# SOLUTIONS

## Module - 1 / JEE-2022

| IN-CHAPTER EXERCISES | Chemistry | States of Matter |
|---|---|---|

### *EXERCISE-A*

**1.** **(a)** $P_{max} = 15atm$ ; $T_{min} = ?$

$P_1 = 12$ atm ; $T_1 = 300$ K

Using : $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \Rightarrow \frac{12}{300} = \frac{15}{T_{min}}$ $[\because V_1 = V_2]$

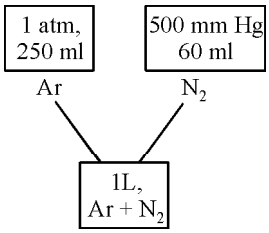
$\Rightarrow$ $T_{min} = 375K \equiv 102°C$ $\Rightarrow$ Above this T, cylinder will burst.

**(b)** $n_{Total\ (final)} = n_{Ar} + n_{N_2}$

Also, $P_{Total}\ V_{final} = P_1V_1 + P_2V_2$

$\Rightarrow$ $P_{Total} \times 1000 = 760 \times 250 + 500 \times 60$

$\Rightarrow$ $P_{Total} = 220$ mm Hg




**(c)** Moles of $O_2 = \frac{PV}{RT} = \frac{\left[\frac{7.6 \times 10^{-10}}{760}\right]}{0.082 \times 273} = 4.46 \times 10^{-14}$

$\Rightarrow$ Number of molecules $= 4.46 \times 10^{-14} \times 6.02 \times 10^{23} = 2.68 \times 10^{10}$

**2.** $n_{H_2} = \frac{PV}{RT} = \frac{750/760 \times 10}{0.082 \times 298} = 0.4$ ; No. of Molecules $= 0.4 \times N_o = 2.4 \times 10^{23}$

weight $= n \times M_{H_2} = 0.4 \times 2 = 0.8$gm

**3.** $d_{mix} = 1.15$g/L ; $P = 750$ mm Hg, $T = 300$ K

$\Rightarrow$ $M_{mix} = \frac{d_{mix}RT}{P} = \frac{1.15 \times 0.082 \times 300}{750/760} = 28.70 = \sum \chi_i Mi$

$\Rightarrow$ $28.70 = M_{N_2} \cdot x + M_{O_2} \cdot (1-x) \Rightarrow x = 0.825$ ; $\%\ N_2 = 82.5$ and $\%\ O_2 = 17.5$

**4.** **(i) (B)** $\frac{r_A}{r_B} = \frac{1}{4} = \sqrt{\frac{M_B}{M_A}} \Rightarrow \frac{M_B}{M_A} = \frac{1}{16}$ and $\frac{\chi_A}{\chi_B} = \frac{g_A/M_A}{g_B/M_B} = \frac{2}{3} \times \frac{1}{16} = \frac{1}{24}$

**(ii) (A)** $d_{mix} = \frac{10}{22.4}$ g/L $\Rightarrow$ $M_{mix} = \frac{d_0RT}{P} = \frac{(10/22.4) \times 0.082 \times 273}{1} = 10$gm/mol

and $M_{mix} = 10 = \Sigma \chi_i\, m_i = M_{He} \times x + M_{H_2} \cdot (1-x) \Rightarrow x = 0.75$ ; $\%\ He = 75$ ; $\%\ N_2 = 25$

**(iii) (A)** Unit of K = unit of $\frac{V}{T} = m^3K^{-1}$.

**(iv) (A)** $\frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow \frac{1}{546} = \frac{P_2}{273} \Rightarrow P_2 = \frac{1}{2}$ atm

**(v) (A)** $\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow \frac{400}{300} = \frac{V_2}{270}$ $\Rightarrow$ $V_2 = 360\ cm^3$ $\Rightarrow$ $\Delta V = -40cm^3$

**(vi) (B)** $M_{Gas} = 2\,V.D. = 2 \times 11.2 = 22.4$ g/mol $\Rightarrow$ $n_{Gas} = \dfrac{11.2}{22.4} = \dfrac{1}{2} \Rightarrow V_{at\ STP} = \dfrac{1}{2} \times 22.4\ Lt = 11.2\ Lt$

