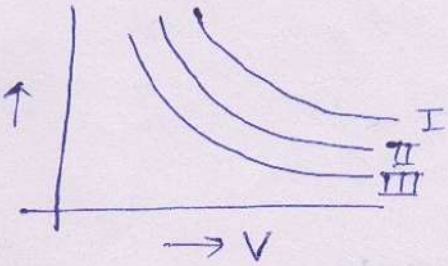
Foundation Builders (OBJECTIVE)

Experimental Gas laws

1-



Boyle's law $PV = \text{Constant}$
$= nRT$

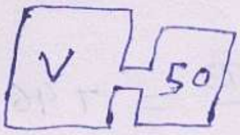
as T ↑ constant also increases

And graph shifted upward.

i.e. $T_1 > T_2 > T_3$

Answer (C)

2-



$P_1 = 21$ atm $\quad V_1 = 50L$

$P_2 = 7$ atm $\quad V_2 = V + 50\ L$

Boyle's law $\quad P_1V_1 = P_2V_2$

$21 \times 50 = 7 \times (V + 50)$

$V = 100L$

Answer (A)

3-

At constant temperature $\quad P_1V_1 = P_2V_2$

$P_1 = P, \quad V_1 = V$

$P_2 = ?, \quad V_2 = 0.95V$

$$P_2 = \frac{P_1V_1}{V_2} = \frac{V}{0.95V}P$$

$P_2 = 1.0526P$

% increases in P = 5.26%

Answer (C)

4-

At constant pressure $\quad \frac{V_1}{T_1} = \frac{V_2}{T_2}$

$V_1 = V \quad T_1 = T$

$V_2 = 1.1V \quad T_2 = ?$

$$T_2 = \frac{V_2T_1}{V_1} = \frac{1.1V}{V}T$$

$T_2 = 1.1T$

% increases in T = 10%

Answer (A)

5- Charles's law

at const. P $\frac{V}{T} = K$ (constant) $\Rightarrow V = KT$

$$\left(\frac{dV}{dT}\right)_P = K$$

Answer (A)

6- $V_1 = 100\,mL$ $T_1 = 100^\circ C = 373\,K$

$V_2 = 200\,mL$ $T_2 = ?$

const. P $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$$T_2 = \frac{V_2 T_1}{V_1} = \frac{200 \times 373}{100} = 746\ K$$

$$T_2 = 746 - 273 = 473^\circ C$$

Answer (B)

7- $T_1 = 27^\circ C = 300\,K$ $P_1 = 12\ atm$

$T_2 = ?$ $P_2 = 14.9\ atm$

at constent V $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$$T_2 = \frac{P_2 T_1}{P_1} = \frac{14.9 \times 300}{12} = 372.5\ K$$

$$T_2 = 372.5 - 273 = 99.5^\circ C$$

Answer (C)

8- Ideal Gas Law

Both flasks have equal size.

no. of moles of $H_2 = \frac{2}{2} = 1$

,, molecules ,, $= N_A$

no. of moles of $N_2 = \frac{2}{28} = \frac{1}{14}$

,, molecules ,, $= \frac{1}{14} N_A$

No. of molecules in flask A > No. of molecules in flask B

Answer (C)

9_

no.of moles of S $= \frac{PV}{RT}$

$P = \frac{723}{760}$ atm, $V = 0.780\,L$, $T = 450+273$
$= 723\,K$

$n = \frac{723 \times 0.780}{760 \times 0.0821 \times 723} = 0.0125$

no.of moles $= \frac{3.2}{\text{Molecular weight}} = 0.0125$

Molecular weight $= \frac{3.2}{0.0125} = 256$

If x atom in one molecule of S
then Molecular weight $= 32x = 256$
$\boxed{x = 8}$

S_8

Answer (D)

10_

$V = \frac{nRT}{P} = \frac{4 \times 0.0821 \times 295 \times 760}{4 \times 720} = 25.565\,L$

Answer (A)

11_

$P_A = 2P_B$, $V_A = 2V_A$, $T_A = 2T_B$
$M_A = M_B$
$m_B = x$, $m_A = ?$

$$\frac{P_A V_A}{n_A T_A} = \frac{P_B V_B}{n_A T_B} \Rightarrow \frac{P_A V_A M_A}{m_A T_A} = \frac{P_B V_B M_B}{m_B T_B}$$

$$\frac{2P_B (2V_B) M_B}{m_A (2T_B)} = \frac{P_B V_B M_B}{x (T_B)} \Rightarrow m_A = 2x \text{ g}$$

Answer (D)

12_

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \Rightarrow T_2 = \frac{P_2 V_2 T_1}{P_1 V_1}$$

$$T_2 = \frac{2.50 \times 200 \times 500}{3 \times 275}$$
$= 303\,K$

$P_1 = 3$atm
$T_1 = 500\,K$
$V_1 = 275L$
$V_2 = 200L$
$P_2 = 2.50$atm

Answer (A)

13-

$$\frac{P_AV_A}{n_AT_A} = \frac{P_{H_2}V_{H_2}}{n_{H_2}T_{H_2}} \qquad P_A = P_{H_2},\ V_A = V_{H_2}$$

$$n_A t_A = n_{H_2} T_{H_2}$$

$$\frac{m_A}{M_A} T_A = \frac{m_{H_2}}{M_{H_2}} T_{H_2} \Rightarrow M_A = \frac{m_A T_A M_{H_2}}{m_{H_2} T_{H_2}}$$

$$M_A = \frac{5.40 \times 300 \times 2}{0.14 \times 290} = 79.8$$

Answer (A)

14-

$$PV = nRT$$

$$PV = \frac{m}{M} RT \Rightarrow PM = \frac{m}{V} RT \Rightarrow PM = dRT$$

$$d = \frac{PM}{RT}$$

Value of M is large, density large. (at const. P&T)

$M_{CH_4} = 16$, $M_{C_2H_2} = 26$, $M_{C_2H_4} = 28$, $M_{C_3H_8} = 44$

Answer (D)

15-

$$n_2 = \frac{n_1}{2} \Rightarrow n_1 = 2n_2$$

$$n_1T_1 = n_2T_2 \Rightarrow T_2 = \frac{n_1T_1}{n_2} = \frac{2n_2(300)}{n_2} = 600K$$

$$T_2 = 600 - 273 = 327°C$$

Answer (D)

16-

$$n_1T_1 = n_2T_2$$

$$n_2 = \frac{n_1T_1}{T_2} = \frac{n_1 300}{400} = \frac{3}{4} n_1$$

fraction of molecult of air goes out $= \frac{n_1 - \frac{3}{4}n_1}{n_1}$

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

Answer (B)

17-

$$C_xH_y + (x + \frac{y}{4})O_2 \longrightarrow xCO_2 + \frac{y}{2} H_2O$$

0.2 0.8 1

$$\frac{x}{1} = \frac{0.8}{0.2} = 4 \Rightarrow x = 4$$

$$\frac{y}{2} = \frac{1}{0.2} = 5 \Rightarrow y = 10$$

C_4H_{10}

Answer (A)

18. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \Rightarrow \frac{P_1V_1}{T_1} = \frac{P_1V_2}{2(2T_1)} \Rightarrow V_2 = 4V_1$ i.e. four times of initial volume.

Answer (D)

19. $$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

$$\frac{300\,V_1}{1(T_1)} = \frac{300\,V_2}{2(T_1)} \qquad [T_1 = T_2]$$

$$V_2 = 2V_1$$

Now separation removed.

Volume $V_3 = V_1 + V_2 = 3V_1$

$n_3 = 1 + 2 = 3$

$$\frac{P_1V_1}{n_1T_1} = \frac{P_3V_3}{n_3T_3}$$

$$\frac{300\,V_1}{1(T_1)} = \frac{P_3(3V_1)}{3(T_1)} \qquad [T_1 = T_3]$$

$P_3 = 300$ mm of Hg

Answer (B)

20. $PV = nRT \Rightarrow PM = dRT \Rightarrow T = \frac{PM}{dR}$

$$T = \frac{1.12 \times 10^9 \times 2}{1.3 \times 0.0821 \times 10^3} \qquad (d = 1.3\ g/cc = 1.3 \times 10^3\ g/L)$$

$T = 2 \times 10^7$ K

Answer (C)

21. $PV = nRT \Rightarrow PV = \frac{m}{M}RT \Rightarrow V = \frac{mRT}{PM}$

The gas which has highest value of M, have the least volume. i.e. HI

Answer (D)

22. $PM = dRT$

for same gas M = constant

T = Constant

$$\frac{P_1}{d_1} = \frac{P_2}{d_2} \Rightarrow \frac{P_1}{d_1} = \frac{P_2}{2d_1} \qquad [d_2 = 2d_1]$$

$P_2 = 2P_1 = 2$atm

23 $PM = dRT$

$d = \frac{PM}{RT}$

for same gas $\frac{P}{T}$ higher, density higher.

i.e. 0°C (273 K), 2 atm

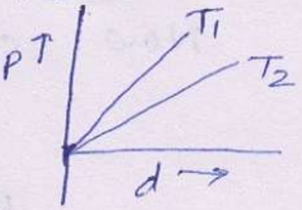
$\boxed{\text{Answer (B)}}$

24- $P = \frac{RT}{M} d$

for same gas T higher, $\frac{RT}{M}$ higher, slope increases

$T_1 > T_2$

$\boxed{\text{Answer (A)}}$



25. Partial pressure will depend upon no. of moles of each gas. As mass of each gas is equal, partial pressure will depend upon relative molecular mass.

