Chapter- 13

KINETIC THEORY

Very Short Answer Type Questions

1) The equation of state for 5g of oxygen at a pressure P and temperature T. When occupying a volume V will be.

(a) $PV = (5/32)RT$ (b) $PV = 5RT$

(c) $PV = (5/2)RT$ (d) $PV = (5/16)RT$

Ans:- _____

2) If 300 ml of a gas 27° at is cooled to 7° at constant pressure, then its final volume will be

(a) 540 ml (b) 350 ml

(c) 280 ml (d) 135 ml

Ans:- _____

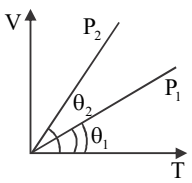
3) The molar specific heat at constant pressure of an ideal gas is (7/2) R. The ratio of specific heat at constant pressure to that at constant volume is.

(a) 7/5 (b) 8/7

(c) 5/7 (d) 9/7

Ans:- _____

4) In the given diagram, what is the relation between pressure P_1 and P_2?



(a) $P_2 = P_1$ (b) $P_2 > P_1$

(c) $P_2 < P_1$ (d) None of these

Ans:- _____

5) The mean free path of molecules of a gas (radius r) is inversely proportional to.

(a) r^3

(b) r^2

(c) r

(d) $\sqrt{r}$

Ans:- _____

6) The ratio of the specific heats in terms of degrees of freedom (n) is given by

(a) $\left(1+\frac{1}{n}\right)$ (b) $\left(1+\frac{n}{3}\right)$

(c) $\left(1+\frac{2}{n}\right)$ (d) $\left(1+\frac{n}{2}\right)$

Ans:- _____

7) Two vessels separately contain two ideal gases A and B at the same temperature, the pressure of A being twice that of B. Under such conditions, the density of A is found to be 1.5 times the density of B. The ratio of molecular weight of A and B is

(a) $\frac{1}{2}$ (b) $\frac{2}{3}$

(c) $\frac{3}{4}$ (d) 2

Ans:- _____

8) One mole of an ideal monatomic gas undergoes a process described by the equation PV^3=constant. The heat capacity of the gas during this process is

(a) 2R (b) R

(c) $\frac{3}{2}R$ (d) $\frac{5}{2}R$

Ans:- _____

9) A gas mixture consists of 2 moles of O_2 and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

(a) 15 RT (b) 9 RT

(c) 11 RT (d) 4 RT

Ans:- _____

10) At what temperature will the rms speed of oxygen molecules become just sufficient for escaping from the Earth's atmosphere? Given: mass of oxygen molecule (m) = , Boltzmann's constant

(a) $1.254\times10^4 K$ (b) $2.508\times10^4 K$

(c) $5.016\times10^4 K$ (d) $8.360\times10^4 K$

Ans:- _____

11) A given sample of an ideal gas occupies a volume V at a pressure P and absolute temperature T. The mass of each molecule of the gas is m. Which of the following gives the density of the gas?

(a) $\frac{P}{kTV}$ (b) mkT

(c) $\frac{P}{kT}$ (d) $\frac{Pm}{kT}$

Ans:- _____

Short questions (2 Marks)

12) Two perfect gases at temperatures T_1 and T_2 are mixed. There is no loss of energy. Find the temperature of the mixture if masses of molecules are m_1 and m_2, and the number of molecules in the gases are n_1 and n_2 respectively.

13) Calculate (a) RMS velocity and (b) mean kinetic energy of one gram molecule of hydrogen at STP. Give density of hydrogen at STP is 0.09 kg m^{-3}.

14) Calculate the temperature at which the RMS speed of nitrogen molecules will be equal to 8km/s. Give molecular weight of nitrogen = 28 and R = 8.3 J/mole/K

15) Calculate the total number of degree of freedom for a mole of diatomic gas at STP.

