Exercise-1

Marked Questions may have for Revision Questions.

PART - I : ONLY ONE OPTION CORRECT TYPE

Section (A) : Gas Laws

1. At constant temperature, in a given mass of an ideal gas
(1) The ratio of pressure and volume always remains constant
(2) Volume always remains constant
(3) Pressure always remains constant
(4) The product of pressure and volume always remains constant

2. Air at sea level is dense. This is a practical application of
(1) Boyle's law (2) Charle's law (3) Avogadro's law (4) Dalton's law

3. If 20 cm^3 gas at 1 atm. is expanded to 50 cm^3 at constant T, then what is the final pressure
(1) $20\times\frac{1}{50}$ (2) $50\times\frac{1}{20}$ (3) $1\times\frac{1}{20}\times 50$ (4) None of these

4. If the pressure and absolute temperature of 2 litres of CO_2 are doubled, the volume of CO_2 would become
(1) 2 litres (2) 4 litres (3) 5 litres (4) 7 litres

5. In the equation of sate of an ideal gas $PV = nRT$, the value of the universal gas constant would depend only on
(1) The nature of the gas (2) The pressure of the gas
(3) The units of the measurement (4) None of these

6. In the equation PV = nRT, which one cannot be the numerical value of *R*
(1) $8.31\times 10^7\, erg\, K^{-1} mol^{-1}$ (2) $8.31\times 10^7\, dyne\, cm\, K^{-1} mol^{-1}$
(3) $8.31\, JK^{-1} mol^{-1}$ (4) $8.31\, atm.K^{-1} mol^{-1}$

7. A sample of gas occupies 100 ml at 27°C and 740 mm pressure. When its volume is changed to 80 ml at 740 mm pressure, the temperature of the gas will be
(1) 21.6 °C (2) 240 °C (3) – 33°C (4) 89.5 °C

8. At 0°C and one atm pressure, a gas occupies 100 cc. If the pressure is increased to one and a half-time and temperature is increased by one-third of absolute temperature, then final volume of the gas will be
(1) 80 cc (2) 88.9 cc (3) 66.7 cc (4) 100 cc

9. A pre-weighed vessel was filled with oxygen at N.T.P. and weighted. It was then evacuated, filled with SO_2 at the same temperature and pressure, and again weighted. The weight of oxygen will be
(1) The same as that of SO_2 (2) 1/2 that of SO_2
(3) Twice that of SO_2 (4) One fourth that of SO_2

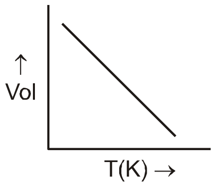
10. Kinetic energy of molecules is highest in :
(1) Gases (2) Solids (3) Liquids (4) Solution

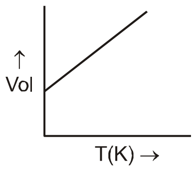
11. The maximum number of molecules is present in
(1) 0.5 g of H_2 gas (2) 10 g of O_2 gas
(3) 15 L of H_2 gas at STP (4) 5 L of N_2 gas at STP

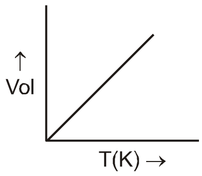
12. The pressure and temperature of 4 dm^3 of carbon dioxide gas are doubled. Then the volume of carbon dioxide gas would be
(1) $2dm^3$ (2) $3dm^3$ (3) $4dm^3$ (4) $8dm^3$

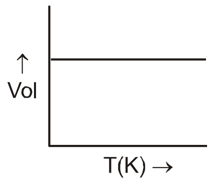
13. A gas at 298 K is shifted from a vessel of 250 cm^3 capacity to that of 1 L capacity. The pressure of the gas will:
(1) become double (2) becomes four times
(3) decrease to half of the original value (4) decrease to one-fourth of the original value

14. The correct representation of Charles' law is given by :Z

(1) 

(2) 

(3) 

(4) 

15. There are 6.02×10^{22} molecules each of N_2,O_2 and H_2 which are mixed together at 760 *mm* and 273 *K*. The mass of the mixture in grams is
(1) 6.2 (2) 4.12 (3) 3.09 (4) 7

16. A bottle of cold drink contains 200 *ml* liquid in which CO_2 is 0.1 molar. Suppose CO_2 behaves like an ideal gas, the volume of the dissolved CO_2 at STP is
(1) 0.224 litre (2) 0.448 litre (3) 22.4 litre (4) 2.24 litre

17. Five grams each of the following gases at 87^oC and 750 *mm* pressure are taken. Which of them will have the least volume
(1) HF (2) HCl (3) HBr (4) HI

18. A certain sample of gas has a volume of 0.2 *litre* measured at 1 *atm*. pressure and 0^oC. At the same pressure but at 273^oC, its volume will be
(1) 0.4 *litres* (2) 0.8 *litres* (3) 27.8 *litres* (4) 55.6 *litres*

19. The constant *R* is
(1) Work done per molecule (2) Work done per degree absolute
(3) Work done per kalvin per mole (4) Work done per mole

20. If two moles of an ideal gas at 546 *K* occupy a volume of 44.8 *litres*, the pressure must be
(1) 2 *atm* (2) 3 *atm* (3) 4 *atm* (4) 1 *atm*

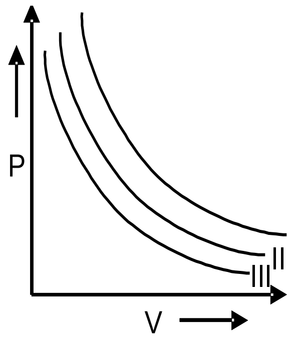
21. How many moles of *He* gas occupy 22.4 *litres* at 30^oC and one atmospheric pressure
(1) 0.90 (2) 1.11 (3) 0.11 (4) 1.0

22. Pure hydrogen sulphide is stored in a tank of 100 *litre* capacity at 20ºC and 2 *atm* pressure. The mass of the gas will be
(1) 34 *g* (2) 340 *g* (3) 282.4 *g* (4) 28.24 *g*

23. One *litre* of a gas weighs 2 *g* at 300 *K* and 1 *atm* pressure. If the pressure is made 0.75 *atm*, at which of the following temperatures will one *litre* of the same gas weigh one *gram*
(1) 450 *K* (2) 600 *K* (3) 800 *K* (4) 900 *K*

