12. Properties of gases

Q1.

Sol: Mass of He- gas = 1g

Volume = 2 lit

P = 2.05 atm

$n_{He} = \frac{1}{4}$

$\therefore$ PV = nRT

$$T = \frac{PV}{nR} = \frac{2.05 \times 2}{0.0821 \times \frac{1}{4}} = \frac{2.05 \times 8}{0.0821} = 200\,K$$

Ans

Q2.

Sol: $d_{He} = 0.1784\ Kg/m^3$ at STP

A/q, : $V_f = 1.5\ Vi$

: mf = mi = constant

$\therefore di = \frac{mi}{Vi}$

$$\Rightarrow df = \frac{mf}{Vf} = \frac{mi}{1.5Vi} = \frac{di}{1.5} = \frac{0.1784}{1.5} = 0.1189\,Kg/m^3$$

Ans

Q3.

Sol: $d_A = 1.43\,g/L.$ at STP

$T = 17^0C = 273 + 17 = 290\ K$

$P = 700\ torr = \frac{700}{760}\ atm$

We have PM = dRT

$\Rightarrow M = \frac{dRT}{P}$ = will remain same

$$\frac{d_1RT_1}{P_1} = \frac{d_2RT_2}{P_2} \quad \Rightarrow d_2 = d_1 . \frac{P_2}{P_1} . \frac{T_1}{T_2}$$

$$d_2 = 1.43\ g/lit. \frac{700}{760} \times \frac{273}{290} = 1.24\,g/lit$$

Ans

Q4.

Sol: W = 3.2 g at NTP

Volume of the container is same, so

$V = \frac{nRT}{P}$ = constant

$$\Rightarrow \frac{n_1RT_1}{P_1} = \frac{n_2.RT_2}{P_2} \quad \Rightarrow \frac{W_1}{M} . \frac{273}{1} = \frac{W_2}{M} . \frac{473}{16}$$

$$W_2 = W_1 \cdot \frac{273}{473} \times \frac{16}{1} = 3.2 \times 9.2346 = 29.55\text{ g}$$ **Ans**

Q5.

Sol: $W_{C_2H_2} = 5g$

$T = 50^0C = 273 + 50 = 323$ K

$P = 740$ mm of Hg

$n\ C_2H_2 = \frac{5}{26}$

$\therefore PV = nRT$

$$V = \frac{\frac{5}{26} \times 0.0821 \times 323}{740/760} = 5.2375\text{ lit}$$

Ans

Q6.

Sol: Volume & pressure will remain same as the bottle volume is fixed & since it is open it will be at constant pressure.

$n.T$ = constant

$n_1T_1 = n_fT_f$

$$\frac{n_1}{n_f} = \frac{Tf}{T_i} = \frac{373}{288}$$

$$\text{Fractional removed} = \frac{nf}{ni} \times 100$$

$$= \left(1 - \frac{n_f}{n_i}\right) \times 100 = \left(1 - \frac{288}{373}\right) \times 100 = 22.8\%$$

Ans

Q7.

Sol: As no. of moles of gases remain same in the bubble

So $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$$\frac{3 \times V_1}{(273+5)} = \frac{1 \times V_2}{(273+25)}$$

$$V_2 = \frac{298 \times 3}{278} V_1$$

$$\frac{4}{3}\pi r_2^3 = \frac{298 \times 3}{278} \times \frac{4}{3}\pi r_1^3 \quad \Rightarrow r_2 = \left(\frac{298 \times 3}{278}\right)^{1/3} r_1 = 0.74\text{cm}$$

Ans

Q8.

Sol: $P = 10^{-6}$ mm of Hg

$T = 25^0C = 298$ K

$PV = nRT$

$$P = \frac{n}{V}RT$$

$$\frac{n}{V} = \frac{P}{RT} = \frac{\frac{10^{-6}}{760}}{0.0821 \times 298} = 5.378 \times 10^{-11}$$

$\therefore$ no. of molecules per volume $= 3.23 \times 10^{10}$ **Ans**

Q9.

Sol: T = 25^0C = 298 K

V = 750 cc

P_{total} = 740 mm with Vapour press. of water = 24 mm

$\therefore$ P water vapour + $P_{N_2} = P_{total}$

$24 + P_{N_2} = 740$ mm

$P_{N_2} = 716$ mm

PV = nRT

$$n = \frac{PV}{RT} = \frac{\frac{716}{760} \times 750 \times 10^{-3}}{0.0821 \times 298\,K} = 0.0288$$

Ans

Q10.

Sol: V = 1 lit, P = 1 atm & T = 25^0C = 298 K

$$Pf = 10^{-4}\text{ mm} = \frac{10^{-4}}{760}\text{atm} = 1.316 \times 10^{-7}\text{atm}$$

PV = nRT

$$n = \frac{PV}{RT} = \frac{1.316 \times 10^{-7} \times 1}{0.0821 \times 298} = 5.38 \times 10^{-8}$$

$\therefore$ No. of molecules = n. $N_A = 5.38 \times 10^{-9} \times 6.023 \times 10^{23} = 3.24 \times 10^{15}$ **Ans**

Q11.

Sol: V = 1 $mm^3 = 10^{-9}m^3 = 10^{-6}$ lit

$$P = 10^{-6}\text{ mm of Hg} = \frac{10^{-6}}{760}\text{atm}$$

T = 25^0C = 298 K

$$n = \frac{PV}{RT} = \frac{10^{-6} \times 10^{-6}}{760 \times 0.0821 \times 298} = 5.378 \times 10^{-17}$$

$\therefore$ no. of molecules $= 3.24 \times 10^7$ **Ans**

Q12.

Sol: Wt of empty vessel = 38.734 g

Wt. of filled vessel = 39.3135 g

$\therefore$ Wt of gas filled = 39.3135 − 38.734 = 0.5795 g

Volume of bulb = 500 w = 5×10^{-1} lit

T = 24^0C = (273 + 24) K = 297 K

Effective mass of 1 mole of air = Mol. wt of air

By, PV = nRT

$$1\times5\times10^{-1}=\frac{0.5795g}{M.W}\times0.0821\times297$$

$$M.W.=\frac{0.5795\times0.0821\times297}{0.5}$$

$$\frac{0.5795\times0.0821\times297}{0.5}=28.26\,g$$ **Ans**

Q13.

Sol: As temp. & volume remained same. Volume will remain same as the volume of vessel it It won't change.

Q14.

Sol: W = 1.293 g

V = 1 lit, at NTP.

$$\text{no. of moles}=\frac{V}{22.4}=\frac{1}{22.4}=\frac{1.293}{M.W._{air}}$$

$\Rightarrow$ $M.W._{air}=29\,g$

For V = 1 lit, W = 1 g $\Rightarrow n_{air}=\frac{1}{29}$

$P=72\text{ cm of Hg}=\frac{72}{76}\text{atm}$

PV = nRT

$$T=\frac{\frac{72}{76}\times1}{0.0821\times\frac{1}{29}}=\frac{72\times29}{76\times0.0821}=334.6$$

Q15.

Sol: M.W of Hydrocarbon = $2.47\times M.W._{air}$ = $2.47\times32=79.04\,g$ **Ans**

Q16.

Sol: $W_i=370\,g$, $P_i=30$ atm, $T_i=298$ K

M = 1 atm, $T_f=273+75=348$ K.