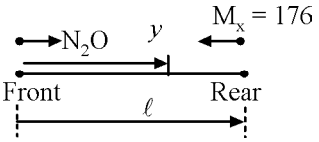
**(vii) (A)** $C(s) + H_2O(\ell) \longrightarrow CO(g) + H_2(g)$

Moles : $48/12 = 4$

$\quad - \quad - \quad 4 \quad 4 \quad \Rightarrow \quad n_{Total} = 4 + 4 = 8 \Rightarrow \quad V_{STP} = 8 \times 22.4\,L = 179.2\,L$

**(viii) (BD)** $\dfrac{r_{He}}{r_{CO}} = \sqrt{\dfrac{M_{CO}}{M_{He}}} = \sqrt{\dfrac{28}{4}} = \sqrt{7}$ ; $\dfrac{r_{He}}{r_{CO_2}} = \sqrt{\dfrac{44}{4}} = \sqrt{11}$ ; $\dfrac{r_{He}}{r_{SO_2}} = \sqrt{\dfrac{M_{SO_2}}{M_{He}}} = \sqrt{\dfrac{64}{4}} = 4$

**(ix) (B)** $\dfrac{r_{N_2O}}{r_x} = \dfrac{y}{\ell - y} = \sqrt{\dfrac{M_x}{M_{N_2O}}} = \sqrt{\dfrac{176}{44}} = 2 \quad \Rightarrow \quad y = \dfrac{2\ell}{3} = \dfrac{2}{3} \times 201 = 134$




**(x)(A)** Gases fill the whole container, seen only in gaseous state.

A, C and D may be oserved in liquids also.

**(xi)(C)** Vapour density of $O_2 = 16 \left( V.d = \dfrac{\text{mol wt}}{2} \right)$

$N_2 = 14$

$V.d = \dfrac{1}{2} \times 16 + \dfrac{1}{2} \times 14 = 15$

**(xii).(D)** In the case of A, B, C there is a change in total pressure. So irrespective of change in mole fraction, partial pressure will change.

Only in the case of 'd' both total pressure and mole fraction do not change.

**(xiii).(B)** Obviously in B, $p_1V_1 = n_1RT$

In $\quad Ap_2V_2 = n_2RT$

$\therefore \quad \dfrac{p_2V_2}{p_1V_1} = 4 = \dfrac{n_2}{n_1}$

Ratio = 4 : 1

**(xiv).(A)** Taking $CH_4$ as indicated by suffice 1 and $SO_2$ by suffix 2

$$\frac{3RT_1}{M_1} = \frac{3RT_2}{M_2}$$

$\therefore \quad \dfrac{T_1}{T_2} = \dfrac{M_1}{M_2} = \dfrac{16}{64} = \dfrac{1}{4} = 0.25$

**(xv).(D)** $\left( \dfrac{2RT}{M} \right)^{1/2} = 2 \left( \dfrac{2 \times R \times 323}{M} \right)^{1/2}$

$\therefore \quad T = 4 \times 323\ K \simeq 1292K \simeq 1019°C$

## EXERCISE-B

**1.** Only $CO_2$ will react with C.

$\Rightarrow$ $C + CO_2 \longrightarrow 2CO$ ; $C + CO \longrightarrow$ no reaction

$x$ $\quad$ $1-x$

$-$ $\quad$ $2x$

$\Rightarrow$ $CO = 2x + (1-x) = 1.6 \Rightarrow x = 0.6\,L \Rightarrow \%\,CO_2 = 60\%$ and $CO = 40\%$

**2.** $C_xH_y(g) + \left(x + \frac{y}{4}\right)O_2(g) \longrightarrow xCO_2(g) + \frac{y}{2}H_2O(\ell)$

Contraction in volume $= 10\left(1 + \left(x + \frac{y}{4}\right) - x\right) = (10 + 100 - 95) \Rightarrow y = 2$

$CO_2$ produced (Absorbed by KOH) $= 10x = 20 \Rightarrow x = 2$ $\}\, C_2H_2$

**3.** $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(\ell)$ ; $C_2H_2(g) + \frac{5}{2}O_2(g) \longrightarrow 2CO_2(g) + H_2O(\ell)$

