power

(2) It provides ribose sugars for nucleic acid synthesis

(3) Provides Erythrose 4-P for synthesis of lignin, anthocyanin, auxin etc

(4) All the above

Q.228 Why $NADH_2$ produced in glycolysis cannot enter mitochondria generally ?

(1) Mitochondrial membrane is impermeable to $NADH_2$

(2) $NADH_2$ is used in cytoplasm only

(3) Both of above

(4) None of the above

Q.229 If malate aspartate shuttle is effective then how many ATPs are formed from Glucose ?

(1) 36 ATP (2) 38 ATP

(3) 30 ATP (4) 34 ATP

Q.230 Where H_2 of $NADH_2$ obtained by glycolysis through Glycerol Phosphate shuttle is transferred ?

(1) In matrix of mitochondria

(2) On inner surface of inner membrane of mitochondria

(3) On inner surface of outer membrane of mitochondria

(4) On outer surface of inner membrane of mitochondria

Q.231 In presence of Glycerol Phosphate shuttle, a glucose molecule yields –

(1) 38 ATP (2) 36 ATP

(3) 34 ATP (4) 30 ATP

Q.232 In prokaryotes, a glucose molecule always yields –

(1) 38 ATP

(2) 36 ATP

(3) 2 ATP

(4) 8 ATP

Q.233 In eukaryotes, a glucose molecule forms –

(1) Always 36 ATP

(2) Always 38 ATP

(3) Always 38 ATP or 36 ATP

(4) None of the above

Q.234 Which is the substrate generally used first of all in respiration ?

(1) Protein

(2) Fat

(3) Carbohydrate

(4) Organic acid

Q.235 The ratio of CO_2 released and O_2 utilised in a definite time by a definite weight of respiratory substrate is called –

(1) Respiration

(2) Temperature quotient

(3) Respiratory ratio

(4) Respiratory effect

Q.236 Why RQ value of carbohydrates is one ?

(1) Carbohydrates breakdown completely in respiration

(2) Carbohydrates have almost equal C and O

(3) Both of above

(4) None of the above

Q.237 Why the RQ value for fats and proteins is less than one ?

(1) Due to less O as compared to C in fats and proteins

(2) Due to incomplete breakdown of fats and proteins

(3) Due to complete breakdown of fats and proteins

(4) Due to more O in fats and proteins

Q.238 The fruits in which rate of respiration increases during ripening is called –

(1) Respiratory fruit (2) Climacteric fruit

(3) Climax fruit (4) Ethylinated fruit

Q.239 The energy-releasing metabolic process in which substrate is oxidised without an external electron acceptor is called-

[AIPMT-2010 (Pre)]

(1) Aerobic respiration (2) Photorespiration

(3) Glycolysis (4) Fermentation

Q.240 In mitochondria, protons accumulate in the :

[AIPMT-2011 (Mains)]

(1) Matrix
(2) Outer membrane
(3) Inner membrane
(4) Intermembrane space

Q.241 Glycogenolysis involes **[RPMT-2011]**

(1) conversion of sugar into glycongen
(2) oxidation of sugar
(3) conversion of glycogen into sugar
(4) conversion of glycogen into fat

ANSWER KEY

EXERCISE-I

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	2	3	1	1	4	2	4	4	3	1	1	2	2	1	3	3	2	4	2	4
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	3	4	1	1	3	1	3	3	3	1	2	2	3	1	3	4	3	4	4	3
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	4	4	4	4	1	2	3	3	1	1	1	1	2	3	2	3	1	2	1	1
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	4	1	2	2	3	1	4	1	2	1	1	2	1	3	4	2	1	2	2	2
Ques.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	3	3	2	3	3	3	4	4	3	1	3	3	3	2	4	3	2	3	3	1
Ques.	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	2	2	3	3	2	1	3	4	4	3	3	2	2	3	4	2	4	3	2	1
Ques.	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
Ans.	3	3	4	3	1	4	4	1	3	3	2	4	4	3	3	3	3	1	2	4
Ques.	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
Ans.	1	4	1	3	3	2	1	2	1	4	3	4	2	1	1	1	2	3	3	4
Ques.	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
Ans.	1	2	1	1	3	1	3	4	3	3	4	4	3	4	2	4	1	1	4	2
Ques.	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
Ans.	1	2	3	3	3	2	4	3	1	2	2	4	1	4	2	4	1	1	4	1
Ques.	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
Ans.	2	2	3	2	1	1	2	4	3	3	3	3	3	2	1	2	1	2	1	2
Ques.	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
Ans.	3	2	3	2	3	3	4	1	2	4	2	1	3	3	3	2	1	2	4	4
Ques.	241																			
Ans.	3																			