Since volume is constant

$$V=\frac{nRT}{P}=\text{constant}\quad\Rightarrow\frac{n_1T_1}{P_1}=\frac{n_2T_2}{P_2}$$

$$\frac{\frac{370}{32}\times298}{30}=\frac{\frac{W_2}{32}\times348}{1}\quad\Rightarrow W_2=\frac{370\times298}{30\times348}=10.56\,g$$

$\therefore$ So wt removed = 370 – 10.6 = 359.4 g **Ans**

Q17.

Sol: $d = 2.28\ g/lit,\ T = 300\ K,\ P = 1\ atm$

$PM = dRT$

$$M = \frac{2.28 \times 0.0821 \times 300}{1} = 56.156g$$

In compound

Elements	% by wt	$\frac{\%\text{by wt}}{M.W} = X$	$X/x\ min$
C	85.7	$\frac{85.7}{12} = 7.14$	$\frac{7.14}{7.14} = 1$
H	14.3	$\frac{14.3}{1} = 14.3$	$\frac{14.3}{7.14} = 2$

$\therefore$ Empirical formula= CH_2

Empirical wt = 14

Mol wt = 56

$$n = \frac{Mol.wt}{emp.wt} = \frac{56}{14} = 4$$

$\therefore$ Molecular formula = (empirical formula)$_4$ = $(CH_2)_4 = C_4H_8$ **Ans**

Q18.

Sol: $V = 1 \times 10^5$ lit

$T = 268\ K\ \&\ P = 2 \times 10^{-3}$ atm

Let w is the wt of He required inflating the balloon

$$PV = \frac{W}{M_{He}}RT$$

$$2 \times 10^{-3} \times 10^5 = \frac{w}{4} \times 0.0821 \times 268 \Rightarrow w = \frac{2 \times 10^2 \times 4}{0.0821 \times 268} = 36.36g$$

Ans

Q19.

Sol: $n_{CH_4} = \frac{1.6}{16} = 0.1,\ n_{CO_2} = \frac{2.2}{44} = 0.05$

$n_{CH_4} + n_{CO_2} = 0.15$

$V = 4$ lit, $T = 273 + 27 = 300$ K.

$\Rightarrow PV = nRT$

$$\Rightarrow P = \frac{nRT}{V} = \frac{0.15 \times 0.0821 \times 300}{4} = 0.924 atm$$

Ans

Q20.

Sol: $T = 100^0C = 373\ K,\ P = 1\ atm,\ d = 0.005970\ g/cc$

$T = 0^0C = 273\ K$

$n_{H_2} = \frac{0.174}{2}$ & $n_{N_2} = \frac{1.365}{28}$

$P_{H_2} = \frac{n_{H_2}.RT}{V} = \frac{0.174}{2} \times \frac{0.0821 \times 273}{2.83} = 0.688\,atm$

$P_{N_2} = \frac{n_{N_2}.RT}{V} = \frac{1.365}{28} \times \frac{0.0821 \times 273}{2.83} = 0.386\,atm$

$P_{total} = P_{N_2} + P_{H_2} = 1.075\,atm$

$\therefore \frac{P_{H_2}}{P_{total}} = \frac{n_{H_2}}{n_{total}} = \frac{0.688}{1.075} = 0.639$ **Ans**

Q24.

Sol: $\underset{NH_3}{V} = 100\,cm^2 = 0.1\,lit$

$t = 32.5\ sec$

$V_{N_2} = 60\,cm^3$

$$\frac{\text{Rate of diffusion of } NH_3}{\text{Rate of diffusion of } N_2} = \sqrt{\frac{M_{N_2}}{M_{NH_3}}}$$

$$\frac{V_{NH_3}/t_{NH_3}}{V_{N_2}/t_{N_2}} = \sqrt{\frac{28}{17}} \Rightarrow \frac{100/32.5}{60/t_{N_2}} = \sqrt{\frac{28}{17}}$$

$$t_{N_2} = \frac{32.5 \times 60}{100}\sqrt{\frac{28}{17}} = 25\,sec$$

Ans

Q25.

Sol: $\frac{r_x}{r_y} = 5 = \sqrt{\frac{M_Y}{M_X}} \Rightarrow \frac{M_Y}{M_X} = 25 \quad \therefore \frac{M_X}{M_Y} = \frac{1}{25}$ **Ans**

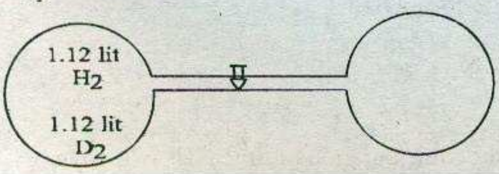
Q26.

Sol: $\frac{r_{CH_4}}{r_X} = 2 = \sqrt{\frac{M_X}{M_{CH_4}}} = \frac{Mx}{16} = 4 \Rightarrow M_x = 64\,g$ **Ans**

Q27.

Sol: $V_{H_2} = 1.12\,lit$

$V_{D_2} = 1.12\,lit$



$$n_{H_2} = \frac{1.12}{22.4} = \frac{1}{20} \Rightarrow (w_{H_2})_i = \frac{1}{20} \times 2 = 0.1\,g$$

$$n_{D_2} = \frac{1.12}{22.4} = \frac{1}{20} \Rightarrow W_{D_2} = \frac{1}{20} \times 4 = 0.2\,g$$

$W_{H_2 f} = 0.05g$

$\therefore$ wt of H_2 diffused = (0.1 – 0.05) = 0.05 g

$$\frac{r_{H_2}}{r_{D_2}} = \frac{W_{H_2}/t_{H_2}}{W_{D_2}/t_{D_2}} = \sqrt{\frac{M.w_{D_2}}{M.w_{H_2}}}$$

$$\frac{0.05}{W_{D_2}} = \sqrt{\frac{4}{2}} = \sqrt{2} \quad (\because t_{H_2} = t_{D_2})$$

$$W_{D_2} = \frac{0.05}{\sqrt{2}} = 0.035\,g$$

$\therefore$ Weight of H_2 in 2^{nd} bulb = 0.05 g

Weight of D_2 in 2^{nd} bulb = 0.035 g

$\therefore$ % of $H_2 = \dfrac{0.05}{0.085} \times 100 = 58.4\%$ **Ans**

% of $D_2 = \dfrac{0.035}{0.085} \times 100 = 41.6\%$ **Ans**

Q28.

Sol: n% of H_2 = 80%

n% of D_2 = 20%

At temp. = 25^0C = 298 K, P = 1 atm, A = 0.20 mm^2

$P_{H_2} = X_{H_2}, P_{total} = 0.8$ atm

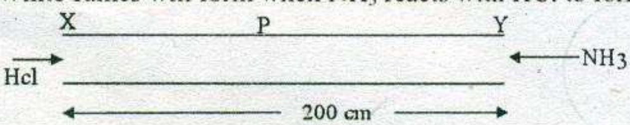
$P_{D_2} = X_{D_2}, P_{total} = 0.2$ atm

$$\therefore \frac{r_{H_2}}{r_{D_2}} = \frac{P_{H_2}}{P_{D_2}}\sqrt{\frac{M_{D_2}}{M_{H_2}}} = \frac{0.8}{0.2}\sqrt{\frac{4}{2}}$$

$$\frac{n_{H_2}\text{ effused}}{n_{D_2}\text{ effused}} = 4\sqrt{2} = 5.656:1$$ **Ans**

Q29.