$x$ ml $\quad$ $x$ ml $\quad$ $100-x$ ml $\quad$ $2(100-x)$ ml

$\Rightarrow$ $CO_2 = x + 2(100-x) = 135$ (Absorbed by KOH) $\Rightarrow x = 65$ ml Thus $\%\,CH_4 = 65$ and $\%\,C_2H_2 = 35$

**4.** $H_2 + CH_4 + CO + C_2H_4$

50 ml $\quad$ 30 ml $\quad$ 14 ml $\quad$ 6 ml

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(\ell)$ ; $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(\ell)$

50 ml $\quad$ 25 ml $\quad$ 30 ml $\quad$ 60 ml

$-$ $\quad$ $-$ $\quad$ 30 ml

$CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$ ; $C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(\ell)$

14 ml $\quad$ 7 ml $\quad$ 6 ml $\quad$ 18 ml

$-$ $\quad$ $-$ $\quad$ 14 ml $\quad$ $-$ $\quad$ $-$ $\quad$ 12 ml

$\Rightarrow$ $O_2$ left $= 150 - (25 + 60 + 7 + 18) = 40$ ml $\}\, \%\,O_2 = 41.67$

$CO_2$ produced $= 30 + 14 + 12 = 56$ ml $\}\, \%\,CO_2 = 58.33$

**5. (i) (B)** $C_xH_y(g) + \left(x + \frac{y}{4}\right)O_2(g) \longrightarrow xCO_2(g) + \frac{y}{2}H_2O(\ell)$

1 ml $\quad$ $x + \frac{y}{4}$ ml $\quad$ $x$ ml $\quad$ $\frac{y}{2}$ ml ($\because$ liquid)

$\Rightarrow$ Contraction in volume $= \left(1 + \left(x + \frac{y}{4}\right) - x\right) = 1 + \frac{y}{4}$ = (Due to 1 ml $C_xH_y$)

$\Rightarrow$ Contraction $= 12\left(1 + \frac{y}{4}\right) = 12 + 100 - 82 = 30$ ml $\Rightarrow$ $y = 6$

$\Rightarrow$ Contraction due to KOH $= 82 - 46 = 36 = 12x$ ($CO_2$) $\Rightarrow$ $x = 3$ $\Rightarrow$ $C_3H_6$

**(ii) (C)** Only CO will react with $O_2$

$\Rightarrow$ $CO + \frac{1}{2}O_2 \longrightarrow CO_2$

x ml  V ml

–  $V - \frac{x}{2}$ ml  x ml

Total Gases $= (15 - x) + x + \left(V - \frac{x}{2}\right)$ ml $= V + 12$ (given) $\Rightarrow$ $x = 6$ ml $\Rightarrow$ $CO_2 = 9$ ml (initially)

$\Rightarrow$ New mixture will contain $= x$ ml $+ (15 - x)$ml $= 15$ ml $CO_2$

$\Rightarrow$ If the original mix. is taken as 25ml, it will contain $\frac{25}{15} \times 9 \equiv 15$ ml $CO_2$ which will reduce the vol to $25 - 15 = 10$ml (CO) after passing through Alkali

**(iii) (C)** $C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$  $C_4H_{10}(g) + \frac{13}{2}O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(\ell)$

x L  –  $(3 - x)$ L  –

–  –  3x L  –  –  $4(3 - x)$ L

$\Rightarrow$ $3x + 4(3 - x) = 10$ (given) $\Rightarrow$ $x = 2$L ($C_3H_8$) and $C_4H_{10} = 1$L

**(iv) (B)** $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$ ; $C_2H_2(g) + \frac{5}{2}O_2(g) \longrightarrow 2CO_2(g) + H_2O(\ell)$

x ml  $\frac{x}{2}$ ml  $(40 - x)$ ml  $\frac{5}{2}(40 - x)$ml

–  –  x ml  –  –  $2(40 - x)$ ml

$105\text{ml} = V_{CO_2} + V_{O_2(\text{left})} = [x + 2(40 - x)] + \left[100 - \frac{x}{2} - \frac{5}{2}(40 - x)\right]$ $\Rightarrow$ $x = 25$ ml(CO) and $C_2H_2 \equiv 15$ ml