24. The density of a gas at 27ºC and 1 *atm* is *d*. Pressure remaining constant at which of the following temperatures will its density become 0.75 d
(1) 20ºC (2) 30ºC (3) 400 *K* (4) 300 *K*

25. I, II, III are three isotherms respectively at T_1, T_2, T_3. Temperature will be in order



(1) $T_1 = T_2 = T_3$ (2) $T_1 < T_2 < T_3$ (3) $T_1 > T_2 > T_3$ (4) $T_1 > T_2 = T_3$

26. The density of neon will be highest at
(1) STP (2) 0ºC and 2 atm (3) 273ºC and 1 atm (4) 273ºC and 2 atm

27. The volume of a gas measured at 27°C and 1 atm pressure is 10 L. To reduce the volume to 2 L at 1 atm pressure, the temperature required is :
(1) 60 K (2) 75 K (3) 150 K (4) 225 K

28. The pressure and temperature of 4 dm^3 of carbon dioxide gas are doubled. Then volume of carbon dioxide gas would be :
(1) 2 dm^2 (2) 3 dm^3 (3) 4 dm^3 (4) 8 dm^3

29. The density of a gas is 1.964 g dm^{-3} at 273 K and 76 cm Hg. The gas is :
(1) CH_4 (2) C_2H_6 (3) CO_2 (4) Xe

30. By the ideal gas law, the pressure of 0.60 mole NH_3 gas is a 3.00 L vessel at 25°C is :
(1) 48.9 atm (2) 4.89 atm (3) 0.489 atm (4) 489 atm

Section (B) : Daltons law of partial pressure

1. The total pressure exerted by a number of non-reacting gases is equal to the sum of the partial pressures of the gases under the same conditions is known as
(1) Boyle's law (2) Charle's law (3) Avogadro's law (4) Dalton's law

2. A cylinder is filled with a gaseous mixture containing equal masses of CO and N_2. The partial pressure ratio is :
(1) $P_{N_2} = P_{CO}$ (2) $P_{CO} = 0.875\ P_{N_2}$ (3) $P_{CO} = 2\ P_{N_2}$ (4) $P_{CO} = ½\ P_{N_2}$

3. Equal volumes of two gases which do not react together are enclosed in separate vessel. Their pressure at 100 mm and 400 mm respectively. If the two vessel are joined together, then what will be the pressure of the resulting mixture (temperature remaining constant) ?
(1) 125 mm (2) 500 mm (3) 1000 mm (4) 250 mm

4. A gaseous mixture contains 56 g of N_2, 44 g CO_2 and 16 g of CH_4. The total pressure of the mixture is 720 mm Hg. The partial pressure of CH_4 is
(1) 180 mm (2) 360 mm (3) 540 mm (4) 720 mm

5. Equal weights of ethane and hydrogen are mixed in an empty container at 25°C. The fraction of the total pressure exerted by hydrogen is :
(1) 1 : 2 (2) 1 : 1 (3) 1 : 16 (4) 15 : 16

6. a sample of O_2 gas is collected over water at 23°C at a barometric pressure of 751 mm Hg (vapour pressure of water at 23°C is 21 mm Hg). The partial pressure of O_2 gas in the sample collected is
(1) 21 mm Hg (2) 751 mm Hg (3) 0.96 atm (4) 1.02 atm

Section (C) : Grahams Law of diffusion

1. If 4 g of oxygen diffuse through a very narrow hole, how much hydrogen would have diffused under identical conditions ?
(1) 16 g (2) 1 g (3) 1/4 g (4) 64 g

2. Two gram of hydrogen diffuse from a container in 10 minutes. How many grams of oxygen would diffuse through the same container in the same time under similar conditions ?
(1) 0.5 g (2) 4 g (3) 6 g (4) 8 g

3. The ratio of the rate of diffusion of a given element to that of helium is 1 : 4. The molecular weight of the element is
(1) 32 (2) 64 (3) 16 (4) None of these

4. The molecular weight of a gas which diffuse through a porous plug at 1/6th of the speed of hydrogen under identical conditions is
(1) 27 (2) 72 (3) 36 (4) 48

5. The time taken for a certain volume of a gas 'X' to diffuse through a small hole is 2 minutes. It takes 5.65 minutes for oxygen to diffuse under the similar conditions. The molecular weight of 'X' is
(1) 8 (2) 4 (3) 16 (4) 32

6. The ratio of rates of diffusion of SO_2, O_2 and CH_4 is :
(1) $1 : \sqrt{2} : 2$ (2) 1 : 2 : 4 (3) $1 : \sqrt{2} : 1$ (4) $1 : 2 : \sqrt{2}$

7. If the four tubes of a car are filled to the same pressure with N_2, O_2, H_2 and *Ne* separately, then which one will be filled first

(1) N_2 (2) O_2 (3) H_2 (4) *Ne*

8. The densities of hydrogen and oxygen are 0.09 and 1.44 g L^{-1}. If the rate of diffusion of hydrogen is 1 then that of oxygen in the same units will be :

(1) 4 (2) 1/4 (3) 16 (4) 1/16

9. The densities of two gases are in the ratio of 1 : 16. The ratio of their rates of diffusion is

(1) 16 : 1 (2) 4 : 1 (3) 1 : 4 (4) 1 : 16

10. Rate of diffusion of a gas is

(1) Directly proportional to its density
(2) Directly proportional to its molecular mass
(3) Directly proportional to the square root of its molecular mass
(4) Inversely proportional to the square root of its molecular mass

11. At constant temperature and pressure which gas will diffuse first H_2 or O_2?

(1) Hydrogen (2) Oxygen
(3) Both will diffuse in same time (4) None of the above

12. X ml of H_2 gas effuses through a hole in a container in 5 sec. The time taken for the effusion of the same volume of the gas specified below under identical conditions is :

(1) 10 sec. He (2) 20 sec. O_2 (3) 25 sec. CO_2 (4) 55 sec. CO_2

Section (D) : Kinetic theory of gases

1. The ratio of root mean square velocity to average velocity of gas molecules at a particular temperature is

(1) 1.086 : 1 (2) 1 : 1.086 (3) 2 : 1.086 (4) 1.086 : 2

2. Which of the following is valid at absolute zero temperature ?

(1) Kinetic energy of the gas becomes zero but the molecuar motion does not become zero
(2) Kinetic energy of the gas becomes zero and the molecular motion also becomes zero
(3) Kinetic energy of the gas decreases but does not become zero
(4) None of the above