EXERCISE-II

Q.1 Respiratory Quotient (R.Q) is defined as - **[Uttaranchal 2004]**

(1) vol. of O_2 / vol. of CO_2

(2) vol. of CO_2 / vol. of O_2

(3) vol. of O_2 / vol. of N_2

(4) vol. of N_2 / vol. of CO_2

Q.2 Pyuvic acid is formed during - **[Uttaranchal 2005]**

(1) Krebs cycle

(2) Glycolysis

(3) Ornithine cycle

(4) Calvin cycle

Q.3 The correct sequence of electron acceptor in ATP synthesis - **[Uttaranchal 2005]**

(1) cyt a,a_3 b, c (2) cyt b, c, a, a_3

(3) cyt b, c_3, a, a_3 (4) cyt c, b, a, a_3

Q.4 Which one of the following contains copper besides iron -

(1) Cytochrome-f

(2) Cytochrome oxidase

(3) Platoquinone

(4) Cytochrome-c_1

Q.5 Where does formaton of acetyl Co-A form pyruvic acid take place - **[Uttaranchal 2006]**

(1) Mitochondria (2) Cholroplast

(3) Cytoplasm (4) Golgi body

Q.6 The number of ATP molecules prduced by electron transport system from kreb's cycle intermediates in a single turn is - **[Uttaranchal 2004]**

(1) 11 (2) 14

(3) 12 (4) 16

Q.7 In anaerobic respiration the number of ATP molecules produced are - **[West Bengal 2006]**

(1) 1 (2) 2

(3) 3 (4) 8

Q.8 In which of the following steps of Krebs cycle CO_2 is evolved - **[West Bengal 2007]**

(1) Isocitric acid $\rightarrow$ oxalosuccinic acid

(2) Oxalosuccinic acid $\rightarrow$ α-ketoglutaric acid

(3) succinic acid $\rightarrow$ fumaric acid

(4) malic acid $\rightarrow$ oxaloacetic acid

Q.9 Which of the following enzyme is not used in Krebs' cycle - **[West Bengal 2007]**

(1) Aconitase (2) Decarboxylase

(3) Aldolase (4) Furmarase

Q.10 End produced of fermentation is - **[West Bengal 2007]**

(1) O_2 (2) N_2O

(3) H_2O (4) C_2H_5OH

Q.11 Gluconeogenesis is - **[West Bengal 2007]**

(1) Formation of glucose from other than carbohydrate

(2) Formation of glycogen

(3) Breakdown of glucose

(4) Formation of ammonia from glucose

Q.12 β-oxidation takes place in - **[West Bengal 2007]**

(1) Matrix of mitochondria

(2) Cell cytoplasm

(3) Inter mitochondrial chamber

(4) Ribosomes

Q.13 In TCA cycle the conversion of succinyl co-A to succinic acid requires - **[West Bengal 2007]**

(1) Acetyl Co-A + GTP + ip

(2) Acetyl Co-A + GDP + iP

(3) Co-A + GTP + iP

(4) GDP + iP

Q.14 Yeast is used in the formation of - **[C.G. PMT 2007]**

(1) Ammonia (2) Alcohol

(3) Curd (4) Petrol

Q.15 Fermentation is represented by equation - **[C.G. PMT 2007]**

(1) $C_6H_{12}O_6+6O_2 \rightarrow 6CO_2+6H_2O+673K$ cal
(2) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH+2CO_2$
(3) $6CO_2+ 12H_2O \rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$
(4) $6CO_2+ 6H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2$

Q.16 Which of the following is formed during respiration ? **[C.G. PMT 2004]**

(1) O_2 (Oxygen)
(2) CO_2 (Carbon dioxide)
(3) NO_2 (NItrogen dioxide)
(4) SO_2 (Shulphur dioxide)

Q.17 The pyruvic acid formed in glycolysis is oxidised to CO_2 and H_2O in a cycle called : **[C.G. PMT 2007]**