**(v) (D)** $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(\ell)$

x ml

Contraction due to combustion $= x[1 + 2 - 1] = 2x$

$C_2H_6(g) + \frac{7}{2}O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(\ell)$

$(100 - x)$ ml

Contraction due to combustion $= (100 - x)\left[1 + \frac{7}{2} - 2\right] = \frac{5}{2}(100 - x)$

$\Rightarrow$ $212 = 2x + \frac{5}{2}(100 - x)$ $\Rightarrow$ $x = 76$ ml

Contraction when resulting gases passed through KOH $= x + 2(100 - x) = 124$ml ($CO_2$)

## EXERCISE-C

**1.** **(a)** Since T is same $\Rightarrow \quad \frac{\nu_{He}}{\nu_{SO_2}} = \sqrt{\frac{M_{SO_2}}{M_{He}}} = 4$ [Take only speed for comparism $\nu \alpha \frac{1}{\sqrt{M}}$]

**(b)** $\nu_{SO_2} = \frac{1}{2}\nu_{He} \quad \Rightarrow \quad \sqrt{\frac{3RT}{M_{SO_2}}} = \frac{1}{2}\sqrt{\frac{3R \times 300}{M_{He}}} \quad \Rightarrow \quad T = 1200K$

**(c)** Since T is same and so K.E. and hence, speeds will be same.

**(d)** Since T is same, K.E. will be same and hence speeds will be same.

**2.** $C_{rms} = \sqrt{\frac{3RT}{M}} \equiv \sqrt{\frac{3P}{\rho}} = \sqrt{\frac{3 \times 1.01 \times 10^5}{0.00143 \times 1000}} = 460.13\,ms^{-1}$

$C_{avg.} = 0.921\, C_{rms} = 429.9\,ms^{-1}$ and $C_{MP} = \frac{C_{rms}}{1.224} = 375.9\ ms^{-1}$

**3.** **(a)** $P = \frac{nRT}{V} = \frac{2 \times 0.082 \times 300}{5} = 9.84\ atm$

**(b)** $\left(P_{Real} + \frac{a}{V_m^2}\right)(V_m - b) = RT \quad \Rightarrow \quad \left(P_{Real} + \frac{4.17}{(5/2)^2}\right)\left(\frac{5}{2} - 0.037\right) = 0.082 \times 300 \quad \Rightarrow \quad P_{Real} = 9.32\,atm$

**4.** **(a)** $\sqrt{\frac{3RT}{M_{H_2}}} = \sqrt{\frac{3R \times 273}{M_{O_2}}} \quad \Rightarrow T = 273 \times \frac{2}{32} = 17.06\,K$

**(b)** $C_{avg.} = \sqrt{\frac{8RT}{\pi M}} \quad \Rightarrow \quad \frac{C_{avg_1}}{C_{avg_2}} = \frac{1}{2} = \sqrt{\frac{T_1}{T_2}} \quad \Rightarrow \quad T_2 = 4T_1 = 1092\,K$

**(c)** $\frac{C_{rms1}}{C_{rms2}} = \sqrt{\frac{T_1}{T_2}} = \frac{5 \times 10^4}{10 \times 10^4} \quad \Rightarrow \quad T_2 = 4T_1$

**5.** **(i) (B)** For $H_2$, the mass is very small and the intermolecular forces of attractions are small. Hence the pressure correction factor $\frac{a}{V^2}$ is negligible at all pressures. Hence van der Waal's equation is reduced to

$$P(V - b) = RT$$

$$PV = RT + Pb$$

This explains why $H_2$ shows positive deviation only.