$\boxed{\text{Answer (C)}}$

Dalton's Law of Partial Pressure

26- $P_A = 1\text{ atm}$, $P_T = 1.5\text{ atm}$, $m_A = 2\text{ gm}$, $m_B = 3\text{ gm}$

$P_B = P_T - P_A = 1.5 - 1 = 0.5\text{ atm}$

$P_A = X_A P_T$, $P_B = X_B P_T$

$$\frac{P_A}{P_B} = \frac{X_A}{X_B} = \frac{n_A}{n_B} = \frac{m_A M_B}{M_A m_B} = \frac{1}{0.5} = 2$$

$$\frac{m_A M_B}{M_A m_B} = 2 \Rightarrow \frac{M_A}{M_B} = \frac{m_A}{2 m_B}$$

$$\frac{M_A}{M_B} = \frac{2}{2(3)} = \frac{1}{3}$$

$\boxed{\text{Answer (C)}}$

27- $P_{O_2} = X_{O_2} P_T = 0.21 \times 750$

$P_{O_2} = 157.5$ mm of Hg

$\boxed{\text{Answer (A)}}$

28- $n_{H_2} = \frac{1}{2}$, $n_{He} = \frac{4}{4} = 1$, $n_{N_2} = \frac{7}{28} = \frac{1}{4}$,

$n_{O_2} = \frac{8}{32} = \frac{1}{4}$

The gas having highest mole fraction i.e. highest no. of moles, will have highest partial pressure. i.e. He

$\boxed{\text{Answer (C)}}$

29- $n_{total} = 0.10 + 0.05 + 0.20 + n_{CO_2}$

$n_{total} = 0.35 + n_{CO_2}$

$PV = n_{total}RT \Rightarrow n_{total} = \frac{PV}{RT}$

$0.35 + n_{CO_2} = \frac{1 \times 9.6}{0.0821 \times 300} = 0.389$

$n_{CO_2} = 0.389 - 0.35 = 0.039 \simeq 0.04$

$\boxed{\text{Answer (A)}}$

Grahams Law

30- $\text{rate} = \frac{V}{t} = \frac{K}{\sqrt{M}}$

$\frac{t_1}{t_2} = \sqrt{\frac{M_1}{M_2}}$ $\Rightarrow t_{He} = \sqrt{2} \times 5 = 7\ \text{sec}$, $t_{CO} = \sqrt{14} \times 5 = 18.7\ \text{sec}$

$t_{CO_2} = \sqrt{22} \times 5 = 23.45\ \text{sec.}$

$\frac{t_{H_2}}{t_{O_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}} = \sqrt{\frac{2}{32}} = \sqrt{\frac{1}{16}} = \frac{1}{4}$

$t_{O_2} = 4t_{H_2} = 4 \times 5 = 20\ \text{sec}$

$\boxed{\text{Answer (B)}}$

31- The gases having the same molecular mass diffuse at the same rate.

i.e. CO_2 & N_2O

$\boxed{\text{Answer (A)}}$

32- $\frac{r_1}{r_2} = \frac{V_1}{V_2}\sqrt{\frac{M_2}{M_1}} = \frac{2}{1}\sqrt{\frac{32}{2}} = \frac{2}{1} \times \frac{4}{1} = 8$

$\boxed{\text{Answer (C)}}$

33- The gas having less molecular mass will travel more distance than other.

$M_{NH_3} = 17 \quad M_{HCl} = 36.5$

i.e. white fumes of NH_4Cl will formed towards HCl end (point C)

$\boxed{\text{Answer (C)}}$

34- Ratio of molecular mass is large, gas can be easily separated.

$\sqrt{\frac{M_{D_2}}{H_2}} = \sqrt{\frac{4}{2}} = \sqrt{2}$, $\sqrt{\frac{CD_4}{CH_4}} = \sqrt{\frac{20}{16}}$, $\sqrt{\frac{C^{14}H_4}{C^{12}H_4}} = \sqrt{\frac{18}{16}}$,

$\sqrt{\frac{U^{238}F_6}{U^{235}F_6}} = \sqrt{\frac{352}{349}}$

$\boxed{\text{Answer (A)}}$

35. $\frac{r_{CH_4}}{r_X} = \sqrt{\frac{M_X}{M_{CH_4}}} = 2 \Rightarrow \frac{M_X}{M_{CH_4}} = 4$

$\Rightarrow M_X = 4 \times 16 = 64$

$\boxed{\text{Answer (A)}}$

(36) Gases having same molecular mass cannot be seperated by diffusion.

$\Rightarrow$ $\boxed{\text{Ans:- (A)}}$

37- $\frac{M_{Br}}{M_{O_2}} = 5$

$\frac{r_{O_2}}{r_{Br}} = \sqrt{\frac{M_{Br}}{M_{O_2}}} = \sqrt{5} = 2.23$

$\boxed{\text{Answer (A)}}$

38- moist air diffuse outside and balloon will collapse.

$\boxed{\text{Answer (A)}}$

(39)

$$\frac{r_{SO_2}}{r_x} = \frac{n/20}{n/60} = \sqrt{\frac{m_x}{64}}$$

$$\Rightarrow m_x = \left(\frac{60}{20}\right)^2 \times 64 \quad \Rightarrow \boxed{\text{Ans (C)}}$$

40- Conceptually inside pressure decreases on steaming hot and when it cool, a vacuum which was created earlier will help to seal the jars.

$\boxed{\text{Answer (D)}}$

Eudiometry

41- $V_{CO} + V_{CO_2} + V_{N_2} = 200\ ml$

Volume of $CO_2 = x$

$CO = y$

$N_2 = 200 - x - y$

$$\begin{array}{lccc} & CO & +\frac{1}{2}O_2 \longrightarrow & CO_2 \\ \text{initial} & y & \frac{y}{2} & \\ \text{final} & 0 & 0 & y \end{array}$$

$$\text{Contraction} = \left(y + \frac{y}{2}\right) - y = \frac{y}{2} = 40\ ml$$

$$y = 80\ ml$$

Remaining volume $= x + y + 200 - x - y$

$= 200\ ml$

on Passing KOH all CO_2 will be absorbed.

Contraction in volume $= x + y$

$x + y = 100$

$x = 20\ ml$

$V_{CO_2} = 20\ ml,\ V_{CO} = 80\ ml,\ V_{N_2} = 100\ ml$

$\boxed{\text{Answer (C)}}$

42_

	$N_xO_y(g)$ +	$y\,H_2(g) \longrightarrow$	$y\,H_2O(l)$ +	$\frac{x}{2}N_2(g)$
initial	10	30	–	0
final	0	0		10

$$\frac{y}{1} = \frac{30}{10} = 3 \Rightarrow y = 3$$

$$\frac{x}{2} = \frac{10}{10} = 1 \Rightarrow x = 2$$

N_2O_3

$\boxed{\text{Answer (C)}}$

43_

$V_{O_2} = x$, $V_{N_2} = y$, $V_{CH_4} = z$

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$

For the maximum heat volume of O_2 should be two times of volume of CH_4.

And as per given condition volume of N_2 should be four times of volume of O_2.

$$\frac{V_{O_2}}{V_{CH_4}} = \frac{n_{O_2}}{n_{CH_4}} = \frac{x_{O_2}}{x_{CH_4}} = 2$$

$$\frac{V_{N_2}}{V_{O_2}} = \frac{n_{N_2}}{n_{O_2}} = \frac{x_{N_2}}{x_{O_2}} = 4$$

$V_{CH_4} = z$, $V_{O_2} = 2z$, $V_{N_2} = 8z$

$x_{CH_4} = \frac{z}{11z} = \frac{1}{11}$, $x_{O_2} = \frac{2z}{11z} = \frac{2}{11}$

$x_{N_2} = \frac{8z}{11z} = \frac{8}{11}$

$\boxed{\text{Answer (A)}}$

44_

Constant volume & temperature $\quad P_{C_2H_2} = x,\ P_{C_3H_8} = y$

$P \propto n$

	$C_2H_2(g)$ +	$\frac{5}{2}O_2(g) \longrightarrow$	$2CO_2(g)$ +	$H_2O(l)$
initial	x	$\frac{5}{2}x$	0	–
final	0	0	$2x$	–

	$C_3H_8(g)$ +	$5O_2(g) \longrightarrow$	$3CO_2(g)$ +	$4H_2O(l)$
initial	y	$5y$	0	–
final	0	0	$3y$	–

$x + y = 80$, $2x + 3y = 230$

$x = 10$ mm, $y = 70$ mm.

Kinetic theory of Gas

(45)

By KTG

$E_K = \frac{3}{2} RT = \frac{3}{2} PV$

$\Rightarrow PV = \frac{2}{3} E_K$

$\Rightarrow$ $\boxed{\text{Ans} \cdot (C)}$

(46)

$KE = \frac{3}{2} RT$

$= \frac{3}{2} \times 2 \times T = 3T$

$\boxed{\text{Ans. (A)}}$

47- $T_1 = 273\,K, \quad T_2 = ?$

$\frac{V_{rms_1}}{V_{rms_2}} = \sqrt{\frac{T_1}{T_2}} = \frac{1}{2}$

$T_2 = 4T_1 = 4 \times 273 = 1092\,K$

$T_2 = 1092 - 273 = 819°C$

$\boxed{\text{Answer (D)}}$

48- $V_{rms}(H_2) = V_{rms}(O_2)$

$\sqrt{\frac{3RT_{H_2}}{M_{H_2}}} = \sqrt{\frac{3RT_{O_2}}{M_{O_2}}} \Rightarrow \frac{T_{H_2}}{M_{H_2}} = \frac{T_{O_2}}{M_{O_2}}$

Answer (B) $T_{H_2} = T_{O_2} \times \frac{M_{H_2}}{M} = 273 \times 2 = 17K$

49 - $K.E \propto T$

As T doubled K.E. also doubled.