3. If a gas is expanded at constant tempertaure

(1) the pressure increase
(2) the kinetic energy of the molecules remains the same
(3) the kinetic energy of the molecules decrease
(4) the number of molecules of the gas increases

4. At the same temperature and pressure, which of the following gases will have the highest kinetic energy per mole ?

(1) Hydrogen (2) Oxygen (3) Methane (4) All the same

5. The ratio amongs most probable velocity, mean velocity and root mean square velocity is given by
(1) 1 : 2 : 3 (2) 1 : $\sqrt{2}$: $\sqrt{3}$ (3) $\sqrt{2}$: $\sqrt{3}$: $\sqrt{8/\pi}$ (4) $\sqrt{2}$: $\sqrt{8/\pi}$: $\sqrt{3}$

6. The root mean square speeds at STP for the gases H_2, N_2, O_2 and HBr are in the order :
(1) $H_2 < N_2 < O_2 <$ HBr (2) HBr $< O_2 < N_2 < H_2$ (3) $H_2 < N_2 = O_2 <$ HBr (4) HBr $< O_2 < H_2 < N_2$

7. Which is not true in case of an ideal gas
(1) It cannot be converted into a liquid
(2) There is no interaction between the molecules
(3) All molecules of the gas move with same speed
(4) At a given temperature, *PV* is proportional to the amount of the gas

8. The r.m.s. velocity of a certain gas is υ at 300 K. The temperature, at which the r.m.s. velocity becomes double
(1) 1200 K (2) 900 K (3) 600 K (4) 150 K

9. The kinetic energy of N molecules of O_2 is x joule at – 123ºC. Another sample of O_2 at 27ºC has a kinetic energy of 2 x. The latter sample contains _______ molecules of O_2
(1) N (2) N/2 (3) 2 N (4) 3 N

10. The kinetic energy for 14 grams of nitrogen gas at 127°C is nearly (mol. mass of nitrogen = 28 and gas constant = 8.31 JK^{-1} mol^{-1})
(1) 1.0 J (2) 4.15 J (3) 2494 J (4) 3.3 J

11. The density of a gas *A* is three times at equal temperature, pressure that of a gas *B*. if the molecular mass of *A* is *M*, the molecular mass of *B* is
(1) 3 *M* (2) $\sqrt{3}\,M$ (3) $M/3$ (4) $M/\sqrt{3}$

12. Kinetic energy and pressure of a gas per unit volume are related as
(1) $P=\frac{2}{3}$K.E (2) $P=\frac{3}{2}$K.E (3) $P=\frac{1}{2}$K.E (4) P = 2 K.E

13. Helium atom is two times heavier than a hydrogen molecule at 298 *K*, the average kinetic energy of helium is
(1) Two times that of a hydrogen molecule (2) Same as that of a hydrogen molecule
(3) Four times that of a hydrogen molecule (4) Half that of a hydrogen molecule

14. At 27ºC, the ratio of *rms* velocities of ozone to oxygen is
(1) $\sqrt{3/5}$ (2) $\sqrt{4/3}$ (3) $\sqrt{2/3}$ (4) 0.25

Section (E) : Real gases

1. The values of Vander Waals constant "a" for the gases O_2, N_2, NH_3 & CH_4 are 1.36, 1.39, 4.17, 2.253 L^2 atm $mole^{-2}$ respectively. The gas which can most easily be liquified is:
(1) O_2 (2) N_2 (3) NH_3 (4) CH_4

2. The pressure of real gases is less than that of ideal gas because of
(1) increase in the number of collisions (2) finite size of particles
(3) intermolecular attraction (4) increase in kinetic energy of the molecules

3. At lower temperature, mostely gases show
(1) negative deviation (2) positive deviation
(3) positive and negative deviation (4) None

4. The Vander Waal's equation explains the behaviour of
(1) Ideal gases (2) Real gases (3) Vapour (4) Non-real gases

5. Any gas shows maximum deviation from ideal gas at
(1) 0ºC and 1 atmospheric pressure (2) 100ºC and 2 atmospheric pressure
(3) –100ºC and 5 atmospheric pressure (4) 500ºC and 1 atmospheric pressure

6. A gas is said to behave like an ideal gas when the relation $PV/T = \text{constant}$. When do you expect a real gas to behave like an ideal gas
(1) When the temperature is low
(2) When both the temperature and pressure are low
(3) When both the temperature and pressure are high
(4) When the temperature is high and pressure is low

7. The units of the van der Waal's constant 'b' are
(1) atmosphere (2) joules (3) L mol^{-1} (4) mol L^{-1}

8. For the non-zero values of force of attraction between gas molecules, gas equation will be :
(1) $PV = nRT - \frac{n^2a}{V}$ (2) PV = nRT + nbP (3) PV = nRT (4) $P = \frac{nRT}{V-b}$

9. At low pressures, the van der Waal's equation is written as :
$$\left[p + \frac{a}{V^2}\right] V = RT$$
The compressibility factor is then equal to:
(1) $\left(1 - \frac{a}{RTV}\right)$ (2) $\left(1 - \frac{RTV}{a}\right)$ (3) $\left(1 + \frac{a}{RTV}\right)$ (4) $\left(1 + \frac{RTV}{a}\right)$

10. Gases deviate from the ideal gas behaviour because their molecules
(1) possess negligible volume (2) have forces of attraction between them
(3) are polyatomic (4) are not attracted to one another

11. A real gas most closely approaches the behaviour of an ideal gas at
(1) 15 atm and 200 K (2) 1 atm and 273 K (3) 0.5 atm and 500 K (4) 15 atm and 500 K

12. A gas can be liquiefied :
(1) above its critical temperature (2) at its critical temperature

(3) below its critical temperature (4) at any temperature

13. Vander Waal's constants '*a*' and '*b*' are related with..... respectively
(1) Attractive force and bond energy of molecules (2) Volume and repulsive force of molecules
(3) Shape and repulsive forces of molecules (4) Attractive force and volume of the molecules

14. The temperature at which real gases obey the ideal gas laws over a wide range of pressure is called
(1) Critical temperature (2) Boyle temperature
(3) Inversion temperature (4) Reduced temperature

15. At high temperature and low pressure, the Vander Waal's equation is reduced to
(1) $\left(p+\frac{a}{V_m^2}\right)(V_m)=RT$ (2) $pV_m=RT$ (3) $p(V_m-b)=RT$ (4) $\left(p+\frac{a}{V_m^2}\right)(V_m-b)=RT$

16. If for the gases, the critical temperature mentioned below i.e.,

Gas	Critical temp.
A	T_{C_1}
B	T_{C_2}
C	T_{C_3}
D	T_{C_4}

$T_{C_1} > T_{C_2} > T_{C_3} > T_{C_4}$
Which of the following can be predicted ?
(1) Ease of liquefaction is minimum in gas D
(2) Gas A has maximum value of van der Waal's constant 'a'
(3) Ease of liquefaction is directly proportional to van der Waal's constant 'a'
(4) All of these

Exercise-2

Marked Questions may have for Revision Questions.