**(ii) (A)** $C_{MP}\ \alpha \sqrt{T} \quad \Rightarrow$ Curve shifts to the right as T increases. $\Rightarrow \quad T_3 > T_2 > T_1$

**(iii) (BCD)** $K.E_{Avg.(Molecule)} = \frac{3}{2}K_B T$

$C_{rms} \alpha \sqrt{T} \qquad ; \qquad P = \frac{1}{3}\frac{m_o N}{V}C_{rms}^2 \quad \Rightarrow \quad P\ \alpha\ C_{rms}^2$

**(iv) (AD)** $K.E_{O_2} = K.E_{He}$ as T is same ; $\frac{C_{avg\,O_2}}{C_{avg\,He}} = \sqrt{\frac{M_{He}}{M_{O_2}}} < 1$

**(v) (C)** $\frac{C_{rms}H_2}{C_{rms}N_2} = \sqrt{7} = \sqrt{\frac{T_{H_2}}{T_{N_2}} \cdot \frac{M_{N_2}}{M_{H_2}}} \Rightarrow T_{N_2} = 2T_{H_2}$

**(vi) (D)** Same T $\Rightarrow$ Same K. E $\Rightarrow$ $\frac{1}{2}m_1u_1^2 = \frac{1}{2}m_2u_2^2 \Rightarrow m_1u_1^2 = m_2u_2^2$

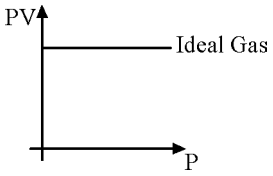
**(vii) (B)** $\frac{C_{rms\,1}}{C_{rms\,2}} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{140}{560}} = \frac{1}{2} \Rightarrow C_{rms}\,(new) = 2V$

**(viii) (C)** $Z > 1 \Rightarrow$ Gas is difficult to compress ; $Z < 1 \Rightarrow$ Gas can be easily compressed

**(ix) (A)** $\frac{C_{avg_1}}{C_{avg_2}} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{300}{600}} = \frac{1}{2} \Rightarrow C_{avg_2} = 0.6\,ms^{-1}$

**(x) (D)** $\Rightarrow$ As $P \to 0 \Rightarrow$ Gas will behave ideally. $(Z \to 1)$

$\Rightarrow$ $PV_m \longrightarrow RT$




**(xi) (D)** $R = 8.314\ J\ mol^{-1}\ K^{-1}$

$leV = 1.6 \times 10^{-19}\ J$

$R = \frac{8.314}{1.6 \times 10^{-19}} eV\ mol^{-1}\ K^{-1} = 5.19 \times 10^{19}\ eV\ mol^{-1}\ K^{-1}$

**(xii) (A)** $V_m > 22.4$ . It is difficult to compress gas.

**(xiii) (A)** Since intermolecular forces are negligible

$P(V - b) = RT$

$PV = RT + Pb$

So Z is always greater than 1.

**(xiv) (A)** $\frac{n^2a}{v^2}$ is included for pressure correction due to the force of attraction between molecules, the molecule near the wall experiences an inward pull and so the pressure exerted is less than the ideal pressure.

**(xv) (C)** $\frac{RT_A}{\pi M_A} = \frac{3RT_B}{M_B}$ $\therefore$ $\frac{8T_A}{3\pi T_B} = \frac{M_A}{M_B} = 16$ ; $\frac{T_A}{T_B} = 16 \times \frac{3\pi}{8} \approx 19$

**(xvi) (C)** Daltons law is applicable only to mixture of gases, that the non reacting.

**(xvii) (D)** $C_{rms} = \left(\frac{3RT}{M}\right)^{1/2}$ $\therefore$ $\frac{3RT}{M} = \left\{\frac{[3 \times 8.314 \times 10^7 \times T]}{2}\right\}$

$= \left(2.15 \times 10^5\right)^2$

$\therefore$ $T = 371\ K;\ t = (T - 273)°C \simeq 100°C$

## MISCELLANEOUS EXERCISE

**1.(C)** Look for low P and high T

**2.(A)** $n_{Total} = \frac{PV}{RT} = \frac{6 \times 3}{0.082 \times 300} = 0.73$

$n_X = n_{Total} - 0.7 = 0.03$

Using Graham's law of Diffusion : $\frac{n_{H_2/t}}{n_X/t} = \frac{0.7}{n_X} = \sqrt{\frac{M_X}{M_{H_2}}} = \sqrt{\frac{M_X}{2}}$