Answer (B)

50 - $V_{rms} \propto \frac{1}{\sqrt{M}}$ at constant T

The molecule having lowest molecular mass has highest rms speed. i.e. CO

Answer (D)

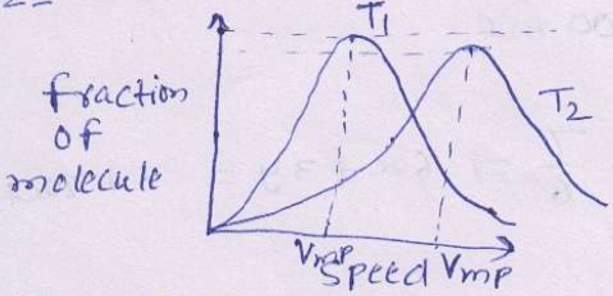
51 - $V_{rms} = \sqrt{\frac{3RT}{M}}$

$V_{avg} = \sqrt{\frac{8RT}{\pi M}}$

$\frac{V_{rms}}{V_{avg}} = \sqrt{\frac{3\pi}{8}} = 1.086$

Answer (A)

52 -

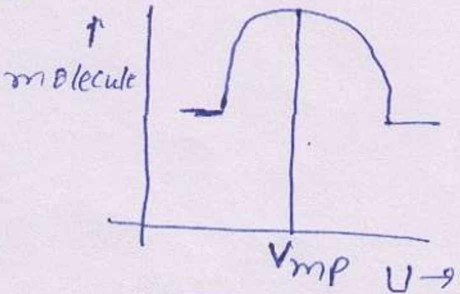


$T_2 > T_1$

Fraction of molecule has acquired most probable velocity decreases.

Answer (B)

53 -



As Temperature increases V_{mp} increases. i.e. curve shifts to higher velocity.

Pressure & volume doesn't effect the curve.

Answer (A)

54 - $K.E. = \frac{3}{2}RT$

$\frac{K.E._1}{K.E._2} = \frac{T_1}{T_2} \Rightarrow \frac{x}{2x} = \frac{150}{300}$

Average Kinetic Energy doesn't depend upon no. of molecules.

Answer (A)

55- $$\frac{V_{rms}(H_2)}{V_{rms}(O_2)} = \sqrt{\frac{T_{H_2}}{M_{H_2}} \times \frac{M_{O_2}}{T_{O_2}}} = \sqrt{\frac{50}{2} \times \frac{32}{800}} = 1$$

Answer (C)

56- $$V_{mp} = V_0 = \sqrt{\frac{2RT}{M}} = \sqrt{\frac{2R(t+273)}{M_{H_2}}}$$

$$V_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3R(2t+273+273)}{M_{H_2}/2}}$$

$$= \sqrt{\frac{3R(t+273)2}{M_{H_2}/2}} = \sqrt{6}\, V_0$$

Answer (D)

57- $T_1 = 27°C = 300\,K$

$V_{rms},\ V_{mp},\ V_{av} \propto \sqrt{T}$

$$\frac{V_{rms_2}}{V_{rms_1}} = \sqrt{\frac{T_2}{T_1}}$$

$$2 = \sqrt{\frac{300+x}{300}}$$

$$4 = \frac{300+x}{300} \Rightarrow x = 900°C$$

Answer (A)

58- With increase in temperature most probable speed increases but fraction of molecules decreases.

Answer (B)

59- I Molecules make elastic collisions with each other and with the walls of their container.

II. Average K.E. doesn't depend upon molecular mass.

III Molecules of a gas are in constant random motion.

IV Different molecules have different K.E, But Average K.E. of molecules (gas) remains constant at given temperature.

Answer (D)

60- $$\frac{V_{rms}(H_2)}{V_{rms}(CH_4)} = \sqrt{\frac{M_{CH_4}}{M_{H_2}}}$$ at constant temperature

$$\frac{V_{rms}(H_2)}{V_{rms}(CH_4)} = \sqrt{\frac{16}{2}} = 2.82$$

$$V_{rms}(H_2) = 0.56 \times 2.82 \text{ Km/s}$$

$$V_{rms}(H_2) = 1.6 \text{ Km/s}$$

Answer (D)

61- $$\frac{V_{avg}(SO_3)}{V_{avg}(Ne)} = \sqrt{\frac{M_{Ne}}{M_{SO_3}}} = \sqrt{\frac{20}{80}}$$

$$V_{avg}(SO_3) = \frac{1}{2} V_{avg}(Ne)$$

Answer (B)

62- Temperature, pressure & volume of both vessel is same.i.e.same no. of moles and same number of molecule.
K.E. remains constant at constant temperature.
density is different as mass is different in both flask.

Answer (C)

63- $$\frac{V_{rms}(O_2)}{V_{rms}(CH_4)} = \sqrt{\frac{M_{CH_4}}{m_{O_2}}} = \sqrt{\frac{16}{32}} = \frac{1}{1.41}$$

Answer (D)

64- As kinetic molecular theory of gases pressure rises due to collision of molecule with the container walls, more frequently.

Answer (B)

65- molecular theory doesn't say about molecular impacts per unit area.

Answer (B)

(66) $KE \propto T$

$\Rightarrow \boxed{\text{Ans (B)}}$

(67) $\boxed{\text{Ans(C)}}$

(68) $v \propto \frac{1}{\sqrt{m}}$

$\boxed{\text{Ans(D)}}$

(69) $K = \frac{3}{2} PV$

$\Rightarrow \frac{K}{V} = \frac{3}{2} P.$

$\boxed{\text{Ans (C)}}$

(70) $v \propto \sqrt{T}$

$\Rightarrow \boxed{\text{Ans (C)}}$

Compressibility Factor

72- $Z = 1$ for ideal gas

Answer (B)

73- He has weak attraction forces. i.e. we can neglect a.

$$\left(P + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

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

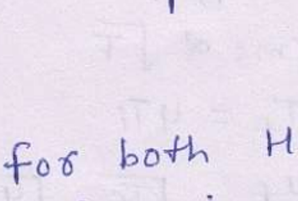
$$PV_m - Pb = RT$$

$$\frac{PV_m}{RT} - \frac{Pb}{RT} = 1 \Rightarrow Z = \frac{PV_m}{RT} = 1 + \frac{Pb}{RT}$$

Answer (C)

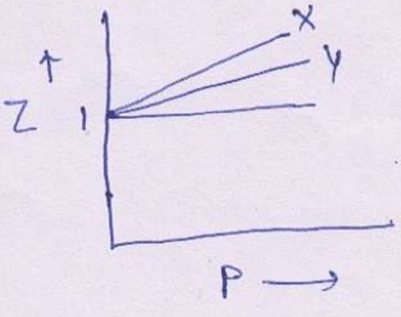
74- no force of attraction i.e. $a = 0$

$$Z = 1 + \frac{Pb}{RT}$$



Answer (B)

75-



for both He & H_2 no attraction force i.e. $a = 0$

$$Z = 1 + \frac{Pb}{RT}$$

b for H_2 is greater than for He.

X → Hydrogen

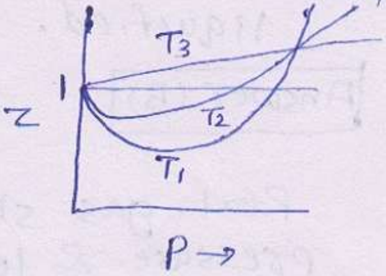
Y → Helium

Answer (A)

76- At higher temperature there is no attraction force, real gas equation becomes

$P(V_m - b) = RT$

$Z = 1 + \frac{Pb}{RT}$



At lower temperature and low pressure

$\left(P + \frac{a}{V_m^2}\right) V_m = RT$

$PV_m + \frac{a}{V_m} = RT \Rightarrow \frac{PV_m}{RT} + \frac{a}{V_m RT} = 1$

$Z = 1 - \frac{a}{V_m RT}$

$T_3 > T_2 > T_1$

Answer (C)

Vander Waal's gas equation

77- for non-zero value of force of attraction

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

$PV + \frac{an^2}{V} = nRT$

$PV = nRT - \frac{n^2 a}{V}$

Answer (A)

78- There is no attraction force in H_2 means least value of 'a'.

Answer (D)

79- The force of attraction is maximum in the case of NH_3 because of Hydrogen bonding, i.e. maximum value of 'a'.

Answer (D)

80- 'a' depends on size & shape, but 'b' depends only upon size of molecule.

Answer (A)

81- The valut of (a) higher, gas can be easily liquefied. i.e. NH_3

Answer (B)

82- Real gas shows maximum deviation at high pressure & low temperature.

Answer (A)

(83) $\frac{a}{V^2}$ term is responsible for intermolecular attraction

Ans (B)

84- Pressure of real gas is less than the pressure calculated for an ideal gas.

Answer (A)

85- Real gas equation

$$\left(P+\frac{a}{\bar{V}^2}\right)\left(\bar{V}-b\right)=RT$$

$$\left(P+\frac{a}{\bar{V}^2}\right)=\frac{RT}{\bar{V}-b}$$

$$P=\frac{RT}{\bar{V}-b}-\frac{a}{\bar{V}^2}$$

$$Z=\frac{P\bar{V}}{RT}=\frac{\bar{V}}{\bar{V}-b}-\frac{a}{\bar{V}RT}$$

Answer (A)

86-

$$Z=\frac{PV}{RT}=A+\frac{B}{V}+\frac{C}{V^2}+\cdots$$

$$A=1\ ,\ B=\left(b-\frac{a}{RT}\right)$$

Temperature at which gas behave like an ideal gas is Boyle's temperature.

i.e. $Z=1$ (B, C ----- are negligible.)

Answer (B)

(87) At Boyle's Temp. real gas behaves like ideal gas for a range of pressure

Ans -(C)

(88) At temp higher than Boyle temp, $Z > 1$

Ans. (C)

(89) Ans (B)

(90) Due to polar nature HCl will have considerable intermolecular force.

