

31.(A) $PV = nRT$

32.(2.20 atm)

$$\text{Rate of effusion } (r) \propto \frac{P}{\sqrt{M}}$$

$$\Rightarrow \frac{r(\text{NH}_3)}{r(\text{HCl})} = \frac{1}{\sqrt{17}} \times \frac{\sqrt{36.5}}{p} \Rightarrow \frac{40}{60} = \frac{1}{p} \sqrt{\frac{36.5}{17}} \Rightarrow p = \frac{3}{2} \sqrt{\frac{36.5}{17}} = 2.20 \text{ atm}$$

33.(0.221 atm)

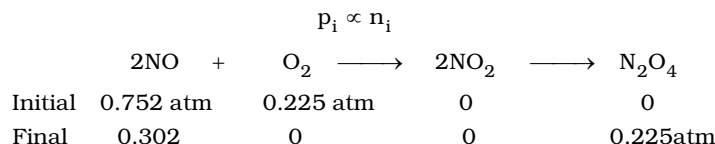
First we calculate partial pressure of NO and O₂ in the combined system when no reaction takes place.

$$pV = \text{constant}$$

$$\Rightarrow p_1 V_1 = p_2 V_2$$

$$\Rightarrow p_2(\text{NO}) = \frac{1.053 \times 250}{350} = 0.752 \text{ atm}; \quad p_2(\text{O}_2) = \frac{0.789 \times 100}{350} = 0.225 \text{ atm}$$

Now the reaction stoichiometry can be worked out using partial pressure because in a mixture.



Now, on cooling to 220 K, N₂O₄ will solidify and only unreacted NO will be remaining in the flask.

$$\therefore p \propto T \quad \therefore \frac{p_1}{p_2} = \frac{T_1}{T_2}$$

$$\Rightarrow \frac{0.302}{p_2} = \frac{300}{220} \Rightarrow p_2(\text{NO}) = 0.221 \text{ atm}$$

34.(1020 g/mol)

$$\text{Total moles of gas in final mixture} = \frac{pV}{RT} = \frac{6 \times 3}{0.082 \times 300} = 0.731$$

$$\therefore \text{Mole of H}_2 \text{ in the mixture} = 0.70$$

$$\therefore \text{Mole of unknown gas (X)} = 0.031$$

Because both gases have been diffused for same time

$$\frac{r(\text{H}_2)}{r(\text{X})} = \frac{0.70}{0.031} = \sqrt{\frac{M}{2}} \Rightarrow M = 1020 \text{ g mol}^{-1}$$

35.(407 ms)

$$\text{Number of moles} = \frac{2 \times 10^{21}}{6 \times 10^{23}} = 0.33 \times 10^{-2}$$

$$p = 7.57 \times 10^3 \text{ Nm}^{-2}$$

$$\text{Now, } pV = nRT \Rightarrow T = \frac{pV}{nR} = \frac{7.57 \times 10^3 \times 10^{-3}}{0.33 \times 10^{-2} \times 8.314} = 276 \text{ K}$$

$$\Rightarrow u_{\text{rms}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \times 8.314 \times 276}{28 \times 10^{-3}}} \text{ms}^{-1} = 496 \text{ms}^{-1}$$

$$\text{Also, } \frac{u_{\text{mps}}}{r_{\text{rms}}} = 0.82 \Rightarrow u_{\text{mps}} = 0.82 \times u_{\text{rms}} = 0.82 \times 496 \text{ms}^{-1} = 407 \text{ms}^{-1}$$

$$C_{\text{rms}} = 496 \text{ms}^{-1}; C_{\text{mp}} = 407 \text{ms}^{-1}$$

36.(F) a is the measure of intermolecular force.

37. (8 : 1)

$$\frac{r_{\text{He}}}{r_{\text{CH}_4}} = \frac{n_{\text{He}}}{n_{\text{CH}_4}} \sqrt{\frac{M_{\text{CH}_4}}{M_{\text{He}}}} = \frac{4}{1} \sqrt{\frac{16}{4}} = 8$$

Initial ratio of rates of effusion gives the initial composition of mixture effusing out.