(1) Calvin cycle
(2) Hill reaction
(3) Krebs cycle
(4) Nitrogen cycle

Q.18 The end product of glycolysis is : **[C.G. PMT 2005]**

(1) Glucose (2) Fructose
(3) Pyruvic acid (4) Ethyl alcohol

Q.19 R.Q. is more than one in case of : **[C.G. PMT 2005]**

(1) Fat (2) Fructose
(3) Glucose (4) Organic acid

Q.20 Total yield in one Kerb cycle : **[C.G. PMT 2006]**

(1) 3 $FADH_2$, 2 $NADH_2$, 1 ATP
(2) 2 $FADH_2$, 2 $NADH_2$, 2 ATP
(3) 2 $NADH_2$, 1 $FADH_2$, 2ATP
(4) 3 $NADH_2$, 1 $FADH_2$, 1 ATP

Q.21 How many ATP will be produced during the production of 1 molecule of Accetyl Co-A from 1 molecule of pyryvic acid ? **[C.G. PMT 2006]**

(1) 3 ATP (2) 5 ATP
(3) 8 ATP (4) 38 ATP

Q.22 Sequence of cytochromes is : **[Jharkhand- 2006]**

(1) cyt. a, b,c, a_3 (2) cyt. b, c, a, a_3
(3) cyt. b, a,,a_3, c (4) cyt. b, c, a_3, a

Q.23 Cytochrome is a : **[Jharkhand- 2006]**

(1) Mg pyrole ring (2) Fe prophyrin ring
(3) Nucleotide (4) Alloy of nichrome

Q.24 Krebs cycle takes place in : **[Jharkhand- 2006]**

(1) mitochondrial matrix
(2) Cytoplasm
(3) Lysosome
(4) Nucleus

Q.25 Cellular respiration occurs in - **[Jharkhand- 2005]**

(1) Chloroplast (2) Golgibodies
(3) Mitochondria (4) Nucleus

Q.26 Maximum amount of energy/ATP is liberated on oxidation of : **[Jharkhand- 2004]**

(1) Fats (2) Proteins
(3) Starch (4) Vitamins

Q.27 More CO_2 is evolved than the volume of oxygen consumed when the respiratory substrate is : **[Jharkhand- 2004]**

(1) Fat (2) Sucrose
(3) Glucose (4) Organic acid

Q.28 Krebs cycle begins with the reaction : **[Jharkhand- 2004]**

(1) Citric acid + Acetyl CO-A
(2) Oxalacetic acid + Pyruvic acid
(3) Oxalacetic acid + Citric acid
(4) Oxaloacetate + Acetyl CO-A

Q.29 Hydrolysis of fat yields : **[Jharkhand- 2004]**

(1) Facts
(2) Fatty acids and glycerol
(3) Mannose and glycerol
(4) Maltose and fatty acid

Q.30 Respiratory quotient of which diet is less than unity ? **[Jharkhand- 2004]**

(1) Carbohydrate (2) Fats

(3) Organic acid (4) Sugar

Q.31 Richest energy compound is : **[Bihar- 2005]**

(1) Creatinine phosphate

(2) Protein

(3) carbohydrate

(4) Fat

Q.32 The stage upto which glycolysis and fermentation is common : **[Bihar- 2005]**

(1) dihydroxy acetone

(2) 3-phosphoglyceraldehyde

(3) pyruvate

(4) glucose-6-phosphate

Q.33 Respiratory quotient of carbohydrate is - **[Bihar- 2005]**

(1) unity (2) greater than unity

(3) less than units (4) equal to five

Q.34 During conversion of pyruvic acid into acetyl Co-A, pyruvic acid is **[Bihar- 2003]**

(1) oxidised (2) reduced

(3) isomerised (4) condensed

Q.35 In Kreb's cycle : **[Bihar- 2003]**

(1) ADP is converted into CO_2

(2) Pyruvic acid is converted into CO_2 and H_2O

(3) Glucose is converted into CO_2

(4) Pyruvic acid is converted into ATP

Q.36 Incomplete breakdown of sugar in anaerobic respiration forms - **[Bihar- 2003]**