Ans (C)

(91) $Z = 1 + 0.34p - \frac{160p}{T} = 1$

$\Rightarrow T = 470$ K

Ans (C)

(92) Ans (C)

(93) Ans (C)

FOUNDATION BUILDERS (Subjective)

Experimental Gas Laws & Ideal Gas Law

1- $P_1 = 250\,kPa, \quad T_1 = 27^oC = 300\,K$

$P_2 = ? \quad , \quad T_2 = 1800\,K$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow P_2 = \frac{T_2}{T_1}P_1$$

$$\Rightarrow P_2 = \frac{1800}{300} \times 250 \times 10^3$$

$$P_2 = 1500 \times 10^3$$

$$\boxed{P_2 = 1.5 \times 10^6\ Pa}$$

$P_2 > 10^6\ Pa$

i.e. cylinder blows up before it melts.

2- (a) $V = \frac{nRT}{P} = \frac{4 \times 0.0821 \times 295 \times 760}{4 \times 720}$

$\boxed{V = 25.56\ \text{litre}}$

(b) $PV = nRT \Rightarrow PV = \frac{m}{M}RT$

$$d = \frac{PM}{RT} = \frac{800 \times 44}{0.0821 \times 760 \times 373} = \boxed{1.5124\ gm/litre}$$

3- (a) $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2} \Rightarrow \frac{P_1}{m_1T_1} = \frac{P_2}{m_2T_2}$ $\quad [\because V_1 = V_2\ \&\ M_1 = M_2]$

$$\Rightarrow m_2 = \frac{P_2 m_1 T_1}{P_1 T_2} = \frac{16 \times 3.2 \times 273}{1 \times 473} = \boxed{29.55\ gm}$$

(b) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \Rightarrow P_2 = \frac{P_1V_1T_2}{T_1V_2}$

$$\Rightarrow P_2 = \frac{750 \times 0.500 \times 323}{760 \times 288 \times 0.400} = \boxed{1.383\ atm}$$

$$\Rightarrow P_2 = 1.383 \times 760 = \boxed{1051.4\ \text{mm of Hg}}$$

4- $T_1 = 27^oC = 300\,K, \quad n_1 = n$

$T_2 = ? \quad , \quad n_2 = n - \frac{3}{5}n = \frac{2}{5}n$

$n_1T_1 = n_2T_2$

5- $N_2O_4 \rightleftharpoons 2NO_2$

$1-x \qquad 2x$

$MW = 2 \times 30.2 = 60.4$

$n_{total} = 1+x$

Mass of a reaction is conserved.

$$\frac{92}{1+x} = 60.4$$

$$\Rightarrow x = 0.52$$

$$\% \text{ of } NO_2 = \frac{2x}{1+x}(100) = \frac{2(0.52)(100)}{1.52} = \boxed{68.8\%}$$

⑥ By Boyle's law

$$V = \frac{100 \times 750}{745} = 100.67 \text{ ml.}$$

7- $$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2} \Rightarrow \frac{V_1}{n_1} = \frac{V_2}{n_2} \quad (\because P \,\&\, T \text{ constant})$$

$$\Rightarrow \left(\frac{4}{3}\pi r_1^3\right)\frac{1}{n_1} = \left(\frac{4}{3}\pi r_2^3\right)\frac{1}{n_2}$$

$$\Rightarrow r_2 = r_1\left(\frac{n_2}{n_1}\right)^{1/3}$$

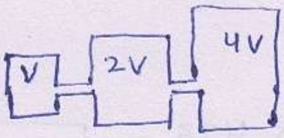
$$r_2 = 10\left(\frac{0.75}{1}\right)^{1/3} = 10 \times 0.908$$

$$r_2 = \boxed{9.08 \text{ cm}}$$

⑧ By Boyle's Law

$$P = \frac{5 \times 750}{1} = 3750 \text{ mm} = 4.93 \text{ atm.}$$

9- (i)



$n \propto V$ at const temperature and pressure.

initial mole ratio $n_A : n_B : n_C = \boxed{1:2:4}$

(ii) As temperature is different in all boxes

$$n \propto \frac{V}{T}$$

$$n_A : n_B : n_C = \frac{V}{300} : \frac{2V}{400} : \frac{4V}{600} = \frac{1}{3} : \frac{1}{2} : \frac{2}{3}$$

$$n_A : n_B : n_C = \boxed{2:3:4}$$

⑩

$$V_f = \frac{100}{288} \times 258 = 89.58 \text{ ml.}$$

⑪

$$\frac{d_1}{d_2} = \frac{T_2}{T_1}$$

$$\frac{24}{18} = \frac{T_2}{300}$$

$$\Rightarrow T_2 = 400K.$$

Daltons Law of Partial Pressure

12 - $n_{total} = \frac{12}{28} + \frac{4}{2} + \frac{9}{32} = 2.71$

$$P_T = \frac{n_{total} RT}{V} = \frac{2.71 \times 0.0821 \times 300}{1}$$

$$P_T = \boxed{66.74 \text{ atm}}$$

13_

$$n_{total} = \frac{10}{2} + \frac{64}{32} = 7$$

$$P_T = \frac{n_{total}RT}{V} = \frac{7 \times 8.314 \times 473}{10 \times 10^{-3}} = \boxed{27.53 \times 10^5 \, N/m^2}$$

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$$

initial	5	2	
final	5-4=1	0	4

$$n_{total} = 5$$

$$P_T = \frac{n_{total} RT}{V} = \frac{5 \times 8.314 \times 473}{10 \times 10^{-3}} = \boxed{19.66 \times 10^5 \, N/m^2}$$

⑭ $p_{O_2} = 800 - 21 = 779$ mm of Hg

$$n_{O_2} = \frac{779}{760} \times \frac{0.1}{0.0821 \times 296}$$

$$V_{O_2} \text{ at NTP} = \frac{779}{760} \times \frac{0.1}{0.0821 \times 296} \times 22400 \text{ ml}$$

$$= 94.5 \text{ ml.}$$

⑮ $$P_f = \frac{(250 \times 650) + (380 \times 650)}{1000} = 409.5 \text{ mm}$$

16-

$$SO_3 \longrightarrow SO_2 + \frac{1}{2}O_2$$
$$1-x \qquad x \qquad x/2 \qquad n_{total} = 1+\frac{x}{2}$$

$$n = \frac{PV}{RT} = \frac{1\times 1}{0.0821\times 900} = 0.0135$$

$$M_{mix} = \frac{0.94}{0.0135} = 69.62$$

$$\frac{80}{1+\frac{x}{2}} = 69.62$$

$$x = 0.3$$

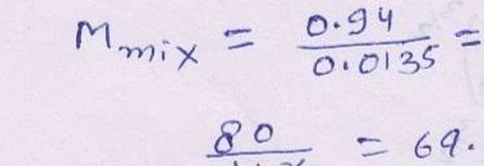
$$P_{SO_3} = \frac{1-x}{1+\frac{x}{2}} P_T = \frac{0.7}{1.15} = \boxed{0.6\ atm}$$

$$P_{SO_2} = \frac{x}{1+\frac{x}{2}} P_T = \frac{0.3}{1.15} = \boxed{0.265\ atm}$$

$$P_{O_2} = 1 - P_{SO_3} - P_{SO_2} = \boxed{0.135\ atm}$$

Graham's Law

17-



$$r \propto \frac{P}{\sqrt{M}}$$

$$\frac{r_{HCl}}{r_{NH_3}} = \frac{P_{HCl}}{P_{NH_3}}\sqrt{\frac{M_{NH_3}}{M_{HCl}}}$$

$$\frac{0.6}{0.4} = \frac{P}{1}\sqrt{\frac{17}{36.5}}$$

$$P = \boxed{2.19\ atm}$$

(18)

$$\frac{r_{ozone}}{r_{Cl_2}} = \frac{6}{5} = \sqrt{\frac{35.5}{d_{ozone}}}$$

$$\Rightarrow d_{ozone} = 24.65.$$

(19)

$$\frac{r_{Cl_2}}{r_X} = \frac{100/t}{127/t} = \sqrt{\frac{M_x}{71}}$$

$$\Rightarrow M_x = 44$$

20-

$$\frac{r_A}{r_B} = \frac{1}{4} \Rightarrow \frac{r_A}{r_B} = \frac{n_A}{n_B}\left(\frac{M_B}{M_A}\right)^{1/2}$$

$$\Rightarrow \frac{1}{4} = \frac{m_A}{m_B}\left(\frac{M_B}{M_A}\right)^{3/2}$$

$$\Rightarrow \frac{1}{4} = \frac{2}{3}\left(\frac{M_B}{M_A}\right)^{3/2}$$

$$\Rightarrow \frac{3}{8} = \left(\frac{M_B}{M_A}\right)^{3/2}$$

$$\Rightarrow \frac{M_B}{M_A} = \left(\frac{9}{64}\right)^{1/3}$$

$$\frac{m_A}{m_B} = \frac{2}{3}$$

$$\frac{X_A}{X_B} = \frac{n_A}{n_B} = \frac{m_A}{M_A} \times \frac{M_B}{m_B} = \frac{2}{3} \times \left(\frac{9}{64}\right)^{1/3}$$

$$\frac{X_A}{X_B} = \left(\frac{8 \times 9}{27 \times 64}\right)^{1/3} = \boxed{\left(\frac{1}{24}\right)^{1/3}}$$

21-

$$\frac{n_{CH_4}}{n_{O_2}} = \frac{4}{2}\left(\frac{M_{O_2}}{M_{CH_4}}\right)^{3/2} = \frac{4}{2}\left(\frac{32}{16}\right)^{3/2} = 4\sqrt{2}$$

$$\frac{n_{SO_2}}{n_{O_2}} = \frac{1}{2}\left(\frac{M_{O_2}}{M_{SO_2}}\right)^{3/2} = \frac{1}{2}\left(\frac{32}{64}\right)^{3/2} = \frac{1}{4\sqrt{2}}$$