$\Rightarrow \quad M_X = 2\left(\frac{0.7}{n_X}\right)^2 = 1088$

**3.(B)** $C_xH_yO_z(g) + \left(x + \frac{y}{4} - \frac{z}{2}\right)O_2(g) \longrightarrow x\,CO_2(g) + \frac{y}{2}H_2O(\ell)$

1 ml $\quad$ $x + \frac{y}{4} - \frac{z}{2}$ ml $\quad$ x ml

Contraction in volume due to combustion = $10\left[\left(1 + x + \frac{y}{4} - \frac{z}{2}\right) - x\right] = 10 + 100 - 90 = 20$

$\Rightarrow \quad 1 + \frac{y}{4} - \frac{z}{2} = 2 \quad \Rightarrow \quad y - 2z = 4 \quad$ **.....(i)**

and Contraction in volume due to absorption of $CO_2$ by NaOH : $10x = 20 \quad \Rightarrow \quad x = 2$

Also, $M_0 = 2\,V.D. = 46 = 12x + y \times 1 + 16z$

$\Rightarrow \quad y + 16z = 22 \quad$ **.....(i)**

$\Rightarrow \quad z = 1$ and $y = 6 \quad \Rightarrow \quad$ Molecular Formula = $C_2H_6O$

**4.(C)** $C_xH_y(g) + \left(x + \frac{y}{4}\right)O_2(g) \longrightarrow x\,CO_2(g) + \frac{y}{2}H_2O(\ell)$

1 ml $\quad$ $x + \frac{y}{4}$ ml $\quad$ x ml

Contraction in volume due to combustion = $5\left(1 + x + \frac{y}{4} - x\right) = 5 + 30 - 25 = 10 \Rightarrow \quad y = 4$

Contraction due to KOH = $25 - 15 = 10 = 5x \Rightarrow \quad x = 2$

$\Rightarrow \quad$ Molecular Formula = $C_2H_4$

**5.(D)** Check yourself that all are correct.

- Decreases with increase in concentration – means increase in the number of molecules
- Increases with decrease in pressure at constant temperature – means increase in the volume available for gas molecules
- Decreases with increase in molecular size – means decrease in the volume of available for gas molecules

**6.(A)** $\frac{r_{N_2}}{r_{XeF_y}} = \frac{1/38}{1/57} = \frac{0.8}{1.6}\sqrt{\frac{M_{XeF_y}}{28}}$

$\Rightarrow \quad M_{XeF_y} = 252 = 131 + 19y \quad \Rightarrow \quad y \approx 6 \quad \Rightarrow \quad$ Molecular Formula = $XeF_6$

**7.(A)** $\left.\begin{aligned} c_{avg} &= \sqrt{\frac{8RT}{\pi M_o}} \\ c_{rms} &= \sqrt{\frac{3RT}{M_o}} \end{aligned}\right\} \Rightarrow \frac{400}{c_{rms}} = \sqrt{\frac{8}{3\pi}} \Rightarrow c_{rms} = 400 \times \sqrt{\frac{3\pi}{8}} = 434.16\,ms^{-1}$

**8. (B)** For intercept, $P \to 0 \Rightarrow Z \to 1$

$\Rightarrow \quad PV_m \to RT$

$\Rightarrow \quad$ Intercept = RT

**9. (A)** $\frac{g_{N_2}}{g_{O_2}} = \frac{1 \times 28}{\frac{7}{8} \times 32} = 1$

**10.(A)**


$3H_2(g) + N_2(g) \longrightarrow 2NH_3(g)$

$n_{H_2} = \frac{600 \times 2V}{RT}$; $\quad n_{N_2} = \frac{900 \times 3V}{RT}$

Clearly, $H_2$ is the limiting agent.