Sol: White fumes will form when NH_3 reacts with HCl to form NH_4Cl.



Let x cm is the distance covered by HCl, then in the same duration of time NH_3 will cover

(200-x) cm.

$$\therefore \frac{d_{HCl}}{d_{NH_3}} = \sqrt{\frac{M_{NH_3}}{M_{HCl}}} \Rightarrow \frac{x}{200-x} = \sqrt{\frac{17}{36.5}} = 0.68$$

$$X = 136.5 - 0.68\,x$$

$$\Rightarrow X = \frac{136.5}{1.68} = 81.245\,\text{cm}$$

Ans

Q30.

Sol: $\frac{V_{H_2}}{V_{O_2}} = \frac{3}{1} \Rightarrow \frac{n_{H_2}}{n_{O_2}} = \frac{3}{1}$ (at cant total P & T)

$$\therefore \frac{P_{H_2}}{P_{O_2}} = \frac{X_{N_2}}{X_{O_2}} = \frac{n_{H_2}}{n_{O_2}} = \frac{3}{1}$$

$$\therefore \frac{\text{Diffusion rate } H_2}{\text{Diffusion rate } O_2} = \frac{P_{H_2}}{Po_2}\sqrt{\frac{Mo_2}{MH_2}} = \frac{3}{1}\sqrt{\frac{32}{2}} = \frac{3}{1}\sqrt{16} = 12:1$$ **Ans**

Q31.

Sol: $\frac{V_{O_2}/t_{O_2}}{V_{Cl_2}/t_{Cl_2}} = \sqrt{\frac{M_{Cl_2}}{M_{O_2}}}$

A/q, $V_{O_2} = V_{Cl_2}$, $t_{O_2} = 3600$ sec ; $t_{Cl_2} = ?$

$$\frac{t_{Cl_2}}{t_{Cl_2}} = \sqrt{\frac{71}{32}}$$

$$t_{Cl_2} = 3600\sqrt{\frac{71}{32}} = 5362\,\text{sec}$$

Ans

Q32.

Sol:- $\frac{\text{Rate of diffusion of } ^{235}UF_6}{\text{Rate of diffusion of } ^{238}UF_6} = \sqrt{\frac{M.w\ ^{238}UF_6}{M.w\ ^{235}UF_6}}$

$$= \sqrt{\frac{238+19\times 6}{235+19\times 6}} = \sqrt{\frac{352}{349}} = \sqrt{1.0086} = 1.0043:1$$ **Ans**

Q33.

Sol: $3O_2 \rightleftharpoons 2O_3$

Initially 1 0

At reac-^{n} $1-3x$ $2x$

Total moles now = 1-x

$$\therefore M.w. = \frac{32}{1-x}$$

Now $\frac{R_{O_2+O_3}}{R_{O_2}} = \sqrt{\frac{M_{O_2}}{M.w_{O_2+O_3}}} = \sqrt{\frac{32}{32/1-x}}$

$0.98 = \sqrt{1-x}$

$1-x = 0.96$

$\therefore x = 0.04$

$\therefore$ Mole % of ozone $= \frac{2x}{1-x}\times 100 = \frac{0.08}{0.96}\times 100 = 8.25\%$

$\therefore$ Volume% = mole% = 8.25% **Ans**

Q34.

Sol: Rate of diffusion of $O_2 = \frac{2000-1500}{47} = \frac{500}{47}$

Rate of diffusion of gas x $= \frac{2000-1500}{74} = \frac{500}{74}$

$\frac{R_{O_2}}{R_{X_2}} = \sqrt{\frac{Mx}{M_{O_2}}} \Rightarrow \frac{\frac{500}{47}}{500/74} = \sqrt{\frac{Mx}{32}}$

$\frac{74}{47} = \sqrt{\frac{Mx}{32}} \Rightarrow \frac{Mx}{32} = 2.48 \Rightarrow \therefore Mx = 79.3$ g **Ans**

Q35.

Sol:- Let M.W. of unknown gas is x

Then M.W. of the mixture of (10% O_2 & 90% unknown gas)

$= \frac{10\times M.w_{O_2} + 90\times M.w_X}{100} = \frac{32+9x}{10}$

Now $\frac{\text{Rate of diffusion of mix}}{\text{Rate of diffusion of } O_2} = \sqrt{\frac{M_{O_2}}{M_{mix}}}$

Under the same condition, same volume of mix & O_2 will be present.

$\frac{V/t_{mix}}{V/t_{O_2}} = \sqrt{\frac{32}{\frac{32+9x}{10}}} \Rightarrow \frac{t_{O_2}}{t_{mix}} = \frac{75}{86} = \sqrt{\frac{320}{32+9x}}$

$0.76 = \frac{320}{32+9x} \Rightarrow 32+9x = \frac{320}{0.76} = 420.75$

$9x = 388.75$

$X = 43.2$ g **Ans**

Q36.

Sol: At constant Pressure, volume ratio = molar ratio

$\frac{n}{n_0} = \frac{80}{100} = \frac{8}{10} = 0.8$

$$2.303\log\left(\frac{n}{n_0}\right) = -\frac{Mgh}{RT}$$

$$2.303\log(0.8) = -\frac{4\times10^{-3}\times9.8\times h}{8.314\times293}$$ Solving, we have h = 13869 m; **Ans**

Q37.

Sol: $d = 0.00009 / cc = 0.0000g\ g / 10^{-3}\ lit = 0.09\ g / lit$

P = 760 mm of Hg

T = 273 K

$\therefore PM = dRT$

$$\Rightarrow \frac{M}{RT} = \frac{d}{P}$$

$$V_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\times8.314\times273}{1\times10^{-3}\,kg}} = 1838\,m/s$$ **Ans**

Q38.

Sol: V = 1 lit

no . of H_2 molecules $= 1.03\times10^{23}$

Pressure = 760 mm of Hg = 1 atm

PV = nRT

$$T = \frac{PV}{nR} = \frac{\dfrac{1\,atm\times1\,lit}{\dfrac{1.03\times10^{23}}{6.023\times10^{23}}\times0.0821}} = \frac{1}{\dfrac{1.03\times0.0821}{6.023}} = 71.225\,K$$

Average squared speed = rms speed $= \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\times8.314\times71.225}{2\times10^{-3}\,Kg}} = 942.47\,m/s$ **Ans**

Q39.

Sol: Escape velocity from earth surface $= \sqrt{2gR}$

$$= \sqrt{2\times9.8\times6.37\times10^{4}}\,m = 11.17\times10^{2}\,m/s$$

Rms speed of hydrogen $= \sqrt{\frac{3RT}{M}} = 11.17\times10^{2}\,m/s$

$$\therefore \sqrt{\frac{3\times8.314\times T}{2\times10^{-3}}} = 11.17\times10^{2} \Rightarrow \frac{3\times8.314\times T}{2\times10^{-3}} = 124.7689\times10^{4}$$

$$\Rightarrow T = \frac{124.768\times10^{4}\times2\times10^{-3}}{3\times8.314} = 100.2\,K$$ **Ans**

Q40.