Eudiometry

23– $C_xH_y(g) + (x+\frac{y}{4})O_2(g) \longrightarrow xCO_2(g) + \frac{y}{2}H_2O(l)$

initial	10	80	0	—
final	0	$80-10(x+\frac{y}{4})$	$10x$	—

Final volume occupied by gas = 70 ml

$$80-10\left(x+\frac{y}{4}\right)+10x = 70$$

$$80-\frac{10y}{4} = 70$$

$$y = 4$$

contraction in volume on passing KOH $= 70-50$
$= 20$ ml.

$$\frac{x}{1} = \frac{20}{10} \Rightarrow x = 2$$

$$\boxed{C_2H_4}$$

24– $C_xH_y(g) + \left(x+\frac{y}{4}\right)O_2(g) \longrightarrow xCO_2(g) + \frac{y}{2}H_2O(l)$

initial	7.5	36	0	—
final	0	$36-7.5(x+\frac{y}{4})$	$7.5x$	—

$$36-7.5\left(x+\frac{y}{4}\right)+7.5x = 28.5 \Rightarrow y=4$$

25- $C_xH_yO_z(g) + \left(x+\frac{y}{4}-\frac{z}{2}\right)O_2(g) \longrightarrow xCO_2(g) + \frac{y}{2}H_2O(l)$

initial	10	100	0	—
final	0	$100-\left(x+\frac{y}{4}-\frac{z}{2}\right)10$	$10x$	—

$$100-\left(x+\frac{y}{4}-\frac{z}{2}\right)10+10x = 90$$

$$100-\left(\frac{y}{4}-\frac{z}{2}\right)10 = 90$$

$$\frac{y}{4}-\frac{z}{2} = 1 \Rightarrow y-2z=4 \quad \text{—(i)}$$

Contraction in volume on passing KOH = 20mL

$$\frac{x}{1}=\frac{20}{10} \Rightarrow x=2$$

Vapour density = 23

Molecular weight = 46

$$24+y+16z = 46$$

$$y+16z = 22 \quad \text{—(ii)}$$

On solving equation (i) & (ii)

$$z=1,\ y=6$$

$\boxed{C_2H_6O}$

(26)

$C_xH_y + \left(x+\frac{y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O(l)$

i	30	200	0	0
f	0	$200-30\left(x+\frac{y}{4}\right)$	$30x.$	0

$$200-30x-7.5y+30x = 230-45 = 185$$

$$\Rightarrow 7.5y = 15 \Rightarrow y=2.$$

& $200-30x-7.5y = 95$

$$30x = 90 \Rightarrow x=3$$

$\boxed{C_3H_2}$

27- $yO_2 \longrightarrow 2O_y$

initial 50 $-$

final $50-x$ $\frac{2x}{y}$

$50 - x + \frac{2x}{y} = 47$ — (i)

$50 - x = 41 \Rightarrow x = 9$ — (ii)

from (i) & (ii)

$y = 3$

$\boxed{O_3}$

28- $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$ $N_2 = 10 - x - y$ mL

intial x z_1

final 0 $z_1 - \frac{x}{2}$ x

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$

initial y z_2 0

final 0 $z_2 - 2y$ y

contraction $= (x + z_1 + y + z_2) - (x + y + z_1 + z_2 - \frac{x}{2} - 2y)$

$= \frac{x}{2} + 2y$

$\frac{x}{2} + 2y = 6.5$ — (i)

contraction on passing KOH = 7 mL = Volume of CO_2

$x + y = 7$ — (ii)

$x = 5$, $y = 2$

$\boxed{V_{CO} = 5\,ml,\ V_{CH_4} = 2\,ml,\ V_{N_2} = 3\,ml}$

㉙

$$C_xH_y + (x+\frac{y}{4})O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O(l)$$

$$7.5 \quad 7.5(x+\frac{y}{4}) \quad 7.5x.$$

$$7.5 + \cancel{7.5x} + \frac{7.5y}{4} - \cancel{7.5x} = 15.$$

$$y = 4$$

$$Mw = 28 = 12x+4$$

$$\Rightarrow x = 2$$

$$\boxed{C_2H_4}$$

Kinetic Theory of Gas

30- (a)

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

$$V_{rms} = \sqrt{\frac{3\times 8.314\times 298}{9.1\times 10^{-31}\times 6.023\times 10^{23}}}$$

$$V_{rms} = 1.16\times 10^{5}\ m/sec$$

$$= \boxed{1.16\times 10^{7}\ cm/sec}$$

(b)

$$V_{avg} = \sqrt{\frac{8RT}{\pi m}}$$

$$\frac{V_{avg}(A)}{V_{avg}(B)} = \sqrt{\frac{T_A}{T_B}\times\frac{m_B}{m_A}} = \sqrt{\frac{300\times 16}{900\times 2}} = \boxed{1.632}$$

31- (a)

$$E = \frac{3}{2}RT = \frac{3}{2}\times 2\times 300 = \boxed{900\ cal}$$

(b)

$$\text{Thermal Energy added} = \frac{3}{2}nR\Delta T$$

$$= \frac{3}{2}\times\frac{3.45}{20.18}\times 2\times 100$$

$$= \boxed{51.29\ cal}$$

32-

$$U_{rms} = \sqrt{\frac{3RT}{M}} \qquad U_{avg} = \sqrt{\frac{8RT}{\pi M}}$$

$$\sqrt{\frac{3RT}{64\times 10^{-3}}} = \sqrt{\frac{8R\times 300}{3.14\times 32\times 10^{-3}}}$$

$$T = \frac{8\times 300\times 2}{3.14\times 3} = 509\ K$$

$$T = 509 - 273 = \boxed{236^{\circ}C}$$

33- $PM = dRT$

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

$$U_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3P}{d}} = \sqrt{\frac{3 \times 1.013 \times 10^5}{9 \times 10^{-2}}} = \boxed{1.83 \times 10^3 \ m/sec}$$

34- (a) $$U_{rms} = \sqrt{\frac{3P}{d}} = \sqrt{\frac{3 \times 1.013 \times 10^5}{1.2504}} = \boxed{494 \ m/s}$$

(b) $$U_{avg} = \sqrt{\frac{8P}{\pi d}} = \sqrt{\frac{8 \times 1.013 \times 10^5}{3.14 \times 1.2504}} = \boxed{455 \ m/s}$$

(c) $$U_{mp} = \sqrt{\frac{2P}{d}} = \sqrt{\frac{2 \times 1.013 \times 10^5}{1.2504}} = \boxed{403 \ m/s}$$

35- $$U_{rms} = \sqrt{\frac{u_1^2 + u_2^2 + u_3^2 + u_4^2 + u_5^2 + u_6^2}{6}}$$

$$= \sqrt{\frac{2^2 + 2.2^2 + 2.6^2 + 2.7^2 + 3.3^2 + 3.5^2}{6}}$$

$$\Rightarrow U_{rms} = \sqrt{\frac{46.03}{6}} = \boxed{2.77 \ m/s}$$

$$U_{avg} = \frac{u_1 + u_2 + u_3 + u_4 + u_5 + u_6}{6}$$

$$\Rightarrow U_{avg} = \frac{2 + 2.2 + 2.6 + 2.7 + 3.3 + 3.5}{6}$$

$$\Rightarrow U_{avg} = \frac{16.3}{6} = \boxed{2.716 \ m/s}$$

36- $PV = nRT$

$$T = \frac{PV}{nR} = \frac{1 \times 1 \times 6.023 \times 10^{23}}{1.03 \times 10^{23} \times 0.0821} = \boxed{71.2 \ K}$$

$$U_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \times 8.314 \times 71.2}{2 \times 10^{-3}}} = \boxed{942 \ m/s}$$

Real Gas Behavior

37- $T_c = 304.2 \ K$, $P_c = 72.9 \ atm$

$$T_c = \frac{8a}{27Rb} \qquad \boxed{P_c = \frac{a}{27b^2}}$$

$$\frac{T_c}{P_c} = \frac{8a}{27Rb} \times \frac{27b^2}{a} = \frac{8b}{R} \Rightarrow b = \frac{RT_c}{8P_c}$$

$$b = \frac{4}{3}\pi r^3 N_A \times 4$$

$$\frac{4}{3}\pi r^3 N_A \times 4 = \frac{RT_c}{8P_c}$$

$$r = \left(\frac{3RT_c}{128\pi N_A P_c}\right)^{1/3}$$

$$r = \left(\frac{3\times 8.314\times 304.2}{128\times 3.14\times 6.023\times 10^{23}\times 72.9\times 1.013\times 10^{5}}\right)^{1/3}$$

$$r = 0.162\times 10^{-9}\ m$$

$$r = \boxed{1.62\ \text{Å}}$$

38-

$$r = \left(\frac{3RT_c}{128\pi N_A P_c}\right)^{1/3}$$

$T_c = -122 + 273 = 151\ K$

$P_c = 48\ atm$

$P_c = 48\times 1.013\times 10^{5}\ Pa$

$$r = \left(\frac{3\times 8.314\times 151}{128\times 3.14\times 6.023\times 10^{23}\times 48\times 1.013\times 105}\right)^{1/3}$$

$$r = 0.147\times 10^{-9}\ m$$

$$r = \boxed{1.47\ \text{Å}}$$

39-

$$b = \left(\frac{4}{3}\pi r^3 N_A\right)\times 4$$

$b = (\text{Volume of one mole})\times 4$

$$b = \frac{200.59}{13.6}\times 4 = \boxed{58.997\ cm^3}$$

40- (a) $P = \frac{nRT}{V} = \frac{22\times 8.314\times 298.15}{44\times 0.5\times 10^{-3}} = \boxed{2.47\times 10^{6}\ Pa}$

(b) $P = \frac{nRT}{V-nb} - \frac{n^2a}{V^2}$

$$P = \frac{0.5\times 8.314\times 298.15}{0.5\times 10^{-3} - 0.5\times 42.67\times 10^{-6}} - \frac{0.5\times 0.5\times 363.76\times 10^{3}\times 10^{-6}}{0.25\times 10^{-6}}$$

$$P = 2.589\times 10^{6} - 0.364\times 10^{6}$$

$$P = \boxed{2.225\times 10^{6}\ Pa}$$

41-

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

$$m = \frac{PVM}{ZRT} = \frac{10.1325 \times 10^{6} \times 100 \times 10^{-3} \times 32 \times 10^{-3}}{0.927 \times 8.314 \times 273.15}$$

$$m = \boxed{15.4\ \text{kg}}$$

42- At Boyle's temperature real gases behave like an ideal gas.

$$T_b = \frac{a}{Rb} = \frac{1.36}{0.0821 \times 0.0318} = \boxed{521\ \text{K}}$$

43- (i) $T_c = \frac{8a}{27Rb}$

T_c will be maximum if $\frac{a}{b}$ value maximum.

