31.(A) $Pv = nRT$

32.(2.20 atm)

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

$$\Rightarrow \quad \frac{r(NH_3)}{r(HCl)} = \frac{1}{\sqrt{17}} \times \frac{\sqrt{36.5}}{p} \quad \Rightarrow \quad \frac{40}{60} = \frac{1}{p}\sqrt{\frac{36.5}{17}} \quad \Rightarrow \quad p = \frac{3}{2}\sqrt{\frac{36.5}{17}} = 2.20 \text{ atm}$$

33.(0.221 atm)

First we calculate partial pressure of NO and O_2 in the combined system when no reaction takes place.

$$pV = \text{constant}$$

$$\Rightarrow \quad p_1V_1 = p_2V_2$$

$$\Rightarrow \quad p_2(NO) = \frac{1.053 \times 250}{350} = 0.752 \text{ atm} \ ; \quad p_2(O_2) = \frac{0.789 \times 100}{350} = 0.225 \text{ atm}$$

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

$$p_i \propto n_i$$

	$2NO$	+	$O_2 \longrightarrow$	$2NO_2 \longrightarrow$	N_2O_4
Initial	0.752 atm		0.225 atm	0	0
Final	0.302		0	0	0.225atm

Now, on cooling to 220 K, N_2O_4 will solidify and only unreacted NO will be remaining in the flask.

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

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

34.(1020 g/mol)

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

$\because$ Mole of H_2 in the mixture = 0.70

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

Because both gases have been diffused for same time

$$\frac{r(H_2)}{r(X)} = \frac{0.70}{0.031} = \sqrt{\frac{M}{2}} \qquad \Rightarrow \qquad M = 1020 \text{ g mol}^{-1}$$

35.(407 ms)

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

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

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

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

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

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

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

37. (8 : 1)

$$\frac{r_{He}}{r_{CH_4}} = \frac{n_{He}}{n_{CH_4}}\sqrt{\frac{M_{CH_4}}{M_{He}}} = \frac{4}{1}\sqrt{\frac{16}{4}} = 8$$

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

Therefore, $n(He) : n(CH_4) = 8 : 1$

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.

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

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

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

1.48 atm ; 2.46 m³

39.(0.34, 0.66)

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.

Therefore, $C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$

$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$

Total moles of O_2 required = $\frac{7}{2}x + 3\,(1.22 - x) = \frac{x}{2} + 3.66$

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

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

Mole fraction of ethane $= 1 - 0.66 = 0.34$

$C_2H_6 = 0.66$; $C_2H_4 = 0.34$

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

$$\begin{array}{llll} & Cl_2 & \rightleftharpoons & 2Cl \\ \text{Moles} & 1-\alpha & & 2\alpha \quad \text{Total} = 1+\alpha \end{array}$$

From diffusion information $\dfrac{r_{(mix)}}{r_{(Kr)}} = 1.16 = \sqrt{\dfrac{84}{M\,(mix)}}$

$\Rightarrow \quad M_{(mix)} = 62.4 \quad \Rightarrow \quad M_{(mix)} = \dfrac{71}{1+\alpha} = 62.4 \quad \Rightarrow \quad \alpha = 0.14$

41.(C) $\dfrac{V_{H_2}}{V_{O_2}} = \sqrt{\dfrac{T_{H_2}}{T_{O_2}} \times \dfrac{M_{O_2}}{M_{H_2}}}$

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) = $\dfrac{V}{V_{ideal}} = 1 \quad \because \quad$ For ideal gas $V = V_{ideal}$

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

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