1. Densities of two gases are with equal mass in the ratio 1 : 2 and their temperatures are in the ratio 2 : 1, then the ratio of their respective pressures is
(1) 1 : 1 (2) 1 : 2 (3) 2 : 1 (4) 4 : 1

2. Gas equation $PV=nRT$ is obeyed by
(1) Only isothermal process (2) Only isobaric process
(3) Both (1) and (2) (4) None of these

3. Two separate bulbs contain ideal gases *A* and *B*. The density of gas *A* is twice that of gas *B*. The molecular mass of *A* is half that of gas *B*. The two gases are at the same temperature. The ratio of the pressure of *A* to that of gas *B* is
(1) 2 (2) 1/2 (3) 4 (4) 1/4

4. A wheather balloon filled with hydrogen at 1 *atm* and 27^oC has volume equal to 12000 *litres*. On ascending it reaches a place where the temperature is –23° C and pressure is 0.5 *atm*. The volume of the balloon is
(1) 24000 *litres* (2) 20000 *litres* (3) 10000 *litres* (4) 12000 *litres*

5. Under what conditions will a pure sample of an ideal gas not only exhibit a pressure of 1 *atm* but also a concentration of 1 *mole* litre^{-1} $R = 0.082 \text{L atm mol}^{-1} K^{-1}$
(1) At STP (2) When $V = 22.4$ *litres*
(3) When $T = 12\,K$ (4) Impossible under any conditions

6. A gas is found to have a formula $[CO]_x$. If its vapour density is 70, the value of x is
(1) 2.5 (2) 3.0 (3) 5.0 (4) 6.0

7. The molecular weight of O_2 and SO_2 are 32 and 64 respectively. If one *litre* of O_2 at 15ºC and 750 *mm* pressure contains '*N*' molecules, the number of molecules in two *litres* of SO_2 under the same conditions of temperature and pressure will be
(1) N/2 (2) N (3) 2N (4) 4N

8. What will be the partial pressure of H_2 in a flask containing 2g of H_2, 14 g of N_2 and 16 g of O_2 :
(1) 1/2 the total pressure (2) 1/3 the total pressure
(3) 1/4 the total pressure (4) 1/16 the total pressure

9. Equal amounts of two gases of molecular weight 4 and 40 are mixed. The pressure of the mixture is 1.1 *atm.* The partial pressure of the light gas in this mixture is
(1) 0.55 atm (2) 0.11 atm (3) 1 atm (4) 0.12 atm

10. Three footballs are respectively filled with nitrogen, hydrogen and helium. If the leaking of the gas occurs with time from the filling hole, then the ratio of the rate of leaking of gases ($r_{N_2} : r_{H_2} : r_{He}$) from three footballs (in equal time interval) is
(1) $\left(1:\sqrt{14} : \sqrt{7}\right)$ (2) $\left(\sqrt{14} : \sqrt{7}:1\right)$ (3) $\left(\sqrt{7}:1 : \sqrt{14}\right)$ (4) $\left(1:\sqrt{7} : \sqrt{14}\right)$

11. Which of the following pairs will diffuse at the same rate through a porous plug
(1) CO, NO_2 (2) NO_2, CO_2 (3) NH_3, PH_3 (4) NO, C_2H_6

12. Which of the following statement is false
(1) The product of pressure and volume of fixed amount of a gas is independent of temperature
(2) Molecules of different gases have the same K.E. at a given temperature
(3) The ideal gas equation is not valid at high pressure and low temperature
(4) The gas constant per molecule is known as Boltzmann constant

13. If $C_1, C_2, C_3......$ represent the speeds of $n_1, n_2, n_3.....$ molecules, then the root mean square speed is

(1) $\left(\dfrac{n_1C_1^2 + n_2C_2^2 + n_3C_3^2 + ...}{n_1 + n_2 + n_3 + ...}\right)^{1/2}$ (2) $\dfrac{(n_1C_1^2 + n_2C_2^2 + n_3C_3^2 + ...)^{1/2}}{n_1 + n_2 + n_3 + ...}$

(3) $\dfrac{(n_1C_1^2)^{1/2}}{n_1} + \dfrac{(n_2C_2^2)^{1/2}}{n_2} + \dfrac{(n_3C_3^2)^{1/2}}{n_3} + ...$ (4) $\left[\dfrac{(n_1C_1 + n_2C_2 + n_3C_3 + ...)^2}{(n_1 + n_2 + n_3 + ...)}\right]^{1/2}$

14. 50 *ml* of hydrogen diffuses out through a small hole from a vessel in 20 *minutes*. The time needed for 40 *ml* of oxygen to diffuse out is

(1) 12 *min* (2) 64 *min* (3) 8 *min* (4) 32 *min*

15. Molecular velocities of the two gases at the same temperature are u_1 and u_2. Their masses are m_1 and m_2 respectively. Which of the following expression is correct ?

(1) $\frac{m_1}{u_1^2} = \frac{m_2}{u_2^2}$ (2) $m_1u_1 = m_2u_2$ (3) $\frac{m_1}{u_1} = \frac{m_2}{u_2}$ (4) $m_1\ u_1^2 = m_2\ u_2^2$

16. At what temperature the RMS velocity of SO_2 be same as that of O_2 at 303 K ?

(1) 273 K (2) 606 K (3) 303 K (4) 403 K

17. In a closed flask of 5 *litres*, 1.0 *g* of H_2 is heated from 300 to 600 *K*. which statement is not correct.

(1) Pressure of the gas increases (2) The rate of collision increases

(3) The number of moles of gas increases (4) The energy of gaseous molecules increases

18. The root mean square velocity of an ideal gas in a closed container of fixed volume is increased from $5 \times 10^4\ cm\,s^{-1}$ to $10 \times 10^4\ cm\,s^{-1}$. Which of the following statement correctly explains how the change is accomplished.