Sol: Rms speed of $H_2 = \sqrt{\frac{3RT_{H_2}}{M_{H_2}}}$ & Rms speed of $O_2 = \sqrt{\frac{3RT_{O_2}}{M_{O_2}}}$

$$2.303\log\left(\frac{n}{n_0}\right) = -\frac{Mgh}{RT}$$

$$2.303\log(0.8) = -\frac{4\times10^{-3}\times9.8\times h}{8.314\times293}$$ Solving, we have h = 13869 m; **Ans**

Q37.

Sol: $d = 0.00009 / cc = 0.0000g\ g / 10^{-3}\ lit = 0.09\ g / lit$

$P = 760$ mm of Hg

$T = 273$ K

$\therefore PM = dRT$

$$\Rightarrow \frac{M}{RT} = \frac{d}{P}$$

$$V_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\times8.314\times273}{1\times10^{-3}\,kg}} = 1838\,m/s$$ **Ans**

Q38.

Sol: V = 1 lit

no . of H_2 molecules = 1.03×10^{23}

Pressure = 760 mm of Hg = 1 atm

PV = nRT

$$T = \frac{PV}{nR} = \frac{1\,atm\times1\,lit}{\frac{1.03\times10^{23}}{6.023\times10^{23}}\times0.0821} = \frac{1}{\frac{1.03\times0.0821}{6.023}} = 71.225\,K$$

Average squared speed = rms speed = $\sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\times8.314\times71.225}{2\times10^{-3}\,Kg}} = 942.47\,m/s$ **Ans**

Q39.

Sol: Escape velocity from earth surface = $\sqrt{2gR}$

$$= \sqrt{2\times9.8\times6.37\times10^4\,m} = 11.17\times10^2\,m/s$$

Rms speed of hydrogen = $\sqrt{\frac{3RT}{M}} = 11.17\times10^2\,m/s$

$$\therefore \sqrt{\frac{3\times8.314\times T}{2\times10^{-3}}} = 11.17\times10^2 \Rightarrow \frac{3\times8.314\times T}{2\times10^{-3}} = 124.7689\times10^4$$

$$\Rightarrow T = \frac{124.768\times10^4\times2\times10^{-3}}{3\times8.314} = 100.2\,K$$ **Ans**

Q40.

Sol: Rms speed of H_2 = $\sqrt{\frac{3RT_{H_2}}{M_{H_2}}}$ & Rms speed of O_2 = $\sqrt{\frac{3RT_{O_2}}{M_{O_2}}}$

A/q, $\sqrt{\frac{3RT_{H_2}}{M_{H_2}}} = \sqrt{\frac{3RT_{O_2}}{M_{O_2}}}$

$\frac{3RT_{H_2}}{2\times10^{-3}} = \frac{3R\times273}{32\times10^{-3}}$ at NTP $\begin{bmatrix} T = 273K \\ P = 1atm \end{bmatrix}$

$T_{H_2} = \frac{2}{32}\times273 = 17K \quad \therefore T_{H_2}(c) = 17-273 = -256^0C$ **Ans**

Q41.

Sol: Rms speed of O_2 at $15^0C = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\times8.314\times(273+15)}{32\times10^{-3}}} = 473.8$ m/s **Ans**

Rms speed of NH_3 at NTP $= \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\times8.314\times273}{17\times10^{-3}}} = 672.8\,m/s$ **Ans**

Rms speed of CH_4 at $500^0C = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\times8.314\times773}{16\times10^{-3}}} = 1097.73\,m/s$ **Ans**

Q42.

Sol: $PV = nRT$

$P = \frac{n}{V}RT$

K.E. of gases $= \frac{3}{2}PV = \frac{3}{2}nRT$

K.E. of gases per unit volume $= \frac{3}{2}P = \frac{3}{2}\frac{nRT}{V}$

$\therefore E = \frac{3}{2}P \Rightarrow P = \frac{2}{3}E$ **Ans**

Q43.

Sol: $V_{mps} = \sqrt{\frac{2RT}{M}}$

Let at temp. T Kelvin Vmps of CO is double to that at $T = 0^0C = 273K$, then

$\sqrt{\frac{2RT}{M}} = 2\sqrt{\frac{2\times R\times273}{M}}$

$T = 4\times273 = 1092$ K

$T = 819^0C$ **Ans**

Q44.

Sol: Average square speed $= \sqrt{\frac{3RT}{M}}$

For $N_2 = \sqrt{\frac{3RT}{28\times10^{-3}}}$

For He at 300 K, Av, square speed = $\sqrt{\frac{3R\times300}{4\times10^{-3}}}$

A/q, $\sqrt{\frac{3RT}{28\times10^{-3}}}=\sqrt{\frac{3R\times300}{4\times10^{-3}}}$

$T=\frac{28\times300}{4}=2100\,K$ **Ans**

Q45.

Sol: K.E. of gaseous molecules = $\frac{3}{2}nRT$

For Avogadro number of gaseous molecule, n = 1

∴ K.E of gaseous molecules per Avogadro's no. of molecule

$=\frac{3}{2}RT=\frac{3}{2}\times8.314\times273=3.4\times10^{3}$ joule

$=3.4\times10^{10}$ ergs **Ans**

Q46.

Sol: Average K.E/mole = $\frac{3}{2}\times8.314\times300=3.74\times10^{3}$ Joule **Ans**

$=3.74\times10^{10}$ ergs. **Ans**

$=\frac{3.74\times10^{3}}{4.2}=892$ caloric **Ans**

Q47.

Sol: Sp. heat at constant volume = 0.075 cal / g-degree

$C_V=0.075\,cal/g^{0}c\times40\,g/mole=3\,cal/mol^{0}c$

$\frac{R}{Y-1}=3$

$\frac{R}{Y-1}=3\Rightarrow Y-1=\frac{2}{3}\Rightarrow Y=\frac{2}{3}+1=5/3=1.67\Rightarrow$ monoatomic gas.

Q48.

Sol: $T=627^{0}C=627+273=900\,K$

P = 1 atm

$W_{eg}=1$ lit

Initially no. of moles = $\frac{\text{initial Wt}}{\text{Mol.wt of }SO_3}$ (∴ Wt remain conserved) = $\frac{0.94}{80}=0.01175$

	$2SO_3 \rightleftharpoons$	$2SO_2$	+ O_2
Initially	0.01175	0	0
At eq-[b]	0.01175 -2x	2x	x

∴ Total no. of moles at equation = 0.01175 + x

For He at 300 K, Av, square speed = $\sqrt{\frac{3R\times300}{4\times10^{-3}}}$

A/q, $\sqrt{\frac{3RT}{28\times10^{-3}}}=\sqrt{\frac{3R\times300}{4\times10^{-3}}}$

$T=\frac{28\times300}{4}=2100\,K$ **Ans**

Q45.

Sol: K.E. of gaseous molecules = $\frac{3}{2}nRT$

For Avogadro number of gaseous molecule, n = 1

$\therefore$ K.E of gaseous molecules per Avogadro's no. of molecule

$=\frac{3}{2}RT=\frac{3}{2}\times8.314\times273=3.4\times10^{3}$ joule

$=3.4\times10^{10}$ ergs **Ans**

Q46.