(1) glucose and CO_2

(2) alcohol and CO_2

(3) water and CO_2

(4) fructose and water

Q.37 Significance of Kreb's cycle : **[Bihar- 2002]**

(1) Synthesis of ATP

(2) Synthesis of amino acid

(3) Synthesis of chlorphyll

(4) All

Q.38 In plants, respirtion takes place : **[Bihar- 2002]**

(1) During day only

(2) During night only

(3) All the 24 hours

(4) At dusk

Q.39 Glycolysis takes place in : **[Bihar- 2001]**

(1) Cytoplasm (2) Nucleus

(3) Plastid (4) Miltochondria

Q.40 In respiration, largest amount of energy is produced in - **[Bihar- 2006]**

(1) anaerobic respiration

(2) Krebs cycle

(3) glycolysis

(4) none of the above

Q.41 Which of the following is not an intermediate in Krebs cycle ? **[Bihar- 2006]**

(1) Acetic acid

(2) Succinyl coenzyme-A

(3) Malic acid

(4) Citric acid

Q.42 The pyruvic acid acid is formed during : **[UP CPMT- 2001]**

(1) Krebs cycle

(2) glycolysis

(3) ornithine cycle

(4) photophosphorylation

Q.43 The number of ATP molecules gained during aerobic respiration of 1 mole of glucose is : **[UP CPMT- 2001]**

(1) 12 (2) 18

(3) 30 (4) 38

Q.44 Alcoholic fermentation takes place in the presence of : **[UP CPMT- 2001]**

(1) maltase

(2) zymase

(3) amylase

(4) invertase

Q.45 The site of EMP pathway in cell is : **[UP CPMT- 2001]**

(1) peroxisome
(2) cytoplasm
(3) matrix of mitochondria
(4) inner membrane of mitochondria

Q.46 Step of respiration are controlled by : **[UP CPMT- 2002]**

(1) Substrates (2) Enzymes
(3) Hormone (4) Bile juice

Q.47 Enzymes of electron transport system is present in : **[UP CPMT- 2003]**

(1) Inner mitochondrial membrane
(2) Matrix
(3) Intermembranous space
(4) Endoplasmic reticulum

Q.48 Which of the following connects glycolysis to Kreb's cycle ? **[MP PMT 2001,UP CPMT- 2003]**

(1) Acetyl CO-A
(2) Ribozyme
(3) Cytochrome oxidase
(4) N-acetyl glucosamine

Q.49 Pyruvic acid is the end product of **[UP CPMT- 2003]**

(1) Kreb's cycle
(2) Electron transport system
(3) Phtosynthesis
(4) Glycolysis

Q.50 Which of the following accepts terminal electron during aerobic respiration ? **[UP CPMT- 2003]**

(1) Molecular O_2 (2) Molecular H_2
(3) Molecular CO_2 (4) $NADOH_2$

Q.51 Glycolysis occurs in : **[UP CPMT- 2004]**

(1) Cytoplasm (2) Nucleus
(3) Mitochondria (4) Both 'a' and 'c'

Q.52 Which one of the following is the first step of glycolysis ? **[UP CPMT- 2004]**

(1) Breakdown of glucose
(2) Phosphorylation of glucose
(3) Conversion of gloucose into fructose
(4) Dehydrogenation of glucose

Q.53 How many ATP molecules released when 1 molecules of glucose is oxidised in our liver cells ? **[UP CPMT- 2005]**

(1) 36 (2) 38 (3) 2 (4) 8

Q.54 Sequence of food materials consumed during starvation is : **[UP CPMT- 2005]**

(1) Carbohydrate $\rightarrow$ fats $\rightarrow$ protein
(2) Carbohydrate $\rightarrow$ proteins $\rightarrow$ fats
(3) Proteins $\rightarrow$ facts $\rightarrow$ carbohydrate
(4) Fats $\rightarrow$ proteins $\rightarrow$ carbohydrate

Q.55 How many ATPs are produced during glycolysis of one molecule of glucose ? **[UP CPMT- 2006]**

(1) 4 (2) 2 (3) 36 (4) 38

Q.56 Final electron acceptor in ETS is : **[UP CPMT- 2006]**

(1) NAD (2) FAD
(3) Oxygen (4) Hydrogen

Q.57 Respiratory cycle where $NADH_2$ are produced is - **[UP CPMT- 2006]**

(1) Calvin cycle (2) Kreb's cycle
(3) EMP pathway (4) HMP shunt

Q.58 Most of the enzymes which participate in Kreb's cycle are found in : **[MP PMT- 2001]**

(1) Matrix of mitochondria
(2) Inner membrane of mitochondria
(3) Outer membrane of mitochondria
(4) Stroma of chloroplast

