Daily Tutorial Sheet 1	JEE Main (Archive)

1.(A) $P_{total} = x_{O_2}.P_{O_2}$

$\frac{P_{total}}{P_{O_2}}$ = fraction of total pressure exerted by O_2.

2.(A) $\frac{r_{CH_4}}{r_x} = \sqrt{\frac{M_x}{M_{CH_4}}}$

3.(D) Let the mass of $H_2 = x$ gm

$$P_{H_2} = (\text{mole fraction of } H_2) \times \text{total pressure} = \left(\frac{x/2}{\frac{x}{2}+\frac{x}{30}}\right) \times P_{total} = \frac{15}{16} \times P_{total}$$

4.(i) XeF_6 (ii) –173°C, 0.82 L

(i) For the same amount of gas being effused

$$\frac{r_1}{r_2} = \frac{t_2}{t_1} = \frac{p_1}{p_2}\sqrt{\frac{M_2}{M_1}} \Rightarrow \frac{57}{38} = \frac{0.8}{1.6}\sqrt{\frac{M_2}{28}} \Rightarrow M_2 = 252\,g\,mol^{-1}$$

Also, one molecule of unknown xenon-fluoride contain only one Xe atom $[M(Xe) = 131]$, formula of the unknown gas can be considered to be XeF_n.

$\Rightarrow$ $131 + 19n = 252;\ n = 6.3,$ hence the unknown gas is XeF_6.

(ii) For a fixed amount and volume, $p \propto T$

$\Rightarrow$ $\frac{1}{1.1} = \frac{T}{T+10}$ where, T = Kelvin temperature

$\Rightarrow$ $T = 100\,K = t + 273 \Rightarrow t = -173°C$

Volume $= \frac{nRT}{p} = \left(\frac{12}{120}\right) \times \frac{0.082 \times 100}{1} = 0.82\,L$

5.(C) $V_{rms} = \sqrt{\frac{3RT}{M}}$ $V_{ave} = \sqrt{\frac{8RT}{\pi M}}$ $\Rightarrow$ $V_{mp} = \sqrt{\frac{2RT}{M}}$

6.(B) **PLAN** To solve this problem, the stepwise approach required, i.e.

(i) Write the van der Waals' equation, then apply the condition that at low pressure, volume become high, i.e. $V - b \simeq V$

(ii) Now calculate the value of compressibility factor (Z).

[Z = pV/RT]

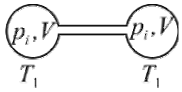
According to van der Waals' equation, $\left(P + \frac{a}{V^2}\right)(V - b) = RT$

At low pressure, $\left(P + \frac{a}{V^2}\right)V = RT \Rightarrow pV + \frac{a}{V} = RT$ or $pV = RT - \frac{a}{v}$

Divide both side by RT, $\frac{pV}{RT} = 1 - \frac{a}{RTV}$

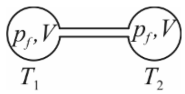
7.(C) According to kinetic theory of gases, gas can be compressed at any pressure because there is no force of attraction and repulsion between gas molecules.

8.(C) At high pressure and low temperature, molecules do have a volume and also exert intermolecular attractions.

9.(B) 

Number of mol of gases in each container $= \dfrac{p_i V}{RT_1}$

Total mol of gases in both containers $= 2\dfrac{p_i V}{RT_1}$



In left chamber $n_1 = \dfrac{p_f V}{RT_1}$ and In right chamber, $n_2 = \dfrac{p_f V}{RT_2}$

Total moles of gases should remain constant $\dfrac{2p_i V}{RT_1} = \dfrac{p_f V}{RT_1} + \dfrac{p_f V}{RT_2} \Rightarrow p_f = 2p_i\left(\dfrac{T_2}{T_1 + T_2}\right)$

10.(B) Real gases show ideal behavior at high temperature and low pressure.

11.(B) As, Density $= \dfrac{\text{Mass}}{\text{Volume}}$; $PV = RT$ $\left(\because V = \dfrac{RT}{P}\right)$

So, $d = \dfrac{MP}{RT}$

Now, $d_1 = x,\ P_1 = 4, M_1 = 28$

$d_2 = 2x, P_2 = 2, M_2 = ?$

So, $\dfrac{d_1}{d_2} = \dfrac{M_1P_1}{RT_1} \times \dfrac{RT_2}{M_2P_2}$

$\therefore \quad \dfrac{d_1}{d_2} = \dfrac{M_1P_1}{M_2P_2} \quad (\because T_1 = T_2)$

$\therefore \quad M_2 = \dfrac{M_1P_1d_2}{P_2d_1} \Rightarrow M_2 = \dfrac{2x \times 28 \times 4}{2 \times x} \Rightarrow M_2 = 112 \text{ g mol}^{-1}$

12.(B) $\dfrac{d_{NH_3}}{d_{HCl}} = \dfrac{M_{NH_3}}{M_{HCl}} = \dfrac{17}{35.5} = 0.47$

13.(D) $n_1T_1 = n_2T_2$

$300 \times n = \left(n - \dfrac{2n}{5}\right) \times T \Rightarrow 300 \times n = \left(\dfrac{3n}{5}\right) \times T \Rightarrow T = 500\text{ K}$

14.(C) $T_C = \dfrac{8a}{27Rb}$

For Kr the value of $\left(\dfrac{a}{b}\right)$ is highest

Thus T_C is also highest

15.(B) $V_{mp} = \sqrt{\dfrac{2RT}{M}}$, where R $\Rightarrow$ universal gas constant $\Rightarrow$ Temperature $\Rightarrow$ Molar mass

Greater the $\dfrac{T}{M}$ ratio, greater will be the speed and higher the speed, the graph will shift towards right

16.(A) $Z = 1 + \dfrac{Pb}{RT}$ for inert gases

$Z \propto b$, 'b' depends on size of the gas atom the gas atom therefore steepest increase in plot of Z is maximum for Xenon.