Sol: Average K.E/mole = $\frac{3}{2}\times8.314\times300=3.74\times10^{3}$ Joule **Ans**

$=3.74\times10^{10}$ ergs. **Ans**

$=\frac{3.74\times10^{3}}{4.2}=892$ caloric **Ans**

Q47.

Sol: Sp. heat at constant volume = 0.075 cal / g-degree

$C_V=0.075\,cal/g^{0}c\times40\,g/mole=3cal/mol^{0}c$

$\frac{R}{Y-1}=3$

$\frac{R}{Y-1}=3\Rightarrow Y-1=\frac{2}{3}\Rightarrow Y=\frac{2}{3}+1=5/3=1.67\Rightarrow$ monoatomic gas.

Q48.

Sol: $T=627^{0}C=627+273=900\,K$

P = 1 atm

$W_{eg}=1$ lit

Initially no. of moles = $\frac{\text{initial Wt}}{\text{Mol.wt of }SO_3}$ ($\because$ Wt remain conserved) = $\frac{0.94}{80}=0.01175$

	$2SO_3$ ⇌	$2SO_2$	+ O_2
Initially	0.01175	0	0
At eq-^{b}	0.01175 -2x	2x	x

$\therefore$ Total no. of moles at equation = 0.01175 + x

$\therefore$ No. of moles at T = 900 K & P = 1 atm

$$= \frac{\text{Volume}}{\text{molar volume}} = \frac{1\,\text{lit}}{\frac{0.0821 \times 900\,\text{lit}}{1}} = 0.0135$$

$\therefore\ 0.01175 + x = 0.0135$

$X = 1.78 \times 10^{-3}$

$$\therefore P_{SO_2} = \frac{2x}{0.01175 + x} \times 1 = \frac{2 \times 1.78 \times 10^{-3}}{0.01353} = 0.266 \text{ atm} \quad \textbf{Ans}$$

$$P_{SO_3} = \frac{0.01175 - 2x}{0.01175 + x} \times 1 \frac{819 \times 10^{-3}}{0.01358} = 0.60\,\text{atm}$$

$$P_{O_2} = P_{total} - (P_{SO_2} + P_{SO_3}) = 1 - 0.266 + 0.60 = 0.1286 \text{ atm} \quad \textbf{Ans}$$

Q49.

Sol: $N_2O_4 \rightleftharpoons 2NO_2$

Initially 1   0

At eg-^{b} 1-x   2x

total moles at eq-^{b} = 1 – x + 2x = 1 + x

A/q, degree of dissociation = 65.6% $= \frac{65.6}{100} \times 1 = 0.656$

$\therefore$ Total no. of moles at eq-^{b} = 1 + 0.0656 = 1.656

Wt at eq-^{b} = wt initially = 92 g

$$\text{Mol. wt (eq-}^b) = \frac{\text{Wt eq}-^b}{\text{no. of mole at eq}-^b} = \frac{92}{1.656}$$

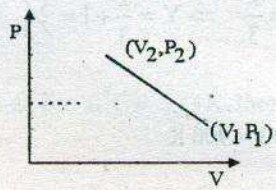
Mol. wt eq-^{b} = 55.56 g   **Ans**

Q50.

Sol: $(V_1, P_1) = (15 \text{ lit}, 2 \text{ atm})$

$(V_2, P_2) = (4 \text{ lit}, 10 \text{ atm})$

Eq,. of line



$$P - P_1 = \frac{P_1 - P_2}{V_1 - V_2}(V - V_1)$$

$$P = P_1 + \frac{P_1 - P_2}{V_1 - V_2}(V - V_1)$$

$$\frac{nRT}{V} = P_1 + \left(\frac{P_1 - P_2}{V_1 - V_2}\right)V - \left(\frac{P_1 - P_2}{V_1 - V_2}\right)V_1$$

$$T = \frac{1}{nR}\left\{P_1 V + \left(\frac{P_1 - P_2}{V_1 - V_2}\right)V^2 - \left(\frac{P_1 - P_2}{V_1 - V_2}\right)V_1 . V\right\}$$

For T to be max, $\frac{dT}{dV} = 0$

$$\frac{dT}{dV} = \frac{1}{nR}\left\{P_1 + 2\left(\frac{P_1 - P_2}{V_1 - V_2}\right)V - \left(\frac{P_1 - P_2}{V_1 - V_2}\right)V_1\right\} = 0$$

$$2\left(\frac{P_1 - P_2}{V_1 - V_2}\right)V = \frac{P_1V_1 - P_2V_1}{V_1 - V_2} - P_1 = \frac{P_1V_1 - P_2V_1 - P_1V_1 + P_1V_2}{V_1 - V_2} = \frac{P_1V_2 - P_2V_1}{(V_1 - V_2)}$$

$$V = \frac{P_1V_2 - P_2V_1}{2(P_1 - P_2)} = \frac{2\times 4 - 10\times 15}{2(2-10)} = 8.875$$

T_{max}, for 1 mole, n =1

$$T_{max} = \frac{1}{R}\left\{2\times 8.875 + \left(\frac{2-10}{15-4}\right)\times(8.875)^2 - \left(\frac{2-10}{15-4}\right)\times 15\times 8.875\right\}$$

$$= \frac{1}{R}\left\{17.75 + \left(\frac{-8}{11}\right)\times 78.7656 - \left(\frac{-8}{11}\right)\times 133.125\right\}$$

$$= \frac{1}{R}\{17.75 + 96.82 + (-57.28)\} = \frac{1}{R}\times 57.286 = \frac{57.286}{0.0821} = 697.76\,K$$

Ans

Q51.

Sol: $Wt_{N_2} = 7g$

$$n_{N_2} = \frac{7}{28} = \frac{1}{4}$$

P = 100 atm & T = 27°C = 300 K

a = 1.39 atm lit² mole⁻², b = 0.391 lit mol⁻¹

From Real gas equation

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

$$\left[100 + \frac{1.39\times\left(\frac{1}{4}\right)^2}{V^2}\right]\left(V - \frac{0.394}{4}\right) = \frac{1}{4}\times 0.0821\times 300 = 6.1575$$

$$\left(100 + \frac{0.086875}{V^2}\right)(V - 0.0985) = 6.1575$$

Solving : V = 0.0588 lit = 58.8 mL **Ans**

Q52.

Sol: $b = 4.2\times 10^{-2}$ lit / mole⁻¹

$$4N_A\frac{4}{3}\pi r^3 = 4.2\times 10^{-2}\times 10^3\,cm^3$$

$$\frac{16}{3}\pi r^3 N_A = 42\,cm^3 \quad\Rightarrow r^3 = \frac{42\times 3}{16\times 11\times 6.023\times 10^{23}} = 4.16\times 10^{-24}\,cm^3$$

$r = 1.608\times10^{-8}\,cm$

$\therefore$ Distance between two molecules = $2r = 3.2176\times10^{-8}$ cm **Ans**

Q53.

Sol: $\left(P+\frac{an^2}{v^2}\right)(V-nb)=nRT$

$\left(15+\frac{6.71\times3^2}{10^2}\right)(10-3\times0.0564)=3\times0.0821\times T$

$(15+0.6039)(10-0.1692)=0.2463T$

$153.398 = 0.2463\,T$

$T=\frac{153.398}{0.2463}=622.813K$ **Ans**

Q54.