Q.59 The connecting link between glycolysis and Krebs cycle is : **[MP PMT- 2001]**

(1) Acetyl CO A (2) CO Q
(3) Conenzyme (4) COA

Q.60 The process of oxidative phosphorylation takes place in : **[MP PMT- 2002]**

(1) Mitochondria (2) Chloroplasts
(3) Ribosomes (4) Cytoplasm

Q.61 Glycolysis is the conversion of : **[MP PMT- 2002]**

(1) Glucose to glycogen
(2) Glycogen to glucose
(3) Glucose to pyruvic acid
(4) Glucose to citric acid

Q.62 Anaerobic respiration takes place in : **[MP PMT- 2002]**
(1) Ribosome (2) Nucleus
(3) Cytoplasm (4) Vacuole

Q.63 Which of the following is the product of glucose fermentation by yeast ? **[MP PMT- 2003]**
(1) $C_6H_{12}O_6$ (2) C_2H_5OH
(3) $(C_6H_{10}O_5)_n$ (4) CH_2OH

Q.64 Fermentation is an : **[MP PMT- 2003]**
(1) Anaerobic respiration
(2) Incomplete oxidation
(3) Excertory process
(4) None of the above

Q.65 Organelles which are regarded as ''Power house of the cell and in which the oxidative reactions of the respiratory process takes place are known as : **[MP PMT- 2004]**
(1) Chloroplast (2) Ribosomes
(3) Mitochondria (4) Endoplasmic reticulum

Q.66 In which of the following, respiration in absence of oxygen also takes place : **[MP PMT- 2004]**
(1) Man (2) Potato
(3) Yeast (4) Spirogya

Q.67 CO_2 is liberated during : **[MP PMT- 2004]**
(1) Ascent of sap (2) Respiration
(3) Photosynthesis (4) Transpiration

Q.68 ATP stands for which of the following - **[MP PMT- 2004]**
(1) Adenine tetraphosphate
(2) Adenine triphosphate
(3) Adenosine diphosphate
(4) Adenosine triphosphate

Q.69 Glycolysis occurs in : **[MP PMT- 2005]**
(1) Vecuoles (2) Nucleolus
(3) Mitochondria (4) Cytoplasm

Q.70 The number of ATP produced during the production of 1 molecule of acetyl CoA from 1 molecule of Pyruvic acid is : **[MP PMT- 2006]**
(1) 3 ATP (2) 8 ATP
(3) 36 ATP (4) 38 ATP

Q.71 The energy produced by one ATP molecule is : **[MP PMT- 2006]**
(1) 7.6 kcal (2) 12 kcal
(3) 20 kcal (4) 100 kcal

Q.72 Which of the following show anaerobic respiration : **[MP PMT- 2006]**
(1) Earthwarm (2) Rabbit
(3) Echinoderms (4) Tapeworms

Q.73 It is belived that the organisms first inhabited earth's sufarce were : **[MP PMT- 2006]**
(1) Autotrophs (2) Mixotrophs
(3) Chemoautotrophs (4) Heterotrophs

Q.74 Pyruvic acid before combining with oxaloacetic acid of Krebs cycle, becomes :
(1) Citric acid (2) Acetoacetic acid
(3) Cis-aconitic acid (4) Acetyl CoA

ANSWER KEY

EXERCISE-II

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	2	2	2	2	1	1	2	2	3	4	1	3	4	2	2	2	3	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	2	2	1	3	1	4	4	2	2	4	3	1	1	2	2	4	3	1	2
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	1	2	4	2	2	2	1	1	4	1	1	2	2	1	2	3	2	1	1	1
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74						
Ans.	3	3	2	2	3	3	2	4	4	1	1	4	4	4						

EXERCISE-III

These questions consist of two statements each, printed as Assertion and Reason. While answering these Questions are required to choose any one of the following four responses.

(1) **If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.**

(2) **If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.**

(3) **If Assertion is True but the Reason is False.**

(4) **If both Assertion & Reason are false.**

Q.1 **Assertion :-** In the process of alcoholic fermentation, the hexose molecule is converted in starch.

Reason:- Alcoholic fermentation is aerobic.

Q.2 **Assertion :-** Respiration occurs both in prokaryotic & eukaryotic cells.

Reason:- In eukaryotic cells respiration in only aerobic.