$\frac{a}{b}$ for Gas A = 15011

" " B = 40530

" " C = 18998.

i.e. T_c will be maximum for $\boxed{\text{Gas B.}}$

(ii) larger the value of b, larger the molecular volume.

i.e. $\boxed{\text{Gas C}}$ has maximum molecular volume.

(iii) least the value of a & b, gases behave as an ideal gas. i.e. $\boxed{\text{Gas A}}$.

44- (i) $P = \frac{nRT}{V} = \frac{15 \times 0.0821 \times 303}{12} = \boxed{31.1\ \text{atm}}$

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

$$= \frac{15 \times 0.0821 \times 303}{12 - 0.0171 \times 15} - \frac{0.2107 \times 15 \times 15}{12 \times 12}$$

$$= 31.777 - 0.329$$

$$P = \boxed{31.44\ \text{atm}}$$

45-

$P = 327.6$ atm

$T = 776.4$ K

$d = 133.2$ gm/L

$$Z = \frac{PV}{nRT} = \frac{PM}{dRT}$$

$$Z = \frac{327.6 \times 18}{133.2 \times 0.0821 \times 776.4} = \boxed{0.695}$$

$$V_m = \frac{V}{n} = \frac{V}{m} M = \frac{M}{d}$$

$$V_m = \frac{18}{132.2} = \boxed{0.135 \text{ L/mol}}$$

46-

$$\frac{P_1 V_1}{Z_1 T_1} = \frac{P_2 V_2}{Z_2 T_2}$$

$$V_2 = \frac{P_1 V_1 Z_2 T_2}{Z_1 T_1 P_2}$$

$$V_2 = \frac{300 \times 1 \times 1.375 \times 273}{1.072 \times 473 \times 600}$$

$$V_2 = \boxed{0.370 \text{ litre}}$$

Get Eq (Mains)

① Gases do not have fixed volume

$\boxed{D}$

② Vapour pressure of any liquid depends only on T.

$\boxed{C}$

③ Dalton's law does not holds for reacting gases

$\boxed{B}$

④ At sea level pressure is max so volume minimum hence density maximum

$\boxed{A}$

⑤ $PV = nRT = k.$

so slope = 0

$\boxed{A}$

⑥ Steam distillation is based on partial pressures

$\boxed{D}$

⑦ $M_x = 16\, M_{He} = 64$

$\boxed{D}$

⑧ $K \propto T$

$\boxed{D}$

⑨ $T \propto P$

$T_f = 8 \times 300 = 2400\,K = 2127^\circ C$

$\boxed{B}$

⑩ $\frac{n_f}{n_i} = \frac{1}{8}$

$n \propto V$.

so $\frac{V_f}{V_i} = \frac{1}{8}$

$\Rightarrow \frac{r_f}{r_i} = \frac{1}{2}$.

$\boxed{B}$

⑪ $n_1 T_1 = n_2 T_2$

$n_2 = n_1 \times \frac{300}{750} = 0.4\, n_1.$

$\boxed{B}$

⑫ $d = PM/RT$

$\Rightarrow \frac{d_1}{d_2} = \frac{800 \times 300}{750 \times 320} = 1$

$\boxed{D}$

⑬ $\frac{16}{14} = \frac{T_2}{273} \Rightarrow T_2 = 312\,K = 39\,°C$

$\boxed{B}$

⑭ $\boxed{B}$

⑮ $\sqrt{\frac{8RT_A}{\pi m}} = 2\sqrt{\frac{8RT_B}{\pi m}}$

$\Rightarrow T_A = 4 T_B$

$\frac{P_A}{P_B} = \frac{T_A}{T_B} \frac{V_B}{V_A} = 4 \times \frac{2}{1} = 8$

$\boxed{D}$

⑯ $\boxed{B}$

⑰ $\boxed{C}$

⑱ $\boxed{A}$

⑲ $\boxed{D}$

⑳ $\boxed{D}$

㉑ At high pressure repulsive forces dominate

$\boxed{D}$

㉒ Real gas behaves like as an ideal gas at high T & low P

$\boxed{C}$

㉓ When repulsive forces dominate

$Z > 1$

$\boxed{C}$

㉔ $V_{ideal} = \frac{1 \times 0.0821 \times 300}{24}$

$= 1.025$

$Z = \frac{0.9}{1.025} < 1$

$\Rightarrow$ negative deviation

$\boxed{A}$

㉕ $\boxed{A}$

㉖ $\boxed{B}$

㉗ if $Z > 1$ repulsive forces dominate hence it is difficult to compress real gas.

$\boxed{C}$

㉘ $\boxed{B}$

㉙

(29) $T_c = \frac{8a}{27Rb}$ $\qquad P_c = \frac{a}{27b^2}$

$$\frac{T_c}{P_c} = \frac{8b}{R} \Rightarrow b = \frac{RT_c}{8P_c}$$

$$V_c = 3b = \frac{3RT_c}{8P_c} = 5L$$

$$\boxed{B}$$

(30) At low P ~~we can~~ b neglected

$$\left(P + \frac{4^2 a}{V^2}\right)(V) = 4RT$$

$$PV + \frac{16a}{V} = 4RT$$

$$PV = 4\left(RT - \frac{4a}{V}\right)$$

$$\frac{PV}{RT - \frac{4a}{V}} = 4$$

$$\boxed{B}$$

Get equipped

①

$$\frac{r_{He}}{r_{CH_4}} = \frac{0.4}{0.6}\sqrt{\frac{16}{4}} = \frac{4}{3}$$

$$\% \, CH_4 = \frac{3}{7} \times 100 = 43\%$$

$\boxed{C}$

(2) Charle's law : $V \propto T(K)$

(B) is the correct graph. (A) is wrong graph.

③ Since Piston is conducting $T_A = T_B$

& frictionless moving piston so $P_A = P_B$

$$n_A = \frac{P_A V_A}{R T_A} \qquad n_B = \frac{P_B \times 3V_A}{R T_B}$$

so $n_B = 3 n_A$.

$$TKE_A = \frac{3}{2} n_A R T_A$$

$$TKE_B = \frac{3}{2} n_B R T_B$$

so $TKE_B = 3 \, TKE_A$

$\boxed{D}$

4) $n_1 = \dfrac{P_1 V_1}{R T_1}$ and $n_2 = \dfrac{P_2 V_2}{R T_2}$

$$\frac{n_2}{n_1} \times 100 = \frac{P_2 V_2 T_1}{P_1 V_1 T_2} \times 100 = 16.66\%$$

$\therefore$ change $= 83.33\%$

(B)

⑤ $P_{gas} = 75 - 10 - 10 = 55$ cm of Hg

$\boxed{A}$

⑥ $P_{N_2} = 860 - 24 = 836$ mm of Hg

$w_{N_2} = \frac{836}{760} \times \frac{100}{11 \times 1000} \times \frac{28}{0.08 \times 250}$

$= 0.014$

$\% = \frac{0.014}{0.42} \times 100 = 3.33\%$

$\boxed{A}$

⑧ $C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O(g)$

$a \qquad ax + \frac{ay}{4} \qquad ax \qquad \frac{ay}{2}$

$a + ax + \frac{ay}{4} = 600$ & $ax + \frac{ay}{2} = 700$.

solving $x = 3$, $y = 8$

$\boxed{C_3H_8}$

[redacted]

(7) 20% mass ⇒ 20% by moles too.

$$N_2O_4 \longrightarrow 2NO_2$$

$t=0$ 1 $-$

$t=t$ $1-0.2$ 0.4 $\Big\}\ n_{total} = 1.2$

$$P = \frac{nRT}{V} = \frac{1.2 \times R \times 600}{(n_1 R T_1 / P_1)}$$

$$= 2.\underline{\underline{4}}\ \text{atm}.$$

(B)

[redacted]

(9) $$\frac{V_2}{V_1} = \frac{\frac{4}{3}\pi r_2^3}{4\pi r_1^3} = \frac{P_1 T_2}{P_2 T_1} = \frac{P \times 2T}{P/4 \times T} = 8$$

$$\Rightarrow \frac{r_2}{r_1} = (8)^{1/3} = 2 \Rightarrow \underline{\underline{100\%}}\ \text{increase.}$$

(A)

(10) POAC on Br

$n_{Br_2} \times 2 = n_{BrF_n} \times 1$

ie $\dfrac{423 \times 2}{\left(\dfrac{22400}{273} \times 423\right)} = \dfrac{4.2}{(80+19n)} \times 1$

∴ $n = \underline{\underline{5}}$ (C)

