

4. STATES OF MATTER (GASES AND LIQUIDS)

PREVIOUS EAMCET BITS

1. In a flask of 'V' litres, 0.2 moles of O₂, 0.4 moles of N₂, 0.1 moles of NH₃ and 0.3 moles of He gases are present at 27°C. If total pressure exerted by these non-reacting gases is 1 atm, the partial pressure exerted by N₂ gas is (2008 M)

- 1) 0.4 atm 2) 0.3 atm 3) 0.2 atm 4) 0.1 atm

Ans: 1

Sol. $P_{N_2} = X_{N_2} \times P$

$$X_{N_2} = \left(\frac{n_{N_2}}{n_{N_2} + n_{O_2} + n_{NH_3} + n_{He}} \right) P$$
$$= \left(\frac{0.4}{0.4 + 0.2 + 0.1 + 0.3} \right) P \Rightarrow \frac{0.4}{1} \times 1 = 0.4 \text{ atm}$$

2. What is the temperature at which the kinetic energy of 0.3 moles of Helium is equal to the kinetic energy of 0.4 moles of Argon at 400 K? (2008 E)

- 1) 400 K 2) 873 K 3) 533 K 4) 300 K

Ans: 3

Sol. $K.E_{He} = K.E_{Ar}$

$$\frac{3}{2} nRT = \frac{3}{2} nRT$$

$$\frac{3}{2} \times 0.3 \times RT = \frac{3}{2} \times 0.4 \times R \times 400$$

$$0.3T = 0.4 \times 400$$

$$T = \frac{0.4 \times 400}{0.3} = 533K$$

3. The most probable velocity of a gas molecule at 298 K is m/s 300 m/s. Its RMS. Velocity in m. s⁻¹ is (2007 M)

- 1) 420 2) 245 3) 402 4) 367

Ans: 4

Sol. $C_p = 0.8166 \times C$

$$C = \frac{C_p}{0.8166} = \frac{300}{0.8166} = 367K$$

4. 138 grams of ethyl alcohol is mixed with 72 grams of water. The ratio of mole fraction of alcohol to water is (2007 E)

- 1) 3 : 4 2) 1 : 2 3) 1 : 4 4) 1 : 1

Ans: 1

Sol.
$$\frac{X_{C_2H_5OH}}{X_{H_2O}} = \frac{138/46}{72/18} = \frac{3}{4}$$

5. A certain mass of a gas occupies a volume of 2 litres at STP. To what temperature the gas must be heated to double its volume keeping the pressure constant? (2007 E)

- 1) 100 k 2) 273 k 3) 273°C 4) 546°C

Ans: 3

Sol.
$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

pressure is constant

$$\therefore \frac{V_1}{T_1} = \frac{V_2}{T_2} = \frac{2}{23} = \frac{4}{T_2}$$

$$T_2 = 546K = 273^\circ C$$

6. What is the ratio of kinetic energies of 3g of hydrogen and 4 gms of oxygen at T(K)? (2005 M)

1. 12:1 2. 6 : 1 3. 1 : 6 4. 24 : 1

Ans: 1

Sol.
$$(KE)_{H_2} = \frac{3}{2} nRT = \frac{3}{2} \times \frac{3}{2} \times RT$$

$$(K.E)_{O_2} = \frac{3}{2} nRT = \frac{3}{2} \times \frac{4}{32} \times RT$$

$$\frac{(K.E)_{H_2}}{(K.E)_{O_2}} = \frac{12}{1} \text{ (or) } 12:1$$

7. A and B are ideal. The molecular weights of A and B are in the ratio of 1:4. The pressure of a gas mixture containing equal weights of A and B is P atm. What is the partial pressure (in atm) of B in the mixture.

(2005 E)

1. $\frac{P}{5}$ 2. $\frac{P}{2}$ 3. $\frac{P}{2.5}$ 4. $\frac{3P}{4}$

Ans: 1

Sol. $P_B = X_B \cdot P$

$$X_B = \frac{n_B}{n_A + n_B} = \frac{x/4}{x/4 + x/1}$$

$$P_B = \left(\frac{x/4}{x/4 + x/1} \right) P = \frac{P}{5}$$

8. At 27°C , 500ml of helium diffuse in 30 minutes. What is the time (in hours) taken for 100ml of SO_2 to diffuse under same experimental conditions
(2004 E)

1. 240 2. 3 3. 2 4. 4

Ans: 4

Sol.
$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\frac{v_1/t_1}{v_2/t_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\frac{v_1}{t_1} \times \frac{t_2}{v_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\frac{v_{\text{He}}}{t_{\text{He}}} \times \frac{t_{\text{SO}_2}}{v_{\text{SO}_2}} = \sqrt{\frac{M_{\text{SO}_2}}{M_{\text{He}}}}$$

$$\frac{500}{30} \times \frac{t_{\text{SO}_2}}{1000} = \sqrt{\frac{64}{4}} \quad \therefore t_2 = 240 \text{ min} = 4 \text{ hours}$$

9. **Assertion(A):** At 300K, kinetic energy of 16 gms of methane is equal to the kinetic energy of 32 gms of oxygen.