16) One mole of an ideal monoatomic gas $(\gamma = 5/3)$ is mixed with one mole of ideal diatomic gas $(\gamma = 7/5)$. What is γ for the mixture?

17) One mole of a monoatomic gas is mixed with three moles of a diatomic gas. What is the molecular specific heat of mixture at constant volume? $R = 8.31 J\ mole^{-1}K^{-1}$

18) At what temperature is the root mean square speed of an atom in an argon gas cylinder equal to the r.m.s speed of a helium gas atom at -20^0C? (Atomic mass of Ar = 39.9u, of He = 4.0u)

19) The container shown in the figure has two chambers, separated by a partition, of volumes V_1 = 2.0 litre and V_2 = 3.0 litre. The chambers

V_1	V_2
μ_1, P_1	μ_2, P_2

contain $\mu_1 = 4.0 \text{ and } \mu_2 = 5.0$ moles of a gas at pressures $_1$ = 1.00 atm and P_2 = 2.00 atm. Calculate the pressure after the partition is removed and the mixture attains equilibrium.

20) Define the number of degrees of freedom. How many degrees of freedom are there of a monoatomic ideal gas?

21) State the law of equipartition of energy. Show that the total internal energy of monoatomic ideal gas of one mole of molecules is (3/2) RT, T is absolute temperature R being gas constant.

22) Explain Boyle's law.

23) Explain Charl's law.

24) Calculate the mean free path of gas molecules, if the number of molecules per cm^3 is 3×10^{19} and the diameter of each molecule is $2\,\text{Å}$?

25) A gaseous mixture consists of 16g of helium and 16g of oxygen. Find γ for the mixture.

26) Calculate the total number of degrees of freedom possessed by 10cc of hydrogen gas at NTP.

27) Show that the RMS velocity of O_2 molecules is $\sqrt{2}$ times that of SO_2. The atomic weight of sulphur is 32 and the atomic weight of oxygen is 16.

28) The density of carbon dioxide gas at 0^0C and at pressure $1.0\times10^5\,\text{Nm}^{-2}$ is $1.98\,\text{kgm}^{-3}$. Find the RMS velocity of its molecules at 0^0C and also at 30^0C, assuming pressure to be constant.

29) What does universal gas constant R signify?

30) At a constant temperature, what is the relation between pressure P and the density ρ of gas?

31) A gas enclosed in a vessel has pressure P, volume V and absolute temperature T. Write the formula for the number of molecules N of the gas.

3 Marks questions.

32) Discuss kinetic interpretation of temperature. Define absolute zero temperature

33) Write the assumptions of an ideal gas.

34) Prove that $\frac{C_p}{C_v} = 1 + \frac{2}{f}$ where f is the number of degrees of freedom. Find $\frac{C_P}{C_V}$ of an ideal gas of diatomic molecules with a rigid bond.

35) A vessel A contains hydrogen and another vessel B whose volume is twice the volume of A contains the same mass of oxygen at the same temperature. Compare (a) average KE of hydrogen and oxygen molecules (b) RMS speeds of hydrogen and oxygen molecules (c) Pressure of gases in A and B. Given molecular weights of hydrogen and oxygen are 2 and 32 respectively.

36) Calculate the RMS velocity of molecules of gas of density 1.5g litre^{-1} at a pressure of $2 \times 10^6 N/m^2$

37) If root means square velocity of the molecules of hydrogen at NTP is, calculate the RMS velocity of oxygen molecules at NTP. Molecular weights of hydrogen and oxygen are 2 and 32 respectively.

38) At standard temperature and pressure, the mean free path of He gas is 300nm.

(a) determine the effective diameter of He atoms

b) the number of atoms per cubic metre

39) Calculate the number of degrees of freedom of molecules of hydrogen in 1c.c of hydrogen gas at NTP?

5Marks questions.

40) ***D***erive the expression for the mean free path of gas molecules.

41) Derive the expression for the pressure of an ideal gas.