4. STATES OF MATTER (GASES AND LIQUIDS)

PREVIOUS EAMCET BITS

1. In a flask of 'V' litres, 0.2 moles of O_2, 0.4 moles of N_2, 0.1 moles of NH_3 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 N_2 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 0.3 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. $K.E_{He} = KE_{Ar}$

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

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

$$0.3T = 0.4 \times 400$$

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

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. $\frac{X_{C_2}H_5OH}{X_{H_2O}} = \frac{138/46}{72/18} = \frac{3}{4}$

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. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

pressure is constant

$\therefore \frac{V_1}{T_1} = \frac{V_2}{T_2} = \frac{2}{23} = \frac{4}{T_2}$ $T_2 = 546K = 273°C$

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

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

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

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. $P_B = X_B.P$

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

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

8. At $27^0 C$, 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. $\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$

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

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

$\frac{v_{He}}{t_{He}} \times \frac{t_{SO_2}}{v_{SO_2}} = \sqrt{\frac{M_{SO_2}}{M_{He}}}$

$\frac{500}{30} \times \frac{t_{SO_2}}{1000} = \sqrt{\frac{64}{4}}$ $\therefore t_2 = 240$ min = 4 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. $KE = \frac{3}{2} nRT$

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 $0.03 g.cm^{-1}$. Its pressure is $10^6 g.cm^{-1}.sec^{-2}$. 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. $c=\sqrt{\frac{3p}{d}}=\sqrt{\frac{3\times10^{6}}{3\times10^{-2}}}=\sqrt{10^{8}}=10^{4}$

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 CH_4 occupies 11.2 lit at STP one mole of any gas occupies 22.4 lit at STP

$\therefore$ (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 = $\sqrt{\frac{c_1^2+c_2^2+c_3^2+.....}{n_1+n_2+n_3.....}}$

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 127^0C is ______ cals. $\left(R=2cal.mole^{-1}.K^{-1}\right)$

(2003 M)

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

Ans: 3

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

$=\frac{3}{2}\times4\times2\times400=4800\,cal$

14 At 27^o C a closed vessel contains equal weight of He, CH_4 and SO_2 exerts a pressure of 210 mm. and partial pressures of He, CH_4 and SO_2 are P_1, P_2 and P_3. 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

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

$$n_2(CH_4) = \frac{64}{16} = 4$$

$$n_3(SO_2) = \frac{64}{64} = 1$$

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

$$p_2(CH_4) = x_{CH_4} \times p = \frac{4}{21} \times 210 = 40mm$$

$$p_3(SO_2) = x_{SO_2} \times p = \frac{1}{21} \times 210 = 10mm$$

$\therefore\ p_1 > p_2 > p_3$

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 .

$3\times10^4 cm/\sec$ (2002 M)

1. $900^o C$ 2. $327^o C$ 3. $627^o C$ 4. $127^o C$

Ans: 3

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

$C_1=10^4 \text{cm/sec}$; $C_2=3\times10^4 \text{cm/sec}$

$T_1=100K$ T_2 = ?

$\frac{10^4}{3\times10^4}=\sqrt{\frac{100}{T_2}} \Rightarrow T_2=900K=627°C$

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

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

Ans: 1

Sol. $\frac{C_1}{C_2}=\sqrt{\frac{T_1}{T_2}}$; $\frac{C_{CO_2}}{C_{N_2O}}=\sqrt{\frac{T_{CO_2}}{T_{N_2O}}}$

$\frac{x}{4x}=\sqrt{\frac{T}{T_{N_2O}}}$

$\frac{x^2}{16x^2}=\frac{T}{T_{N_2O}}$

$T_{N_2O}=16T$

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. $PV=nRT$

$\frac{n}{v}=$ 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 Avogadros law at constant presume 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) N_2O 3) CO 4) CO_2

Ans: 1

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

22.4 lit of a gas weight is $\longrightarrow$?

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

$\therefore$ 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 O_2 = $\frac{6.4}{32} = 0.2$

Number of moles of N_2 = $\frac{5.6}{28} = 0.2$

Mole fraction of N_2 = $\frac{0.2}{0.2+0.2} = \frac{1}{2}$

Partial presume of N_2 = mole fraction $\times$ total presume of N_2

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

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 (Cp) $= 0.8166 \times \text{RMS velocity}$

$= 0.8166 \times 12240 = 10000\ cm/sec$

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 presume and temperature and constant.

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

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

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

25. What is the value of gas constant? R.in $Jmol^{-1}K^{-1}$ (2000 M)

1) 82.1 2) 8.314×10^2 3) 8.314 4) 0.0821

Ans: 3

Sol. R values in Joule/ mole is 8.314

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