Sol: $NH_4NO_2(s)\longrightarrow N_2(g)+2H_2O(g)$

2.55 g

$\frac{2.55}{64}=0.0398\,\text{moles}$

$T=26^0C=273+26=299K$

$P=745\text{ mm of Hg}=\frac{745}{760}\text{atm}$

Moles of N_2 produced = moles of NH_4NO_2 taken = 0.0398 moles

$PV = nRT$

$V=\frac{0.0398\times0.0821\times299}{745/760}=0.977\times\frac{760}{745}=0.9966\,\text{lit}$ **Ans**

Q55.

Sol: $V_{rms}=\sqrt{\frac{3RT}{M}}$

(i) As T increases, V_{rms} increases.

(ii) Volume doesn't effect the volume of the sample.

(iii) No effect, because temperature of the molecules doesn't change.

Q56.

Sol: Allowable $Ni(CO)_4$ = 1 part in 10^9 part of air = 1 volume in 10^9 volume of air

Volume of laboratory = $110\,m^2\times2.7 = 2.97\times10^2 m^3 = 2.97\times10^5$ lit

$\therefore$ So allowable volume of $Ni(CO)_4$ molecules $=\frac{1}{10^9}\times2.97\times10^5 = 2.97\times10^{-4}$

$T = 24^0C = (273+24)\,K = 297\,K$

P = 1 atm

PV = nRT

$1\times 2.97\times 10^{4} = n\times 0.0821\times 297$

$n = \frac{2.97\times 10^{-4}}{24.384} = 0.122\times 10^{-4}$

$\therefore$ Wt of $Ni(CO)_4 = 0.122\times 10^{-4}(58.7+4\times 28)$

$= 0.122\times 10^{-4}\times 170.7 = 20.825\times 10^{-4}$ g **Ans**

Q57.

Sol: molar volume = 10.1 lit

at P = 745 mm of Hg

& T = -138°C = (273 – 138)K = 235 K

For ideal gas, molar volume $= \frac{RT}{P} = \frac{0.0821\times 135}{745/760} = 11.3$ lit

$\neq$ Given molar volume

$\therefore$ So the gas doesn't behave ideally.

Q58.

Sol:

Elements	**% by mass**	$\frac{\%\text{ by mass}}{\text{At.no}} = x$	$x/3.84$
C	46.2	$\frac{46.2}{12} = 3.85$	1
N	53.8	$\frac{53.8}{14} = 3.84$	1

Empirical formula of cyanogens $\rightarrow$ CN

Empirical weight = 12 + 14 = 26 g

At, T = 25°C = 298 K,

$P = 750$ mm of Hg $= \frac{760}{760} = 1$atm

W = 1 g,

& V= 0.476 lit

$\therefore$ PV = nRT

$PV = \frac{W}{M}RT \Rightarrow M = \frac{wRT}{PV} = \frac{1\times 0.0821\times 298}{\frac{750}{760}\times 0.476} = 52$

$\therefore$ Mol.wt = Emp. Wt. × n

$52 = 26\times n \Rightarrow n = 2$

$\therefore$ Molecular formula of cynogen $= (CN)_2 = C_2N_2$ **Ans**

P = 1 atm

PV = nRT

$1 \times 2.97 \times 10^{4} = n \times 0.0821 \times 297$

$n = \frac{2.97 \times 10^{-4}}{24.384} = 0.122 \times 10^{-4}$

$\therefore$ Wt of $Ni(CO)_4 = 0.122 \times 10^{-4} (58.7 + 4 \times 28)$

$= 0.122 \times 10^{-4} \times 170.7 = 20.825 \times 10^{-4}$ g **Ans**

Q57.

Sol: molar volume = 10.1 lit

at P = 745 mm of Hg

& $T = -138^0C = (273 - 138)K = 235$ K

For ideal gas, molar volume = $\frac{RT}{P} = \frac{0.0821 \times 135}{745/760} = 11.3$ lit

$\neq$ Given molar volume

$\therefore$ So the gas doesn't behave ideally.

Q58.

Sol:

Elements	**% by mass**	$\frac{\%\text{ by mass}}{\text{At.no}} = x$	$x/3.84$
C	46.2	$\frac{46.2}{12} = 3.85$	1
N	53.8	$\frac{53.8}{14} = 3.84$	1

Empirical formula of cyanogens $\to$ CN

Empirical weight = 12 + 14 = 26 g

At, $T = 25^0C = 298$ K,

$P = 750$ mm of Hg $= \frac{760}{760} = 1$atm

W = 1 g,

& V= 0.476 lit

$\therefore$ PV = nRT

$PV = \frac{W}{M}RT \Rightarrow M = \frac{wRT}{PV} = \frac{1 \times 0.0821 \times 298}{\frac{750}{760} \times 0.476} = 52$

$\therefore$ Mol.wt = Emp. Wt. $\times$ n

$52 = 26 \times n \quad \Rightarrow n = 2$

$\therefore$ Molecular formula of cynogen = $(CN)_2 = C_2N_2$ **Ans**

Q4. Ans - (c) $V_i = \frac{nRT}{P_i}$ $\quad V_f = \frac{nR2Ti}{Pi/2} = 4Vi$

Q5. Ans -(b) $V \propto T$

$$\frac{V_f}{V_i} = \frac{T_f}{T_i} \Rightarrow \frac{2\,lit}{2\,lit} = \frac{T_f}{273\,K} \;;\quad T_f = 546\,K.$$

Q6. Ans -(d) Since no. of molecules/ moles are independent from identity of the gas.

So if 1 lit has N no. of molecules.

$\therefore 4$ ——— $4N$ ———

Q7. Ans -(a) $d_X = 3d_Y$

$M_Y = 2M_X$

$P_X M_X = d_X RT$ ------(1)

$P_Y M_Y = d_Y RT$ ------(2)

(1) ÷ (2): $\frac{P_X}{P_Y} \cdot \frac{M_X}{M_Y} = \frac{d_X}{d_Y}$

$$\frac{P_X}{P_Y} = \left(\frac{d_X}{d_Y}\right)\left(\frac{M_Y}{M_X}\right) = 3.2 = 6\,\text{time}$$

Q8. Ans -(a) $V \alpha \sqrt{\frac{T}{M}}$

A/q, $X_A = 4X_B$ at same T

$$\sqrt{\frac{T}{M_A}} = 4\sqrt{\frac{T}{M_B}}$$

$$M_B = 16M_A \Rightarrow \frac{M_A}{M_B} = \frac{1}{16}$$

Q9. Ans -(a) Mol. mass = $2 \times$ V.d. = $2 \times 11.2 = 22.4$ g

$\therefore$ no of moles in 22.4 g = $\frac{22.4}{22.4} = 1$

$\therefore$ Volume at NTP = 1×22.4 lit = 22.4 lit **Ans**

Q10. Ans -(c) $n_{O_2} = {}^{32}\!/_{32} = 1$

$n_{H_2} = \frac{3}{2} = 1.5$

$n_{total} = n_{O_2} + n_{H_2} = 2.5$

total volume occupied = 2.5×22.4 lit = 56 lit **Ans**

Q11. Ans no. of moles remain same

$$\frac{W_{SO_2}}{M_{SO_2}} = \frac{W_{O_2}}{M_{O_2}} \Rightarrow \frac{W_{O_2}}{W_{SO_2}} = \frac{M_{O_2}}{M_{SO_2}} = \frac{1}{2}$$

Q12. Ans -(c) At constant V, $P \propto n$

$\therefore$ if no. of moles is halved then pressure will also reduce to $P/2$.