Reason (R): At constant temperature, kinetic energy of one mole of all gases is equal (2004 E)

The correct answer is

1. Both A and R are true and R is the correct explanation of A
2. Both A and R are true but R is not the correct explanation of A
3. A is true, R is not true
4. A is not true but R is true

Ans: 1

Sol.
$$\text{KE} = \frac{3}{2}nRT$$

Number of moles of CH_4 and O_2 is equal to one.

As the number of moles of CH_4 and O_2 are same hence (i) is correct answer.

10. The density of an ideal gas is 0.03g.cm^{-3} . Its pressure is $10^6\text{g.cm}^{-1}.\text{sec}^{-2}$. What is its RMS velocity (in cm sec^{-1})

(2004 M)

1. 10^3 2. 3×10^4 3. 10^8 4. 10^4

Ans: 4

Sol. $c = \sqrt{\frac{3p}{d}} = \sqrt{\frac{3 \times 10^6}{3 \times 10^{-2}}} = \sqrt{10^8} = 10^4$

11. Assertion(A): 8 grams of methane occupies 11.207 liters of volume at 273K and 1atm pressure
Reason (R): One mole of any gas at STP occupies 22.414 litres of volume (2004 M)

The correct answer is

1. Both A and R are true and R is the correct explanation of A
2. Both A and R are true but R is not the correct explanation of A
3. A is true, R is not true
4. A is not true but R is true

Ans : 1

- Sol. 8 g of CH₄ occupies 11.2 lit at STP one mole of any gas occupies 22.4 lit at STP

∴ (1) is correct answer.

12. If a gas contains only three molecules that move with velocities of 100,200,500. What is the RMS velocity of the gas in m sec⁻¹.

(2003 E)

- 1) $100\sqrt{\frac{8}{3}}$ 2) $100\sqrt{30}$ 3) $100\sqrt{10}$ 4) $\frac{800}{3}$

Ans: 3

Sol. RMS velocity = $\sqrt{\frac{c_1^2 + c_2^2 + c_3^2 + \dots}{n_1 + n_2 + n_3 + \dots}}$

RMS velocity = $\sqrt{\frac{(100)^2 + (200)^2 + (500)^2}{3}} = \sqrt{10^5}$

= $100\sqrt{10}$

13. The kinetic energy of 4 moles of nitrogen gas at 127^oC is _____ cal. ($R = 2\text{cal.mole}^{-1}.K^{-1}$)

(2003 M)

1. 4400 2. 3200 3. 4800 4. 1524

Ans: 3

Sol. $KE = \frac{3}{2}nRT$

= $\frac{3}{2} \times 4 \times 2 \times 400 = 4800\text{cal}$

- 14 At 27^o C a closed vessel contains equal weight of He, CH₄ and SO₂ exerts a pressure of 210 mm. and partial pressures of He, CH₄ and SO₂ are P₁, P₂ and P₃. Which one of the following is correct?

(2002 E)

- 1) $P_3 > P_2 > P_1$ 2) $P_1 > P_2 > P_3$ 3) $P_1 > P_3 > P_2$ 4) $P_2 > P_3 > P_1$

Ans: 2

Sol. Let us suppose each gas has 64 gm weight

$$n_1(\text{He}) = \frac{64}{4} = 16$$

$$n_2(\text{CH}_4) = \frac{64}{16} = 4$$

$$n_3(\text{SO}_2) = \frac{64}{64} = 1$$

$$p_1(\text{He}) = x_{\text{He}} \times p = \frac{16}{21} \times 210 = 160\text{mm}$$

$$p_2(\text{CH}_4) = x_{\text{CH}_4} \times p = \frac{4}{21} \times 210 = 40\text{mm}$$

$$p_3(\text{SO}_2) = x_{\text{SO}_2} \times p = \frac{1}{21} \times 210 = 10\text{mm}$$

$$\therefore P_1 > P_2 > P_3$$

15. 4 gms of an ideal gas occupies 5.6035 liters of volume at 546K and 2atm pressure. What is its molecular weight?

(2002 E)

1. 4 2. 16 3. 32 4. 64

Ans: 2

Sol. $PV = nRT$; $n = \frac{Wt}{GMW}$

$$PV = \frac{Wt}{GMW} \times R \times T$$

$$2 \times 5.6035 = \frac{4}{GMW} \times 0.0821 \times 546$$

$$GMW = \frac{4 \times 0.0821 \times 546}{2 \times 5.6035} = 16$$

16. At 400K temperature and 0.0821 Pressure the density of Carbondioxide is (gm/lit) (2002 M)

- 1) 0.01 2) 0.11 3) 2.5 4) 4.4

Ans: 2

Sol. $d = \frac{PM}{RT}$ $d = \frac{0.0821 \times 44}{0.0821 \times 400} = 0.11$

17. At 100K r.m.s velocity of a gas is 10^4 cm/sec hence at what temperature r.m.s velocity becomes .

$$3 \times 10^4 \text{ cm/sec}$$

(2002 M)

