PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 30

Total Marks : 31

Max. Time : 33 min.

Topic : Gaseous State

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.2 to Q.3	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.1,4	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.5,9	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

1. A gaseous organic compound has a density of 2.5 kg/m^3 at 2 atm and at 273^{0}C. The molecular formula of the compound can be :

(A) C_3H_4O (B) C_4H_6O (C) C_4H_8 (D) C_5H_{10}

2. The ratio of rates of diffusion of SO_2, O_2 and CH_4 under identical conditions is :

(A) 1 : $\sqrt{2}$: 2 (B) 1 : 2 : 4 (C) 2 : $\sqrt{2}$: 1 (D) 1 : 2 : $\sqrt{2}$

3. If the number of molecules of SO_2 (molecular weight = 64) effusing through an orifice of unit area of cross-section in unit time at 0°C and 1 atm pressure is n, the number of He molecules (atomic weight = 4) effusing under similar conditions at 273°C and 0.25 atm is :

(A) $\frac{n}{\sqrt{2}}$ (B) $n\sqrt{2}$ (C) 2n (D) $\frac{n}{2}$

4. The time taken for effusion of 32 mL of oxygen gas will be the same as the time taken for effusion of which gas sample under identical conditions : (Take $\sqrt{2}$ = 1.4, $\sqrt{3}$ = 1.7)

(A) 64 mL of H_2 (B) 50 mL of N_2 (C) 44.8 mL of CH_4 (D) 22.4 mL of SO_2

5. 5 mL of He gas diffuses out in 1 second from a hole. Find the volume of SO_2 that will diffuse out from the same hole under identical conditions in 2 seconds.

Comprehension # (Q.6 to Q.8)

Graham's Law :

"Under similar conditions of pressure (partial pressure), the rate of diffusion of different gases is inversely proportional to square root of the density of different gases."

rate of diffusion $r \propto \frac{1}{\sqrt{d}}$ (d = density of gas)

r = volume flow rate $= \frac{dV_{out}}{dt}$

r = moles flow rate $= \frac{dn_{out}}{dt}$

r = distance travelled by gaseous molecules per unit time $= \frac{dx}{dt}$

The general form of the Grahams law of diffusion shows the variation of rate of diffusion of a gas with pressure of gas, temperature of gas, area of cross-section of orifice and molecular mass of the gas.

Now answer the following questions :

6. A bottle of dry NH_3 & a bottle of dry HCl connected through a long tube are opened simultaneously under identical conditions at both ends. The white ammonium chloride ring first formed will be:

(A) at the centre of the tube (B) near the HCl bottle

(C) near the NH_3 bottle (D) throughout the length of tube

7. At room temperature, A_2 gas (vapour density = 40) at 1 atm pressure and B_2 gas (vapour density = 10) at p atm pressure are allowed to diffuse through identical pinholes from opposite ends of a glass tube of 1m length and of uniform cross-section. The two gases first meet at a distance of 60 cm from the A_2 end. The value of p is :

(A) $\frac{4}{3}$atm (B) $\frac{1}{3}$atm (C) $\frac{3}{4}$atm (D) $\frac{1}{6}$atm

8. A mixture containing 2 moles of He and 1 mole of CH_4 is taken in a closed container and made to effuse through a small orifice of container. Then, which is the correct effused volume percentage of He and CH_4 initially, respectively :

(A) 40%, 60% (B) 20% , 80% (C) 80% , 20% (D) 60% , 40%

9. Pressure in a bulb dropped from 2000 to 1500 mm in 50 minute, when the contained oxygen leaked through a small hole. The bulb was then completely evacuated. A mixture of oxygen and another gas of molecular weight 72 in molar ratio 1 : 1 at a total pressure of 6000 mm was introduced. Find the molar ratio of two gases remaining in the bulb after a period of 70 minute.

Answer Key

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1.	(A)	**2.**	(A)	**3.**	(A)	**4.**	(CD)		
5.	**2.5 ml.**	**6.**	(B)	**7.**	(B)	**8.**	(C)	**9.**	9/46

Hints & Solutions

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1. $d = \frac{PM}{RT}$ $\quad \therefore 2.5 = \frac{2 \times M_{gas}}{0.082 \times 546}$ $\quad \therefore M_{gas} = 56$

$\therefore$ Both (A) & (C) options are correct.

5. Rate of diffusion of He $= \frac{5mL}{15} = 5ml/s = r_{He}$ (say)

$\therefore \quad r_{SO_2} = r_{He} \times \frac{1}{4} = 5ml/s \times \frac{1}{4}$

$\therefore$ Volume of SO_2 diffused in 2.0 seconds

$= \frac{5}{4} \times 2$ ml $=$ **2.5 ml Ans.**

7. $\frac{r_{A_2}}{r_{B_2}} = \frac{P_{A_2}}{P_{B_2}} \sqrt{\frac{VD_{B_2}}{VD_{A_2}}}$

$\frac{60/\Delta t}{40/\Delta t} = \frac{1}{P} \sqrt{\frac{10}{40}}$

$P = \frac{1}{3}$ atm

8. Rate of diffusion of He $= r_1$
rate of diffusion of $CH_4 = r_2$

$\frac{r_1}{r_2} = \frac{n_1}{n_2} \sqrt{\frac{M_2}{M_1}} = \frac{2}{1} \sqrt{\frac{16}{4}} = \frac{4}{1}$

Diffused mole of He $= \frac{4}{5} \times 100 = 80\%$

Diffused mole of $CH_4 = \frac{1}{5} \times 100 = 20\%$

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