$\Rightarrow \quad N_2$ left $= \frac{2700\,V}{RT} - \frac{400\,V}{RT} = \frac{2300\,V}{RT}$ and $NH_3$ formed $= \frac{800V}{RT}$

$\Rightarrow \quad P_{new} = \frac{(\frac{3100\,V}{RT})RT}{5V} = 620\,mm$

**11.(C)** $\frac{r_A}{r_B} = \frac{2}{1} = \sqrt{\frac{M_B}{M_A}}$

$\frac{c_{rms\,A}}{c_{rms\,B}} = \sqrt{\frac{T_A}{M_A} \cdot \frac{M_B}{T_B}} = \sqrt{\frac{2}{1}} \times 2 = \frac{2\sqrt{2}}{1}$ [Rate $\propto c_{rms}$]

**12.(C)** As we move away from the origin in a P-V curve for Boyle's law, T increases for the isotherms.

**13.(C)** Mass of the gas = 50.5 – 50 = 0.5 gm ;

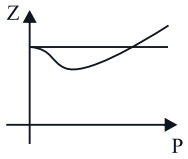
mass of liquid = 148 – 50 = 98 gm = 0.98 $V_{ml} \Rightarrow \quad V_{ml} = 100$ ml

Use : PV = nRT

$\Rightarrow \quad 1 \times 0.1 = \frac{0.5}{M_0} \times 0.082 \times 300 \Rightarrow M_0 = 123\,gm$

**14.(B)** Slope $= \frac{b}{RT}$ only in the high pressure region.

For $H_2$ and He, $a \approx 0 \Rightarrow$ Slope $= \frac{b}{RT}$



**15.(B)** $Z = \frac{PV_m}{RT} = \frac{PV}{nRT} = \frac{PV \times M_0}{g \times RT} = \frac{PM_0}{\rho RT}$

$\Rightarrow \quad Z = \frac{0.5 \times 5}{0.3 \times 0.082 \times 300} = 0.34 < 1 \quad \Rightarrow$ Attractive forces dominate

**16.(B)** $\frac{r_X}{r_{H_2}} = \frac{1}{3\sqrt{3}} = \sqrt{\frac{m_{H_2}}{M_X}} \Rightarrow M_X = 54\,gm = 12n + (2n-2)$

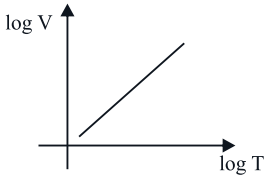
$\Rightarrow \quad 14n = 56 \Rightarrow n = 4$

**17.(B)** $Z = \frac{V_{m,\,real}}{V_{m,\,ideal}} = 0.9 \quad \Rightarrow$ Attractive molecular forces

**18.(AC)** $V = (const.)\,T = kT$

$\Rightarrow \quad \log V = \log T + \log k$

$\Rightarrow$




Charle's law

**19.(ACD)** When $V_m$ approaches large value, P approaches zero $\Rightarrow Z = 1$

When P approaches large value $\Rightarrow Z > 1$ and increases

van der Waals gas constant doesn't depend on the temperature and pressure and depend on the identity of the gas.

A real gas exerts pressure less than an ideal gas due to the presence of the attractive forces.

**20.(A)** $P_i = P_f$

$\Rightarrow \quad \frac{10RT}{V_i} = \frac{9RT}{V_f} \quad \Rightarrow \quad V_f = \frac{9V_i}{10}$

$P_{O_{2i}} = \frac{3RT}{V_i}$ and $P_{O_{2f}} = \frac{2RT}{V_f}$

$\Rightarrow \quad \frac{P_{O_{2i}} - P_{O_{2f}}}{P_{O_{2i}}} = \frac{3 - \frac{20}{9}}{3} = 26\%$

**21.(D)** Check that 500 K is Boyle's Temperature.

$\Rightarrow \quad 500 = \frac{a}{2 \times b} \Rightarrow \frac{a}{b} = 1\ k\,cal\ atm^{-1}$

**22.(A)** Slope in high P region $= \frac{b}{RT} = \frac{2.2 - 2}{1200 - 1000}$

$= \frac{0.2}{200} = 10^{-3}\ atm^{-1}$

**23.(C)** $Z = 2 = \frac{PV_m}{RT}$

$\Rightarrow \quad V_m = \frac{2RT}{P} = \frac{0.082 \times 200 \times 2L}{500} = 0.066\,L$

**24.(A)** $Z \approx 1$ for a large pressure range in low pressure region.