Q.3 **Assertion :-** Pentose phosphate pathway is also known as cytosolic decarboxylation.

Reason:- All the carbon dioxide is released in cytosal during this pathway.

Q.4 **Assertion :-** Aerobic (oxygenated) atmosphere on earth is maintained due to the action of photosynthetic organisms

Reason:- Cyanobacteria are non oxygenic form of plants

Q.5 **Assertion :-** Value of R.Q. is more than one during the germination of fatty seeds.

Reason:- More CO_2 liberated than absorbed O_2 in fat-oxidation.

Q.6 **Assertion :-** Enzymes of Krebs cycle are endo enzymes.

Reason:- All the enzymes of Kreb's cycle function inside the cell

Q.7 **Assertion :-** Kerbs cycle is called as amphibolic pathway of respiration

Reason:- Krebs cycle takes place in cytosol

Q.8 **Assertion :-** Pyruvic acid can not enter in mitochondria

Reason:- Pyruvic acid is 4-Carbon compund.

Q.9 **Assertion :-** Fermentation is an incomplete oxidation of substrate outside the cell.

Reason:- In Alocholic fermentation the hexose converts in to glucose & fructose

Q.10 **Assertion :-** Glyoxilate cycle is an example of gluconeogenesis.

Reason:- Glyoxilate cycle operates in stroma of chloroplast.

Q.11 **Assertion :-** Only 2 molecules of ATP generates in anaerobic respiration

Reason:- Anaerobic respiration is incomplete oxidation of respiratory substrate

Q.12 **Assertion :-** 4-carbon intermediate of Kreb's-cycle is **Erythrose**-P

Reason:- Kreb's-cycle occurs in night

Q.13 **Assertion :-** Lactic acid is produced anaerobically in human muscles

Reason:- The reaction is catalysed by lactobacillus

Q.14 **Assertion :-** Anaerobic respiration gives only 2 ATP.

Reason:- Only one $FADH_2$ reacts at ETS in anaerbic respiration

Q.15 **Assertion :-** Glycolysis is also known as oxidative anabolism.

Reason:- Glucose splits during this and some intermediates involve in anabolism

Q.16 **Assertion :-** Anaerobic respiration occurs only in fungi.

Reason:- Fungi are green plants.

Q.17 **Assertion :-** HMP-shunt is alternate of Glucose oxidation.

Reason:- This take place in cytoplasm.

Q.18 **Assertion :-** Kreb-cycle is called as TCA-cycle.

Reason:- First formed compound of Krebs cycle is tri carboxylic acid.

Q.19 **Assertion :-** Respiration is a vital process.

Reason:- Respiration is characteristic of only living cells.

Q.20 **Assertion :-** Glycolysis is common step in aerobic & anaerobic respiration.

Reason:- Glycolysis splits the pyruvate in to H_2O & CO_2

Q.21 **Assertion :-** HMP shunt is also known as Reductive pentose phosphate pathway.

Reason:- Reduction of pentose sugar ribulose occurs during HMP shunt.

Q.22 **Assertion :-** Succinyl CoA is the precursor of most pf porphyrin ring containing compounds

Reason:- Chlorophyll is synthesised from succinyl Co-A.

Q.23 **Assertion :-** Reduction of NAD in glycolysis is energy conserving step.

Reason:- Energy neither be created nor be destroyed.

Q.24 **Assertion :-** Glycolysis is common between aerobic & anaerobic respiration.

Reason:- Glycolysis can takes place in presence and absence of O_2

Q.25 **Assertion :-** Lactobacillus Perfoms fermentation

Reason:- Lactobacillus is an anaerobic bacteria

Q.26 **Assertion :-** Oxidative decarboxylation occurs in mitochondria.

Reason:- Link reaction and Kreb's cycle occurs in mitochondria.

Q.27 **Assertion :-** Formation of Acetyl CoA in mitochondria is known as link reaction.

Reason:- Acetyl CoA is a compound which links the glycolysis & TCA-cycle

Q.28 **Assertion :-** HMP shunt is known as oxidative decarbroxylation.

Reason:- HMP shunt involves removal of H^+/e and CO_2

ANSWER KEY

EXERCISE-III

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	4	3	1	3	4	1	3	4	3	3	1	4	3	3	1	4	2	1	1	3
Ques.	21	22	23	24	25	26	27	28												
Ans.	4	2	2	1	2	1	1	1												