(11) $V_{gas\ mix} = 150\ mL - V_{H_2O}$

$P_{gas} = 161\ mm = \text{vap. pressure} + P_{O_2}$

∴ $P_{O_2} = 161 - 28 = 133\ mm\ Hg.$

∴ $V_{O_2} = \dfrac{(150 - V_{H_2O})}{1000} L = \dfrac{n_{O_2} R T}{P_{O_2}} = \dfrac{0.001 \times \frac{1}{12} \times 300}{(133/760)}$

∴ $V_{H_2O} \approx \underline{10\ mL}$

(B)

(12) $\Sigma n_{total} = n_1 + n_2 + n_3$

or $\dfrac{P_{total} V_{total}}{R T} = \dfrac{P_1 V_1}{RT} + \dfrac{P_2 V_2}{RT} + \dfrac{P_3 V_3}{RT}$

∴ $P_{total} = \dfrac{P_1 V_1 + P_2 V_2 + P_3 V_3}{V_{total}} = \underline{1.412\ atm}$

(A)

⑭ $$\sqrt{\frac{8RT}{\pi m_A}} = \sqrt{\frac{3RT}{m_B}}$$

$$\Rightarrow\ 8\, m_B = \frac{3\pi}{8}\, m_A$$

$$\Rightarrow\ m_B > m_A.$$

so to equate their mean speed

$$T_B > T_A$$

$$\Rightarrow \boxed{B}$$

⑮ at low P attractive force dominate
at high P repulsive force dominate

so $\boxed{D}$

⑯ $$P_2 - P_1 = \ell$$

$$\frac{Pb}{b'} - \frac{Pa}{a'} = \ell$$

$$P = \frac{\ell}{\frac{b}{b'} - \frac{a}{a'}}$$

$$\boxed{A}$$

⑰.

$$n_{tot} = \frac{5.6 \times 3}{0.082 \times 273} = 0.75$$

$n_{N_2} = 0.5$

so $n_x = 0.25$

$\Rightarrow M_x = 4\, M_{N_2} = 112$

$\boxed{B}$

(13) $n = \frac{PV}{RT} = \frac{w}{\text{mol.wt.}}$

ie $\text{mol. wt.} = \frac{w \times RT}{PV}$

$= \frac{0.4429 \times \frac{1}{12} \times 373}{\left(743/760\right) \times (0.1153)}$

$= 120.\underline{\underline{32}}\ g$

(A)

[redacted]

One or more than one right

(1) i, ii, iii : all right. (D)

(2) (B), (D) are wrong.

$Z_{critical} = \frac{\frac{\cancel{8}a}{\cancel{27}\cancel{b}b^2} \times 3\cancel{b}}{\cancel{R} \times \frac{8a}{\cancel{27}R\cancel{b}}} = \frac{3}{8}$

At zero K, $KE_{avg} = \frac{3}{2}RT$ per mole = Zero.

(3) (B). Here, $Z<1$. Attractive tendency is shown.

(4) rate $\propto \frac{PA}{\sqrt{TM}}$. Hence (A), (B), (C)

(5) time $= \frac{V}{\text{rate}}$. rate $\propto \frac{PA}{\sqrt{TM}}$ or $\frac{1}{\sqrt{M}}$

$\therefore$ time $\propto V\sqrt{M}$

time is same. That is, $V_1\sqrt{M_1} = V_2\sqrt{M_2}$

$\therefore$ (C), (D) $\left[32\sqrt{32} = 27.3\sqrt{44} = 22.62\sqrt{64}\right]$

(6) (A): when 'a' is negligible, $Z = 1 + \frac{Pb}{RT}$

(C): when 'a' and 'b' are negligible, $Z = 1$

(7) $V_{mp} = \sqrt{\frac{2RT}{M}}$ ie $V_{mp} \propto \sqrt{T}$ and $\propto \frac{1}{\sqrt{M}}$

$\therefore$ (A), (B) and (D) are right.

(8) (C) is wrong.
$P_c = \frac{a}{27b^2}$ or $P_c \propto \frac{1}{b^2}$.

(9) (B), (C), (D): obvious.

(10) (A); (C), (D)
A: $Z_{ideal} = 1$
C: obvious
D: $Z<1 \Rightarrow V_{real} < V_{ideal} \Rightarrow$ attractive tendency.

(11) (B), (C)

(B) : $U_{mps} = \sqrt{\frac{2RT}{M}} \Rightarrow T\uparrow ; U_{mps}\uparrow$

(C) : obvious. Maxwellian distribution.

(12) (A), (C), (D)

A : 'a' = 0 and $Z = 1 + \frac{Pb}{RT}$

C : 'a' and 'b' can be found out.

D : at high P, $Z = 1 + \frac{Pb}{RT}$

$\text{Slope} = \frac{b}{RT} > 0$ for all gases.

[redacted]

(13) (A), (B)

A: T is constant $\therefore V\uparrow \Rightarrow P\downarrow$

B: $KE_{avg} = \frac{3}{2}kT$. Since 'T' is constant.

Comprehension

Passage I

(1) $PV = nRT$

$\therefore \left(\frac{\partial P}{\partial T}\right)_V = \frac{nR}{V} ; \left(\frac{\partial V}{\partial P}\right)_T = -\frac{nRT}{P^2} ; \left(\frac{\partial V}{\partial T}\right)_P = \frac{nR}{P}$

$\therefore \text{product} = \frac{nR}{\cancel{V}} \times -\frac{\cancel{nRT}}{\cancel{P^2}} \times \frac{nR}{\cancel{P}} = -\frac{n^2R^2}{P^2}$

$= -\frac{R^2}{P^2}$ (for one mole)

(A)

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

$\log V = \log\left(\frac{nR}{P}\right) + \log T$

y-intercept $= \log\left(\frac{nR}{P}\right) = \log\left(\frac{R}{P}\right)$ for 1 mole.

(C)

(3) $V_{STP} = n \times 22.4\,L = \frac{1.8}{18} \times 22.4\,L = \underline{\underline{2.24\,L}}$

(A)

(4) $U_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\times8.314\times300}{64\times10^{-3}}} = 3.42\times10^{2}$

(A)

(5) $U_{rms} = 3\sqrt{R} = \sqrt{\frac{3R\times300}{M}} = 3\sqrt{\frac{100R}{M}}$

$\Rightarrow M = 100 \quad \therefore [C]$

Passage 2

(1) When $V = 0$, $P = 1$

$\Rightarrow Pe^{0} = 1 = 2\times C\times500 \Rightarrow C = \frac{1}{1000}$

(B)

(2) $P = \left(\frac{nC}{e^{V/2}}\right)T \Rightarrow \text{slope} = \frac{2C}{e} = \frac{2}{1000e}$

(D)

(3) $P = \left(\frac{nC}{e^{V/2}}\right)T \Rightarrow P = \left(\frac{\left(\frac{PV}{RT}\right)C}{e^{V/2}}\right)T$

~~or $P = \left(\frac{1\times 200}{0.0821\times 200}\right)\times\frac{10^{-3}}{e^{100}}\times 821$~~

$$P = \left(\frac{1\times \cancel{200}}{0.0821\times \cancel{200}}\right)\times\frac{10^{-3}}{e^{100}}\times 821 = \frac{10}{e^{100}} \text{ atm.}$$

(A)

Passage-3

① (B). obvious from graph shape.

② (D) $T_c = \frac{8a}{27Rb}$. Greater is T_c, greater is deviation from ideal behavior.

③ (B). $Z_{critical} = \frac{3}{8} = 0.375$.

Passage-4

①

$$\frac{n-3}{3-2} = \frac{T-200}{200-300} \text{ (straight line)}$$

or $n-3 = \frac{-T}{100} + 2$

or $n = 5 - \frac{T}{100}$

(C)

② $V = \frac{nRT}{P}$ ∴ $V = \left(5 - \frac{T}{100}\right)\frac{RT}{P}$

but, $P = 1$ ∴ $V = 5RT - \frac{RT^2}{100}$

(B)

③ $\frac{dV}{dT}=0 \Rightarrow -\frac{2RT}{100}+5R = 0$

$\Rightarrow T = 250 = -23^\circ C$

(B)

④ Putting $T=250$,

$V = 5R\times 250 - \frac{R\times 250^2}{100}$

$= 1250R - 625R = \underline{\underline{625R}}$

[D]

Passage 5

① (A) obvious. All H_2O freezes in B at $-70^\circ C$.

② $n_{H_2O} + n_{CO_2} + n_{N_2} = \frac{PV}{RT} = \frac{(564/760)\times 1}{R\times 298}$

$= 0.0303$

$n_{N_2} + n_{CO_2} = \frac{(219/760)\times 1}{R}\left(\frac{1}{298}+\frac{1}{203}\right)$

$= 0.02906$

$\therefore n_{H_2O} = 0.0013$

③ All CO_2 freezes over at 'C'. Only N_2 remains as gas. Hence [D].

④ $n_{N_2} = \frac{(33.5/760)\times 1}{R}\left(\frac{1}{298}+\frac{1}{203}+\frac{1}{83}\right)$

$= 0.0109$. [B]

⑤ $n_{CO_2} = 0.02906 - 0.0109 = 0.018$

[C]

Passage - 6

① rate $\propto \frac{1}{\sqrt{M}}$ and time $= \frac{\text{Vol.}}{\text{rate}}$ $\therefore$ time $\propto V \times \sqrt{M}$

$\therefore 5 = k \cdot X \cdot \sqrt{2} \Rightarrow k = \frac{5}{X\sqrt{2}}$

(B) for O_2, time $= \cancel{\frac{5}{X\sqrt{2}} \times \sqrt{32}}$

$= \frac{5}{X\sqrt{2}} \cdot X \cdot \sqrt{32} = \underline{\underline{20\,s}}$

② (A): self explanatory.