1. 900°C 2. 327°C 3. 627°C 4. 127°C

Ans: 3

Sol.
$$\frac{C_1}{C_2} = \sqrt{\frac{T_1}{T_2}}$$

$$C_1 = 10^4 \text{ cm/sec}; C_2 = 3 \times 10^4 \text{ cm/sec}$$

$$T_1 = 100\text{K} \quad T_2 = ?$$

$$\frac{10^4}{3 \times 10^4} = \sqrt{\frac{100}{T_2}} \Rightarrow T_2 = 900\text{K} = 627^\circ\text{C}$$

18. The r.m.s velocity of CO_2 at a temperature T (in Kelvin) is $x \text{ cm.sec}^{-1}$. At what temperature (in Kelvin) the r.m.s velocity of nitrous oxide would be $4x \text{ cm.sec}^{-1}$? HINT : $C \propto \sqrt{T}$ (2001 E)

- 1) $16T$ 2) $2T$ 3) $4T$ 4) $32T$

Ans: 1

Sol.
$$\frac{C_1}{C_2} = \sqrt{\frac{T_1}{T_2}}; \frac{C_{\text{CO}_2}}{C_{\text{N}_2\text{O}}} = \sqrt{\frac{T_{\text{CO}_2}}{T_{\text{N}_2\text{O}}}}$$

$$\frac{x}{4x} = \sqrt{\frac{T}{T_{\text{N}_2\text{O}}}}$$

$$\frac{x^2}{16x^2} = \frac{T}{T_{\text{N}_2\text{O}}}$$

$$T_{\text{N}_2\text{O}} = 16T$$

19. 'n' mole of an ideal gas at temperature T (in Kelvin) occupy "V" litres of volume, exerting a pressure of 'P' atmospheres. What is its concentration (in mole.lit)? (R = gas constant) (2001 E)

- 1) P/RT 2) PT/R 3) RT/P 4) R/PT

Ans: 1

Sol. $PV = nRT$

$$\frac{n}{V} = \text{concentration}$$

$$\frac{n}{V} = \frac{P}{RT}$$

20. What are the conditions under which the relation between volume (V) and number of moles (n) gas plotted? (P = pressure; T = temperature) (2001 M)

- 1) Constant P & T 2) Constant T & V 3) Constant P & V 4) Constant n & V

Ans: 1

Sol. According to Avogadro's law at constant pressure and temperature volume of a gas is directly proportional to number moles of a gas

21. 7.5 grams of a gas occupy 5.6 litres of volume at STP. The gas is (Atomic weights of C, N and O are 12, 14 and respectively) (2001 M)

- 1) NO 2) N₂O 3) CO 4) CO₂

Ans: 1

Sol. 5.6 lit of a gas at STP wt is \longrightarrow 7.5 gm

22.4 lit of a gas weight is \longrightarrow ?

$$= \frac{22.4 \times 7.5}{5.6} = 30\text{g}$$

\therefore molecular weight is 30 gm and the gas is = NO

22. The total pressure of a mixture of 6.4 grams of oxygen and 5.6 grams of nitrogen present in a 2 litre vessel is 1200 mm. What is the partial pressure (in mm) of nitrogen? (2000 E)

- 1) 1200 2) 600 3) 900 4) 200

Ans: 2

Sol. Number of moles of O₂ = $\frac{6.4}{32} = 0.2$

Number of moles of N₂ = $\frac{5.6}{28} = 0.2$

Mole fraction of N₂ = $\frac{0.2}{0.2+0.2} = \frac{1}{2}$

Partial pressure of N₂ = mole fraction \times total pressure of N₂

$$= \frac{1}{2} \times 1200 = 600\text{mm}$$

23. The RMS velocity of an ideal gas at 300K is 12240 cm.Sec⁻¹. What is its most probable velocity (in.cm.sec⁻¹) at the same temperature. (2000 E)

- 1) 10000 2) 11280 3) 1000 4) 12240

Ans: 1

Sol. Most probable velocity (C_p) = 0.8166 \times RMS velocity

$$= 0.8166 \times 12240 = 10000 \text{ cm/sec}$$

24. The volume of 10 moles of an ideal gas is 1 litre at and 1 atm Pressure. What is the volume (in lit) of 20 moles of same gas at same temperature and pressure? (2000 M)

- 1) 2 2) 4 3) 1 4) 8

Ans: 1

Sol. Gas is same and pressure and temperature and constant.

$$PV_1 = n_1RT, \quad \frac{P}{T} = \frac{n_1R}{V_1}$$

$$PV_2 = n_2RT, \quad \frac{P}{T} = \frac{n_2R}{V_2}$$

$$\therefore \frac{n_1R}{V_1} = \frac{n_2R}{V_2} \quad \frac{n_1}{V_1} = \frac{n_2}{V_2} \Rightarrow \frac{10}{1} = \frac{20}{V_2} \Rightarrow V_2 = 2$$

25. What is the value of gas constant? R.in Jmol⁻¹K⁻¹ (2000 M)

- 1) 82.1 2) 8.314 x 10² 3) 8.314 4) 0.0821

Ans: 3

Sol. R values in Joule/ mole is 8.314

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