(1) By heating the gas, the temperature is doubled

(2) By heating the gas, the pressure is quadrupled (*i.e.* made four times)

(3) By heating the gas, the volume is one fourth quadrupled

(4) By heating the gas, the pressure is doubled

19. The *rms* speed of N_2 molecules in a gas is *u*. If the temperature is doubled and the nitrogen molecules dissociate into nitrogen atoms, the *rms* speed becomes

(1) $u/2$ (2) 2*u* (3) 4*u* (4) 14*u*

20. If the v_{rms} is $30R^{1/2}$ at 27ºC then calculate the molar mass of gas in kilogram.

(*1) 1 (2) 2 (3) 4 (4) 0.001

21. The temperature at which real gases obey the ideal gas law over a wide range of pressure is called

(1) Critical temperature (2) Boyle temperature

(3) Inversion temperature (4) Reduced temperature

22. An ideal gas can't be liquefied because

(1) its critical temperature is always above 0°C

(2) its molecules are relatively smaller in size

(3) it solidifies before becoming a liquid

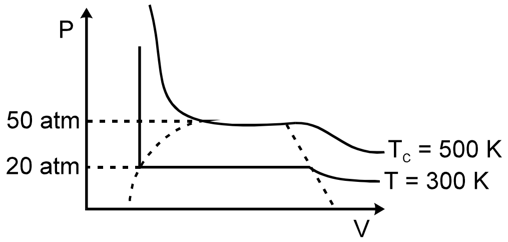
(4) forces operative between its molecules are negligible

23. When is deviation more in the behaviour of a gas from the ideal gas equation PV = nRT ?

(1) At high temperature and low pressure (2) At low temperature and high pressure

(3) At high temperature and high pressure (4) At low temperature and low high pressure

24. For a real gas the P-V curve was experimentally plotted, and it had the following appearance. With respect to liquefaction. Choose the ***correct*** statement.



(1) at T = 500 K, P = 40 atm, the state will be liquid.
(2) at T = 300 K, P = 50 atm, the state will be gas
(3) at T < 300 K, P > 20 atm, the state will be gas
(4) at 300 K < T < 500 K, P > 50 atm, the state will be liquid.

25. The van der Waal's parameters for gases W,X,Y and Z are

Gas	$a(\text{atm L}^2 \text{mol}^{-2})$	$b(\text{L mol}^{-1})$
W	4.0	0.027
X	8.0	0.030
Y	6.0	0.032
Z	12.0	0.027

Which one of these gases has the highest critical temperature ?
(1) W (2) X (3) Y (4) Z

26. An ideal gas obeying kinetic theory of gases can be liquefied if
(1) Its temperature is more than critical temperature T_C
(2) Its pressure is more than critical pressure P_C
(3) Its pressure is more than P_C at a temperature less than T_C
(4) It cannot be liquefied at any value of P and T

27. At high temperature and low pressure van der Waal's equation can be expressed as
(1) $\left(P+\frac{a}{V^2}\right)(V-b)=RT$ (2) $\left(P+\frac{a}{V^2}\right)V=RT$
(3) P (V – b) = RT (4) PV = RT

28. At constant volume, pressure and temperature are related as (T_0 = STP temp.)
(1) $P_t = P_0\left(1+\frac{t}{273}\right)(t={}^\circ C)$ (2) $P_t = P_0\frac{T_0}{T}$ (T = in K)
(3) $P_0 = P_t\left(\frac{273+t}{273}\right)$ (4) All of these

29. The slope of the graph between log P and log V at constant temperature for a given mass of a gas is
(1) +1 (2) –1 (3) $\frac{1}{T}$ (4) $\frac{1}{n}$

30. The compressibility of a gas is less than unity at S.T.P. therefore,
(1) V_m > 22.4 litres (2) V_m < 22.4 litres (3) V_m = 22.4 litres (4) V_m = 44.8 litres

31. The rms velocity of hydrogen is $\sqrt{7}$ times the rms velocity of nitrogen. If T is the temperature of the gas, then
(1) $T_{(H_2)} = T_{(N_2)}$ (2) $T_{(H_2)} > T_{(N_2)}$ (3) $T_{(H_2)} < T_{(N_2)}$ (4) $T_{(H_2)} = \sqrt{7}\ T_{(N_2)}$

32. At 100°C and 1 atm, if the density of liquid water is 1.0 g cm^{-3} and that of water vapour is 0.0006 g cm^{-3}, that the volume occupied by water molecules in 1 liter of st eam at that temperature is :
(1) 6 cm^3 (2) 60 cm^3 (3) 0.6 cm^3 (4) 0.06 cm^3

33. The term that corrects for the attractive forces present in a real gas in the vander Waals equation is
(1) nb (2) $\frac{an^2}{V^2}$ (3) $-\frac{an^2}{V^2}$ (4) –nb

Exercise-3

PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. At 25ºC and 730 mm pressure, 380 mL of dry oxygen was collected. If the temperature is constant, what volume will the oxygen occupy at 760 mm pressure ? **[AIPMT 1999]**
(1) 365 mL (2) 300 mL (3) 400 mL (4) 350 mL

2. Which one of the following statements is wrong for gases ? **[AIPMT 1999]**
(1) Gases do not have definite shape and volume.
(2) Volume of the gas is equal to volume of container confining the gas.
(3) Confined gas exerts uniform pressure on the walls of its container in all directions.
(4) Mass of gas cannot be determined by weighing a container in which it is enclosed.

3. Which of the following expression correctly represents the relationship between the average molar kinetic energy, $\overline{KE}$ of CO and N_2 molecules at the same temperature ? **[AIPMT 2000]**
(1) $\overline{KE}_{CO} < \overline{KE}_{N_2}$ (2) $\overline{KE}_{CO} > \overline{KE}_{N_2}$ (3) $\overline{KE}_{CO} = \overline{KE}_{N_2}$
(4) Cannot be predicted unless volumes of the gases are given.