Therefore, $n(\text{He}) : n(\text{CH}_4) = 8 : 1$

38.(2.46 m³, 1.48 atm)

Weight of butane gas in filled cylinder = 29 – 14.8 kg

\Rightarrow During the course of use, weight of cylinder reduces to 23.2 kg

\Rightarrow Weight of butane gas remaining now = 23.2 – 14.8 = 8.4 kg

Also, during use, V (cylinder) and T remains same.

$$\text{Therefore, } \frac{p_1}{p_2} = \frac{n_1}{n_2} \Rightarrow p_2 = \left(\frac{n_2}{n_1} \right) p_1 = \left(\frac{8.4}{14.2} \right) \times 2.5 \quad \left[\text{Here, } \frac{n_2}{n_1} = \frac{w_2}{w_1} \right] = 1.48 \text{ atm}$$

Also, pressure of gas outside the cylinder is 1.0 atm.

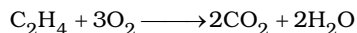
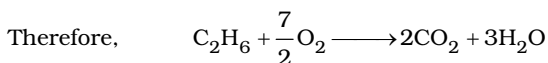
$$\Rightarrow pV = nRT \Rightarrow V = \frac{nRT}{p} = \frac{(14.2 - 8.4) \times 10^3}{58} \times \frac{0.082 \times 30}{1} \text{L} = 2460 \text{L} = 2.46 \text{m}^3$$

1.48 atm ; 2.46 m³

39.(0.34, 0.66)

$$\text{The total moles of gaseous mixture} = \frac{pV}{RT} = \frac{1 \times 40}{0.082 \times 400} = 1.22$$

Let the mixture contain x mole of ethane.



$$\text{Total moles of O}_2 \text{ required} = \frac{7}{2}x + 3(1.22 - x) = \frac{x}{2} + 3.66$$

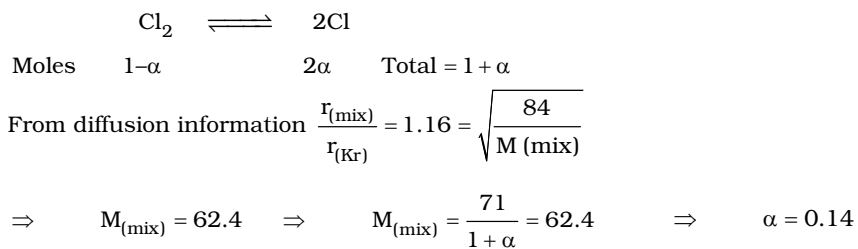
$$\Rightarrow \frac{130}{32} = \frac{x}{2} + 3.66 \Rightarrow x = 0.805 \text{ mole ethane and } 0.415 \text{ mole ethane.}$$

$$\Rightarrow \text{Moles fraction of ethane} = \frac{0.805}{1.22} = 0.66$$

$$\text{Mole fraction of ethane} = 1 - 0.66 = 0.34$$

$$\text{C}_2\text{H}_6 = 0.66; \quad \text{C}_2\text{H}_4 = 0.34$$

40.(0.14) If ' α ' is the degree of dissociation, then at equilibrium



41.(C) $\frac{V_{\text{H}_2}}{V_{\text{O}_2}} = \sqrt{\frac{T_{\text{H}_2}}{T_{\text{O}_2}} \times \frac{M_{\text{O}_2}}{M_{\text{H}_2}}}$

42.(F) Ideal gas cannot be liquefied as there is no intermolecular attraction between the molecules of ideal gas.
Hence, there is no point of forming ideal solution by cooling ideal gas mixture.

43.(B) Compressibility factor (Z) = $\frac{V}{V_{\text{ideal}}} = 1 \quad \because \quad \text{For ideal gas } V = V_{\text{ideal}}$

44.(Less) Less; $E = \frac{3}{2}RT$

45.(C) $\frac{p_A}{p_B} = \frac{n_A}{n_B} \sqrt{\frac{M_B}{M_A}}$ (at constant T and V)