Q13. Ans -(d) $\frac{n_A}{n_B} = \frac{3}{5}$ Let $n_A = 3x \Rightarrow n_B = 5x$

$P_A + P_B \propto (n_A + n_B)$ & $P_B \propto n_B$

$$\Rightarrow \frac{P_A + P_B}{P_B} = \frac{n_A + n_B}{n_B} = \frac{8x}{5x}$$

$$\frac{8}{PB} = \frac{8}{5} \Rightarrow PB = 5\,atm$$

Q14. Ans -(a) $\frac{n_{CH_4}}{n_{O_2}} = \frac{W_{CH_4}/M_{CH_4}}{Wo_2/M_{O_2}} = \frac{M_{O_2}}{M_{CH_4}} = \frac{32}{16} = 2:1$

(Given $w_{CH_4} = w_{O_2}$)

$$\therefore X_{O_2} = \frac{1}{3}$$

$$\therefore \frac{P_{O_2}}{P_{total}} = X_{O_2} = \frac{1}{3}$$

Q15. Ans -(c)

$d_A = 2d_B$ $\quad$ $P_A.M_A = d_A RT$

$M_A = \frac{1}{2}M_B$ $\quad$ $P_B.M_B = d_B RT$

$$\frac{P_A}{P_B}.\frac{M_A}{M_B} = \frac{d_A}{d_B}$$

$$\Rightarrow \frac{P_A}{P_B} = \frac{d_A}{d_B}.\frac{M_B}{M_A} = 2:2 = 4:1$$

Q16. Ans -(d) $Pf = \frac{P_1V_1 + P_2V_2}{V_1 + V_2} = \frac{1 \times 600 \times 0.5 \times 800}{2} = \frac{600 + 400}{2} = 500$ mm

Q17. Ans -(a) $\frac{r_A}{r_B} = \frac{4}{1} = \sqrt{\frac{M_B}{M_A}} = \sqrt{\frac{P_B}{P_A}}$ $\quad \therefore \frac{P_A}{P_B} = \frac{1}{16}$

Q18. Ans -(a) CO_2 & N_2O have same molar mass.

Q19. Ans -(a) $\frac{r_{H_2}}{r_{O_2}} = \frac{m_{H_2}}{m_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{H_2}}} = \sqrt{\frac{32}{2}} = 4$

$$\frac{2}{m_{O_2}} = 4 \Rightarrow m_{O_2} = \frac{2}{4} = \frac{1}{2}g$$

Q20. Ans -(a) H_2, O_2 N_2 & He, that gas will be reinflated which will be of least Mol

Q21. Ans -(b) $\frac{n_{CH_4}}{n_{H_2}} = \frac{M_{H_2}}{M_{CH_4}}$ (for equal not) $= \frac{2}{16} = \frac{1}{8}$

$\frac{n_{H_2}}{n_{CH_4}} = \frac{8}{1} \quad \Rightarrow \frac{n_{H_2}}{n_{total}} = \frac{8}{9} = X_{H_2}$

$\therefore P_{H_2} = X_{H_2} P_{total} \quad \Rightarrow X_2 = \frac{P_{H_2}}{P_{total}} = \frac{8}{9}$ **Ans**

Q22. Ans -(c) Sp.gravity $= \frac{d_{sub}}{d_{water}} \approx \frac{d_{sub}}{g/lit}$

Also for gas CCl_4, PM = dRT

$1 \times 54 = d \times 0.0821 \times 273 \quad d = \frac{154}{22.4} = 6.875\,g/lit$

$\therefore$ Sp. gravity $= d_{sub} = 6.875$ g / lit

Q23. Ans -(c) T = 27 K

P = 1.5 bar = 1.5 atm

$V_{rms} = 1 \times 10^4$ cm/s

$V_{rms} = \sqrt{\frac{3RT}{M}}$

If T is increased 3 times, $V_{rms} = \sqrt{3}.v_{rms} = \sqrt{3} \times 10^4\,cm/s$

Q24. Ans -(a) $\frac{V_{rms}}{V_{avg}} = \sqrt{\frac{3}{8/\pi}} = \sqrt{\frac{3 \times 3.14}{8}} = \sqrt{\frac{9.42}{8}} = \sqrt{1.1775} = 1.085 : 1$

Q25. Ans -(a) $Ti = 27^0C = 300K$

$T_f = 927^0C, 1200K$

$\therefore$ since $V \propto \sqrt{T}$

$\frac{V_f}{V_i} = \sqrt{\frac{T_f}{T_i}} = \sqrt{\frac{1200}{300}} = 2$

$V_f = 2 \times 0.3\,m/s = 0.6\,m/s$ **Ans**

Q26. Ans -(a) $\because K.E/_{mole} = \frac{3}{2}RT$

Q27. Ans -(b) $T_i = 400\,K$

$T_f = 800\,K$

$\therefore$ K.E. is increased by two times $\therefore$ K.E $\propto$ T.

Q28. Ans -(a) $T_i = -123^0C = 150$ K

$T_f = 27^0C = 300$ K

$\therefore \frac{K.E.f}{K.E.f} = \frac{n_f}{n_i}.\frac{T_f}{T_i} \Rightarrow \frac{2x}{x} = \frac{n_f}{n_i}.\frac{300}{150} \Rightarrow n_f = n_i$

Q21. Ans -(b) $\frac{n_{CH_4}}{n_{H_2}} = \frac{M_{H_2}}{M_{CH_4}}$ (for equal not) $= \frac{2}{16} = \frac{1}{8}$

$\frac{n_{H_2}}{n_{CH_4}} = \frac{8}{1} \quad \Rightarrow \frac{n_{H_2}}{n_{total}} = \frac{8}{9} = X_{H_2}$

$\therefore P_{H_2} = X_{H_2} P_{total} \quad \Rightarrow X_2 = \frac{P_{H_2}}{P_{total}} = \frac{8}{9}$ **Ans**

Q22. Ans -(c) Sp.gravity $= \frac{d_{sub}}{d_{water}} \approx \frac{d_{sub}}{g/lit}$

Also for gas CCl_4, PM = dRT

$1 \times 54 = d \times 0.0821 \times 273 \quad d = \frac{154}{22.4} = 6.875\, g/lit$

$\therefore$ Sp. gravity $= d_{sub} = 6.875$ g / lit

Q23. Ans -(c) T = 27 K

P = 1.5 bar = 1.5 atm

$V_{rms} = 1 \times 10^4$ cm/s

$V_{rms} = \sqrt{\frac{3RT}{M}}$

If T is increased 3 times, $V_{rms} = \sqrt{3}.v_{rms} = \sqrt{3} \times 10^4$ cm

Q24. Ans -(a) $\frac{V_{rms}}{V_{avg}} = \sqrt{\frac{3}{8/\pi}} = \sqrt{\frac{3 \times 3.14}{8}} = \sqrt{\frac{9.42}{8}} = \sqrt{1.1775} = 1.085 : 1$

Q25. Ans -(a) $Ti = 27^0C = 300K$

$T_f = 927^0C, 1200K$

$\therefore$ since $V \propto \sqrt{T}$

$\frac{V_f}{V_i} = \sqrt{\frac{T_f}{T_i}} = \sqrt{\frac{1200}{300}} = 2$

$V_f = 2 \times 0.3\, m/s = 0.6\, m/s$ **Ans**

Q26. Ans -(a) $\because K.E/_{mole} = \frac{3}{2}RT$

Q27. Ans -(b) $T_i = 400\, K$

$T_f = 800\, K$

$\therefore$ K.E. is increased by two times $\therefore$ K.E $\propto$ T.