4. The rate of diffusion of a gas having molecular weight just double of nitrogen gas is 56 ml s^{-1}. The rate of diffusion of nitrogen will be : **[AIPMT 2000]**
(1) 79.19 ml s^{-1} (2) 112.0 ml s^{-1} (3) 56 ml s^{-1} (4) 90.0 ml s^{-1}

5. The beans are cooked earlier in pressure cooker, because : **[AIPMT 2001]**
(1) b.p. increases with increaing pressure
(2) b.p. decreases with increaing pressure
(3) extra pressure of pressure cooker, softens the beans
(4) internal energy is not lost while cooking in pressure cooker

6. Vander Waal's real gas, act as an ideal gas, at which condition ? **[AIPMT 2002]**

(1) High temperature, low pressure
(2) Low temperature, high pressure
(3) High temperature, high pressure
(4) Low temperature, low pressure

7. The surface tension of which of the following liquids is maximum ? **[AIPMT 2005]**
(1) H_2O (2) C_6H_6 (3) CH_3OH (4) C_2H_5OH

8. If a gas expands at constant temperature, it indicates that : **[AIPMT 2008]**
(1) kinetic energy of molecules decreases.
(2) pressure of the gas increases.
(3) kinetic energy of molecules remains the same.
(4) number of the molecules of gas increases.

9. 50 mL of each gas A and of gas B takes 150 and 200 seconds respectively for effusing through a pin hole under the similar condition. If molecular mass of gas A is 36, the molecular mass of gas B will be : **[AIPMT 2012]**
(1) 96 (2) 128 (3) 32 (4) 64

10. A certain gas takes three times as long to effuse out as helium. Its molecular mass will be : **[AIPMT 2012]**
(1) 27 u (2) 36 u (3) 64 u (4) 9 u

11. For real gases van der Waals equation is written as **[AIPMT 2012]**

$$\left(p+\frac{an^2}{V^2}\right)(V - nb) = n RT$$

where 'a' and 'b' are van der Waals constants.
Two sets of gases are :
(I) O_2, CO_2, H_2 and He (II) CH_4, O_2 and H_2
The gases given in set-I in increasing order of 'b' and gases given in set-II in decreasing order of 'a', are arranged below. Select the correct order from the following :
(1) (I) $He < H_2 < CO_2 < O_2$ (II) $CH_4 > H_2 > O_2$
(2) (I) $O_2 < He < H_2 < CO_2$ (II) $H_2 > O_2 > CH_4$
(3) (I) $H_2 < He < O_2 < CO_2$ (II) $CH_4 > O_2 > H_2$
(4) (I) $He < H_2 < O_2 < CO_2$(II) $CH_4 > O_2 > H_2$

12. Maximum deviation from ideal gas is expected from : **[NEET 2013]**
(1) N_2 (g) (2) CH_4 (g) (3) NH_3 (g) (4) H_2 (g)

13. A gas such as carbon monoxide would be most likely to obey the ideal gas law at : **[AIPMT 2015]**
(1) high temperatures and low pressures.
(2) low temperatures and high pressures.
(3) high temperatures and low pressures.
(4) low temperatures and low pressures.

14. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape. What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape ? **[NEET -2016]**
(1) 1/2 (2) 1/8 (3) 1/4 (4) 3/8

15. The correction factor 'a' to the ideal gas equation corresponds to **[NEET -2018]**
(1) Density of the gas molecules
(2) forces of attraction between the gas molecules
(3) electric field present between the gas molecules
(4) volume of the gas molecules

16. Given vander Waals constant for NH_3, H_2, O_2 and CO_2 are respectively 4.17, 0.244, 1.36 and 3.59, which one of the following gases is most easily liquefied ? **[NEET -2018]**
(1) NH_3 (2) CO_2 (3) O_2 (4) H_2

17. A gas at 350 K and 15 bar has molar volume 20 percent smaller than that for an ideal gas under the same conditions. The correct option above the gas and its compressibility factor (Z) is : **[NEET-1 -2019]**
(1) Z < 1 and repulsive forces are dominant. (2) Z > 1 and attractive forces are dominant.
(3) Z > 1 and repulsive forces are dominant. (4) Z < 1 and attractive forces are dominant.

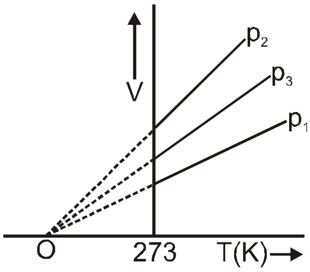
18. Under isothermal condition, a gas at 300 K expands from 0.1 L to 0.25 L against a constant external pressure of 2 bar. The work done by the gas is : [Given that 1 L bar = 100 J] **[NEET-1 -2019]**
(1) 30 J (2) – 30J (3) 5 kJ (4) 25 J

19. In water saturated air, the mole fraction of water vapour is 0.02. If the total pressure of the saturated air is 1.2 atm, the partial pressure of dry air is - **[NEET-2 -2019]**
(1) 1.18 atm (2) 1.76 atm (3) 1.176 atm (4) 0.98 atm

20. The volume occupied by 1.8 g of water vapour at 374ºC and 1 bar pressure will be – **[NEET-2 -2019]**
[Use R = 0.083 bar LK^{-1} mol^{-1}]
(1) 96.66 L (2) 55.87 L (3) 3.10 L (4) 5.37 L

PART - II : AIIMS QUESTION (PREVIOUS YEARS)

1. The volume-temperature graphs of a given mass of an ideal gas at constant pressure are shown below **[AIIMS 2008]**



What is the correct order of pressures ?
(1) $p_1 > p_3 > p_2$ (2) $p_1 > p_2 > p_3$ (3) $p_2 > p_3 > p_1$ (4) $p_2 > p_1 > p_3$

2. The root mean square velocity of one mole of a monatomic gas having molar mass M is U_{rms}. The relation between the average kinetic energy (E) of the gas and U_{rms} is : **[AIIMS 2010]**
(1) $U_{rms} = \sqrt{\frac{3E}{2M}}$ (2) $U_{rms} = \sqrt{\frac{2E}{3M}}$ (3) $U_{rms} = \sqrt{\frac{2E}{M}}$ (4) $U_{rms} = \sqrt{\frac{E}{3M}}$

3. In the vander Waals equation, 'a' signifies : **[AIIMS 2011]**
(1) intermolecular attraction
(2) intramolecular attraction
(3) attraction between molecular and wall of container
(4) volume of molecules

4. X ml of H_2 gas effuse through a hole in a container in 5 seconds. The time taken for the effusion of the same volume of the gas specified below under identical conditions is : **[AIIMS 2012]**

(1) 10 seconds : He (2) 20 seconds : O_2 (3) 25 seconds : CO (4) 55 seconds : CO_2

5. The rate of diffusion of SO_2, CO_2, PCl_3 and SO_3 are in the following order **[AIIMS 2013]**

(1) $PCl_3 > SO_3 > SO_2 > CO_2$ (2) $CO_2 > SO_2 > PCl_3 > SO_3$

(3) $SO_2 > SO_3 > PCl_3 > CO_2$ (4) $CO_2 > SO_2 > SO_3 > PCl_3$

6. The gas with the highest critical temperature is **[AIIMS 2014]**

(1) H_2 (2) He (3) N_2 (4) CO_2

7. **Assertion :** Greater the value of van der Wall's constant 'a' greater is the liquefaction of gas.