Q28. Ans -(a) $T_i = -123^0C = 150$ K

$T_f = 27^0C = 300$ K

$\therefore \frac{K.Ef}{K.Ef} = \frac{n_f}{n_i} \cdot \frac{T_f}{T_i} \Rightarrow \frac{2x}{x} = \frac{n_f}{n_i} \cdot \frac{300}{150} \Rightarrow n_f = n_i$

Q29. Ans -(b) K.E. is independent from mass $K.E = \frac{3}{2}nRT$

Q30. Ans -(a) K.E. of gas molecules = $\frac{3}{2}KT = \frac{3}{2} \times \frac{8.314}{6.023 \times 10^{23}} \times 273 = 5.66 \times 10^{-21}$ J.

Q31. Ans -(a) Again because K.E is independent from mass.

Q32. Ans -(d) K.E. only depend as temperature not on identity.

Q33. Ans -(b) $n_1C_{v_1} + n_2Cv_2 + n_3Cv_3 = (n_1 + n_2 + n_3)Cv.$

$$1.\frac{3}{2}R + 1\frac{5}{2}R + 1.3R = (1+1+1)Cv$$

$$C_V = \frac{R\left(\frac{8}{2}+3\right)}{3} = \frac{7}{3}R$$

$$\Rightarrow \frac{R}{Y-1} = \frac{7}{3}R \Rightarrow Y-1 = \frac{3}{7} \quad \Rightarrow Y = \frac{3}{7}+1 = \frac{10}{7} = 1.428$$

Q34. Ans -(b) $K.E/_{mole} = \frac{3}{2}RT, \Delta K.E. = \frac{3}{2}R\Delta T$

For monoatomic gas, $C_P = \frac{5/3\, R}{5/3 - 1} = \frac{5}{2}R$

$$\Delta Q = \frac{5}{2}R\Delta T = \frac{5}{2}R(\text{for } \Delta T = 1^0C)$$

$$\therefore \Delta K.E. \text{ for } \Delta T = 1 = \frac{3}{2}R \quad \therefore \text{ fractional} = \frac{\Delta K.E}{\Delta Q} = \frac{3}{5}$$

Q35. Ans -(c):- gas can be liquefied easily if intermolecular forces are higher & it will happen if value of a is larger.

Order of a

$NH_3 > CH_4 > N_2 > O_2$

$\therefore$ NH_3 can be liquefied more easily.

Q36. Ans -(b) $(1+1)\ C_v = 1.C_{v_1} + 1.C_{v_2} = \frac{3}{2}R + \frac{5}{2}R = 4R$

$C_v = 2R = 4$ Cal

Q37. Ans -(d) $\because$ Av. Translational K.E.= $\frac{3}{2}KT$. Proportional to temp.

Q38. Ans -(c) $V_{rmsH_2} = \sqrt{\frac{3R \times 50}{2 \times 10^{-3}}}$ => $V_{rmsO_2} = \sqrt{\frac{3R \times 800}{32 \times 10^{-3}}}$

$$V_{rmsH_2} = V_{rmsO_2} \Rightarrow \frac{V_{rmsH_2}}{V_{rmsO_2}} = 1$$

Q39. Ans -(b) Z = 1. For ideal gas

$Z=\frac{PV}{nRT}=1$

Q40. Ans -(b) $\frac{r_{H_2}}{r_{He}}=\sqrt{\frac{4}{2}}=\sqrt{2} \quad \Rightarrow \frac{r_{H_2}}{r_{O_2}}=\sqrt{\frac{32}{2}}=\sqrt{16}=4=\frac{t_{O_2}}{t_{H_2}} \Rightarrow t_{O_2}=4\times t_{H_2}$

So, the time taken by O_2 for diffusion of same amount as that of O_2 is 4 times greater.

$\therefore 5\times 4=20\,\text{sec}$

Q41. Ans -(b) $P\propto nT \quad \Rightarrow \frac{P_f}{P_i}=\frac{n_f T_f}{n_i T_i}$

$N_2O_4 \rightleftharpoons 2NO_2$

Initially: 1   0

Finally: 1-0.2   0.4

$\frac{P_f}{1}=\frac{1.2\times 600}{1\times 300}=2.4\,\text{atm};\quad \text{total moles}=1.2$

Q42. Ans -(b) Atomspheric pressure $=10{,}000\times 9.8=9.8\times 10^4$ N/mL $\approx 1\times 10^2$ kPa

Q43. Ans -(c) $Z=\frac{PV}{RT}=\frac{1\times 22.4}{0.0821\times 273}=\frac{22.4}{22.4}=1$

Q44. Ans -(b)

$PM=dRT \quad \Rightarrow \frac{d}{P}=\frac{M}{RT} \quad \Rightarrow 2.86=\frac{M}{0.0821\times 273}$

$M=64.06\,g$

Q45. Ans -(d) $\therefore V_{rms}=\sqrt{\frac{3RT}{M}}$

Q46. Ans -(d) $76\times 13.6\times g=h\times 1\times g$

$h=76\times 13.6\,cm=1033.6\,cm$

Q47. Ans -(c)

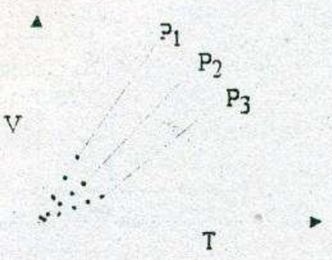
$V=\left(\frac{nRT}{P}\right)T$

Slope is max^m for 1.

$\therefore$ order of slope

$\left(\frac{nR}{P}\right)_1>\left(\frac{nR}{P}\right)_2>\left(\frac{nR}{P}\right)_3$

$P_3>P_2>P_1$ **Ans**



Q48. Ans -(a) $2H_2 + O_2 \rightleftharpoons 2H_2O$

0.588   0.302

Clearly limiting reagent is H_2

because required $H_2 = 2 \times 0.302$ atm $= 0.604$ atm > given amount

Q49. Ans -(b) $\left(\frac{\partial T}{\partial P}\right)_H = +ve, \quad \text{if } T < Tc$

$\therefore$ T decreases as P decreases, so cooling occur

$\left(\frac{\partial T}{\partial P}\right)_H = -ve, \quad \text{if } T > T_C$

$\therefore$ T increases as P decreases, so heating occur.

Q50. Ans -(d) From previous explanation

Q51. Ans -(a) and (d) $\because \ P_{real} + P_{real} + \frac{an^2}{V^2}$ & $V_{real} = V_{real} - nb$

Q52. Ans -(c) because at $T = 273$ K, $V_{molar} = 22.4$ lit

at $T = 373$ K, $V_{molar} = 30.6$ lit