Reason : 'a' indirectly measures the magnitude of attractive forces between the molecules.

[AIIMS 2015]

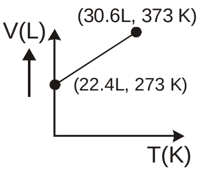
(1) If both assertion and reason are true and reason is the correct explanation of assertion.

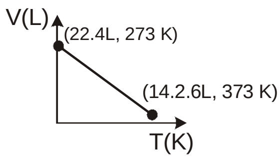
(2) If both assertion and reason are true but reason is not the correct explanation of assertion.

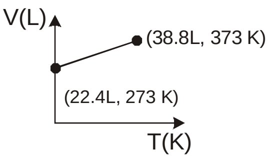
(3) If Assertion is true but reason is false.

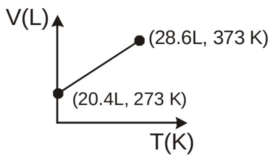
(4) If both assertion and reason are false.

8. Which of the following volume (V)-temperature (T) plots represent the behaviour of one mole of an ideal gas at one atmospheric pressure. **[AIIMS 2015]**

(1) 

(2) 

(3) 

(4) 

9. At a moderate pressure, the van der Waals equation is written as **[AIIMS 2016]**

$$\left[P + \frac{a}{V^2}\right]V = RT$$

The compressibility factor is equal to

(1) $\left(1 - \frac{a}{RTV}\right)$ (2) $\left(1 - \frac{RTV}{a}\right)$ (3) $\left(1 + \frac{a}{RTV}\right)$ (4) $\left(1 + \frac{RTV}{a}\right)$

10. **Assertion :** Critical temperature of CO_2 is 304 K, it cannot be liquiefied above 304 K. **[AIIMS 2016]**

Reason : At a certain temperature for a fix amount of idea gas, volume $\propto \frac{1}{\text{pressure}}$

(1) If both assertion and reason are true and reason is the correct explanation of assertion.

(2) If both assertion and reason are true but reason is not the correct explanation of assertion.

(3) If Assertion is true but reason is false.

(4) If both assertion and reason are false.

11. In van der Waals' equation of state for non-ideal gas, the term that accounts for intermolecular force is **[AIIMS 2017]**

(1) (V = b) (2) $(RT)^{-1}$ (3) $\left(P+\frac{a}{V^2}\right)$ (4) RT

12. A gas (1g) at 4 bar pressure. If we add 2gm of gas B then the total pressure inside the container is 6 bar. Which of the following is true ? **[AIIMS 2018]**

(1) $M_A = 2M_B$ (2) $M_B = 2M_A$ (3) $M_A = 4M_B$ (4) $M_B = 4M_A$

13. **Assertion :**The surface tension of water is more than other liquid. **[AIIMS 2018]**

Reason : Water molecules have strong inter molecular H-bonding as attractive force.

(1) If both assertion and reason are true and reason is the correct explanation of assertion.

(2) If both assertion and reason are true but reason is not the correct explanation of assertion.

(3) If assertion is true but reason is false.

(4) If both assertion and reason are false.

14. In vanderwaal equation at const temperature 300 K, a = 1.4 atm lt^2 $mole^{-2}$, v = 100 ml, n = 1 mole, what is pressure of gas : **[AIIMS 2018]**

(1) 42 atm (2) 210 atm (3) 500 atm (4) 106 atm

15. Gas in a cylinder is maintained at 10 atm pressure and 300 K temperature. The cylinder will explode if pressure of gas beyond 15 atm. What is maximum temperature to which gas can be heated ?

(1) 400 K (2) 500 K (3) 450 K (4) 250 L **[AIIMS 2018]**

16. At constant temperature Gases A & B, density of (A) is twice that of B and molar mass of A is half of B. Ratio of their pressures is $\frac{P_A}{P_B}$ is : **[AIIMS 2018]**

(1) ¼ (2) 1 (3) 4 (4) 2

PART - III : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. Value of gas constant R is : **[AIEEE 2001]**

(1) 0.082 litre atm. (2) 0.987 cal mol^{-1} K^{-1} (3) 8.3 J mol^{-1} K^{-1} (4) 83 erg mol^{-1} K^{-1}

2. Kinetic theory of gases proves : **[AIEEE 2002]**

(1) Only Boyle’s law (2) Only Charles law

(3) Only Avagadro's law (4) All of these

3. For an ideal gas, number of moles per litre in terms of its pressure P, gas constant R and temperature T is: **[AIEEE 2002]**

(1) PT/R (2) PRT (3) P/RT (4) RT/P

4. According to kinetic theory of gases in an ideal gas between two successive collisions a gas molecule travels: **[AIEEE 2003]**

(1) In a straight line path (2) With an accelerated velocity

(3) In a circular path (4) In a wavy path

5. What volume of hydrogen gas, at 273 K and 1 atm pressure will be consumed in obtaining 21.6g of elemental boron (atomic mass = 10.8) from the reduction of boron trichloride by hydrogen? **[AIEEE 2003]**

(1) 89.6 L (2) 67.2 L (3) 44.8 L (4) 22.4 L

6. As the temperature is raised from 20°C to 40°C, the average kinetic energy of neon atoms changes by a factor : **[AIEEE 2004]**

(1) 2 (2) $\sqrt{\frac{313}{293}}$ (3) $\frac{313}{293}$ (4) $\frac{1}{2}$

7. In vander Waal's equation of state of the gas law, the constant 'b' is a measure of : **[AIEEE 2004]**

(1) Intermolecular collisions per unit volume (2) Intermolecular attractions

(3) Volume occupied by the molecules (4) Intermolecular repulsions

8. Which one of the following statements is not true about the effect of an increase in temperature on the distribution of molecular speeds in a gas ? **[AIEEE 2005]**

(1) The area under the distribution curve remains the same as under the lower temperature

(2) The distribution becomes broader

(3) The fraction of the molecules with the most probable speed increases

(4) The most probable speed increases

9. For gaseous state, if most probable speed is denoted by C*, average speed by $\bar{C}$ and mean square speed by C, then for a large number of molecules the ratios of these speeds are : **[JEE(Main) 2013]**

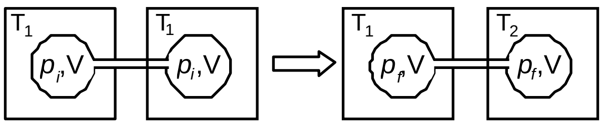
(1) C* : $\bar{C}$: C = 1.225 : 1.128 : 1 (2) C* : $\bar{C}$: C = 1.128 : 1.225 : 1

(3) C* : $\bar{C}$: C = 1 : 1.128 : 1.225 (4) C* : $\bar{C}$: C = 1 : 1.225 : 1.128

10. If Z is a compressibility factor, vander Waals equation at low pressure can be written as : **[JEE(Main) 2014]**

(1) $Z = 1 + \frac{RT}{Pb}$ (2) $Z = 1 - \frac{a}{VRT}$ (3) $Z = 1 - \frac{Pb}{RT}$ (4) $Z = 1 + \frac{Pb}{RT}$

11. Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure p_i and temperature T_1 are connected through a narrow tube of negligible volume as shown in the figure below. The temperature of one of the bulbs is then raised to T_2. The final pressure p_f is: **[JEE(Main) 2016]**



(1) $2p_i\left(\frac{T_1}{T_1+T_2}\right)$ (2) $2p_i\left(\frac{T_2}{T_1+T_2}\right)$ (3) $2p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$ (4) $p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

12. 0.5 moles of gas A and x moles of gas B exert a pressure of 200 Pa in a container of volume 10 m³ at 1000 K. Given R is the gas constant in JK^{-1} mol^{-1}, x is : **[JEE(Main) 2019]**

(1) $\frac{4-R}{2R}$ (2) $\frac{2R}{4+R}$ (3) $\frac{2R}{4-R}$ (4) $\frac{4+R}{2R}$

13. An open vessel at 27°C is heated until two fifth of the air (assumed as an ideal gas) in it has escaped from the vessel. Assuming that the volume of the vessel remains constant, the temperature at which the vessel has been heated is: **[JEE(Main) 2019]**

(1) 750 K (2) 750°C (3) 500 ºC (4) 500 K

14. The volume of gas A is twice than that of gas B. The compressibility factor of gas A is thrice than that of gas B at same temperature. The pressures of the gases for equal number of moles are : **[JEE(Main) 2019]**

(1) $2P_A = 3P_B$ (2) $P_A = 2P_B$ (3) $3P_A = 2P_B$ (4) $P_A = 3P_B$

Answers

EXERCISE - 1

SECTION (A)

1.	(4)	**2.**	(1)	**3.**	(1)	**4.**	(1)	**5.**	(3)	**6.**	(4)	**7.**	(3)
8.	(2)	**9.**	(2)	**10.**	(1)	**11.**	(3)	**12.**	(3)	**13.**	(4)	**14.**	(3)
15.	(1)	**16.**	(2)	**17.**	(4)	**18.**	(1)	**19.**	(3)	**20.**	(1)	**21.**	(1)
22.	(3)	**23.**	(1)	**24.**	(3)	**25.**	(3)	**26.**	(2)	**27.**	(1)	**28.**	(3)
29.	(3)	**30.**	(2)										

SECTION (B)

1.	(4)	**2.**	(1)	**3.**	(4)	**4.**	(1)	**5.**	(4)	**6.**	(3)

SECTION (C)

1.	(2)	**2.**	(4)	**3.**	(2)	**4.**	(2)	**5.**	(2)	**6.**	(1)	**7.**	(3)
8.	(2)	**9.**	(2)	**10.**	(4)	**11.**	(1)	**12.**	(2)				

SECTION (D)

1.	(1)	**2.**	(2)	**3.**	(2)	**4.**	(4)	**5.**	(4)	**6.**	(2)	**7.**	(3)
8.	(1)	**9.**	(1)	**10.**	(3)	**11.**	(3)	**12.**	(1)	**13.**	(2)	**14.**	(3)

SECTION (E)

1.	(3)	**2.**	(3)	**3.**	(1)	**4.**	(2)	**5.**	(3)	**6.**	(4)	**7.**	(3)
8.	(1)	**9.**	(1)	**10.**	(2)	**11.**	(3)	**12.**	(3)	**13.**	(4)	**14.**	(2)
15.	(2)	**16.**	(4)										

EXERCISE - 2

1.	(1)	**2.**	(3)	**3.**	(3)	**4.**	(2)	**5.**	(3)	**6.**	(3)	**7.**	(3)
8.	(1)	**9.**	(3)	**10.**	(1)	**11.**	(4)	**12.**	(1)	**13.**	(1)	**14.**	(2)
15.	(4)	**16.**	(2)	**17.**	(3)	**18.**	(2)	**19.**	(2)	**20.**	(1)	**21.**	(2)
22.	(4)	**23.**	(2)	**24.**	(4)	**25.**	(4)	**26.**	(4)	**27.**	(4)	**28.**	(1)
29.	(2)	**30.**	(2)	**31.**	(3)	**32.**	(3)	**33.**	(2)				

EXERCISE - 3

PART-I

1.	(1)	**2.**	(4)	**3.**	(3)	**4.**	(1)	**5.**	(1)	**6.**	(1)	**7.**	(1)
8.	(3)	**9.**	(4)	**10.**	(2)	**11.**	(4)	**12.**	(3)	**13.**	(1)	**14.**	(2)
15.	(2)	**16.**	(1)	**17.**	(4)	**18.**	(2)	**19.**	(3)	**20.**	(4)		

PART-II

1.	(1)	**2.**	(3)	**3.**	(1)	**4.**	(2)	**5.**	(4)	**6.**	(4)	**7.**	(1)
8.	(1)	**9.**	(1)	**10.**	(2)	**11.**	(3)	**12.**	(4)	**13.**	(1)	**14.**	(4)
15.	(3)	**16.**	(2)										

PART-III

1.	(3)	**2.**	(4)	**3.**	(3)	**4.**	(1)	**5.**	(2)	**6.**	(3)	**7.**	(3)
8.	(3)	**9.**	(3)	**10.**	(2)	**11.**	(2)	**12.**	(1)	**13.**	(4)	**14.**	(1)