③ $\frac{r_{NH_3}}{r_{HCl}} = \frac{36.5}{BC} = \sqrt{\frac{M_{HCl}}{M_{NH_3}}} = \sqrt{\frac{36.5}{17}}$

$\therefore BC = 24.909 \simeq 25$ cm. (B)

Passage - 7

① (D): Obvious. Flask 2 is at lower temperature. and Flask 1 when connected ~~o~~overall temperature lies between that of flasks 1 and 2.

② (B): obvious. A is faster ~~to~~ and lighter than B.

③ (C): Can be said for sure.

Passage 8

① (C): lower molecular ~~wt~~weight than air (29) and hence lower density $\left(d = \frac{PM}{RT}\right)$

② (B) : Same molecular weight as He.

③ $\text{Payload} = W_{air} - W_{gas,He}.$

$$D_{air} = \frac{PM}{RT} = \frac{1 \times (0.8 \times 28 + 0.2 \times 32)}{\frac{1}{12} \times 300}$$

$$= 1.152\,g/L$$

$$D_{He} = \frac{1 \times 4}{\frac{1}{12} \times 300} = 0.16\,g/L$$

$$\therefore \text{payload} = V_{balloon}(d_{air} - d_{He})$$

$$= 100\,(1.152 - 0.16) \approx 100\,g$$

(B)

Get Equipped for IIT JEE ⑦

One or more than one option correct

14 $V_{CO} = x \quad V_{O_2} = y \quad V_{CO_2} = 100-x-y$

$CO + \frac{1}{2}O_2 \rightarrow CO_2$

initial $x \quad y$

if CO limiting reagent $x < 2y$

final $0 \quad y-\frac{x}{2} \quad x$

On passing KOH all CO_2 absorbed.

$100 - x - y + x = 80$

$100 - y = 80 \Rightarrow y = 20$ ml

$\boxed{\text{Answer (B)}}$

if O_2 limiting reagent $x > 2y$

$CO + \frac{1}{2}O_2 \rightarrow CO$

initial $x \quad y$

final $x-2y \quad 0 \quad 2y$

$100 - x - y + 2y = 80$

$100 - x + y = 80$

$\boxed{\text{Answer (A)}}$

15- $C_xH_{y}(g) + \left(x+\frac{y}{4}\right)O_2(g) \rightarrow xCO_2(g) + \frac{y}{2}H_2O(l)$

initial $V_{HC} \quad V_{O_2} \quad 0 \quad -$

final $0 \quad V_{O_2} - \left(x+\frac{y}{4}\right)V_{HC} \quad xV_{HC}$

contraction $= V_{HC}\left(1+\frac{y}{4}\right)$

% contraction $= \frac{V_{HC}\left(1+\frac{y}{4}\right)}{V_{HC}+V_{O_2}} \times 100 = 25\%$

from option $\boxed{\text{Answer (A)}}$

$C_xH_yO_z(g) + \left(x+\frac{y}{4}-\frac{z}{2}\right)O_2(g) \rightarrow xCO_2(g) + \frac{y}{2}H_2O$

initial $V_{HC} \quad V_{O_2} \quad 0 \quad -$

final $0 \quad V_{O_2} - \left(x+\frac{y}{4}-\frac{z}{2}\right)V_{HC} \quad xV_{HC} \quad -$

contraction $= V_{HC}\left(1+\frac{y}{4}-\frac{z}{2}\right)$

Contraction % $= \dfrac{V_{HC}\left(1+\frac{y}{4}-\frac{z}{2}\right)}{V_{HC}+V_{O_2}} \times 100 = 25\%$

$\boxed{\text{Answer (C)}}$

16 − $C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$

initial	x	y	0	−
final	0	$y-5x$	$3x$	−

if C_3H_8 limiting

Contraction $= (x+y) - (y-2x) = 3x = 45$

$x = 15$ ml

$x + y = 100$ ml $\Rightarrow$ $y = 85$ ml

$\boxed{\text{Answer (A)}}$

if O_2 limiting

$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$

initial	x	y	0	−
final	$x-\frac{y}{5}$	0	$\frac{3y}{5}$	−

Contraction $= (x+y) - \left(x+\frac{2y}{5}\right) = 45$

$\Rightarrow \frac{3y}{5} = 45$

$y = 75$ ml, $x = 25$ ml

$\boxed{\text{Answer (B)}}$

Comprehension Type

Passage 9

1 − After combustion N_2 remains and when it reacts with excess hydrogen, NH_3 produced.

$\boxed{\text{Answer (D)}}$

V_{HC} ml alkane

V_{O_2} ml O_2

$10-V_{HC}\,V_{O_2}$ ml NH_3

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

initial	V_{HC}	V_{O_2}	0	−
final	0	0	xV_{HC}	

Contraction in volume on passing KOH = Volume of CO_2

$$\frac{2}{V_{HC}} = x \quad -(i)$$

All O_2 reacts with alkane, the only gas remains is N_2.

$$V_{HC}\left(x+\frac{y}{4}\right) = V_{O_2} \quad -(ii)$$

2-

$$N_2 + 3H_2 \rightarrow 2NH_3$$

initial $10 - V_{HC} - V_{O_2}$ $\quad$ 0

final $\quad$ $2(10 - V_{HC} - V_{O_2})$

$$2(10 - V_{HC} - V_{O_2}) = 8$$

$$V_{HC} + V_{O_2} = 6 \quad -(iii)$$

$$V_{N_2} = 4 \text{ mL}$$

$\boxed{\text{Answer (B)}}$

3- Volume of O_2 after first combustion = 0 mL

$\boxed{\text{Answer (C)}}$

4- from equation (i) (ii) (iii)

$x = 1$

$y = 4$

CH_4

$\boxed{\text{Answer (A)}}$

MATCHING TYPE

1- (A) H_2 {$P = 200$ atm, $T = 273 K$}

at high pressure $Z > 1$, attraction force neglected.

$P(V - nb) = nRT$

$\boxed{P, S}$

(B) $P \sim 0$ atm, gas behave as an ideal gas.

$\boxed{R}$

(C) $CO_2(g)$ ($P = 1$atm, $T = 273 K$)

low pressure $Z < 1$, attraction force dominates.

$\boxed{P, Q}$

(D) large molar volume, real gas behave as an ideal gas

$PV = nRT$

$\boxed{R}$

2- (A) Z for ideal gas $= 1$

$\boxed{R}$

(B) at low pressure

$\left(P + \frac{a}{V^2}\right)V = RT \Rightarrow Z = \frac{PV}{RT} = 1 - \frac{a}{VRT}$

$\boxed{S}$

(C) at high pressure

$P(V - nb) = nRT$

$n = 1 \Rightarrow \quad \frac{PV}{RT} = 1 + \frac{Pb}{RT}$

$\boxed{Q}$

(D) $T_C = \frac{8a}{27Rb}$

$\boxed{P}$

3- (A) $V_{rms} = \sqrt{\frac{3RT}{M}}$

$\boxed{R}$

(B) $V_{Avg} = \sqrt{\frac{8RT}{\pi M}}$

$\boxed{P}$

(C) $V_{mp} = \sqrt{\frac{2RT}{M}}$

$\boxed{S}$

(D) $P = \frac{1}{3}\frac{mn(\bar{c})^2}{V}$

$\boxed{Q}$

4- (A) Density of gas $d = \frac{PM}{RT}$

$\boxed{P, Q}$

(B) K.E. [illegible] $= \frac{3}{2} RT$

$\boxed{P, S}$

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

$\boxed{P, Q}$

(D) rate $\propto T$

$\propto n$

$\propto \frac{1}{\sqrt{M}}$

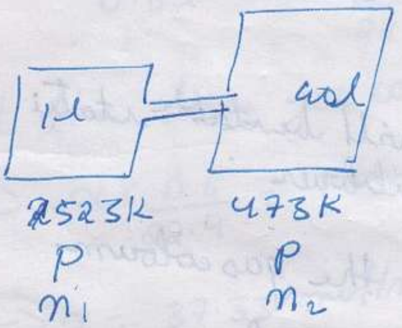
$\boxed{P, Q, R}$

Advance level.

Q.①

Mols of N_2 present = $\frac{10\times 1}{R\times 298}$ = 0.41

Mols of I_2 ~~prestnt~~ present = 0.04



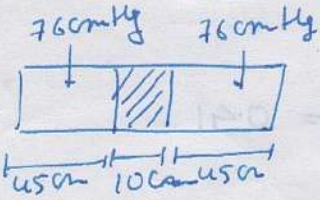
Finally pressure in both vessel must be equal

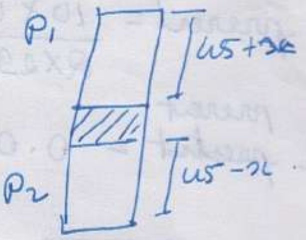
$n_1 + n_2 = 0.41 + 0.04 = 0.45$

$\Rightarrow \frac{P\times 1}{R\times 523} + \frac{P\times 40}{R\times 473} = 0.45$

$\Rightarrow P \simeq 0.425$ atm.

Q.②





Let A be the crosssectional area.

Let x be the shift.

$\boxed{P_2 = P_1 + 10}$ since Hg will be ~~stable~~ static at equilibrium.

Apply gas laws between the gas coloumn before and after held vertical.

$$\Rightarrow P_1(45+x)A = 76(45)A$$

$$P_2(45-x)A = 76(45)A$$

$$\Rightarrow P_1 = \frac{76\times45}{45+x}.$$

$$P_2 = \frac{76\times45}{(45-x)}.$$

$$\Rightarrow \frac{76\times45}{45-x} = \frac{76\times45}{45+x} + 10$$

$$\Rightarrow \boxed{x \approx 3\,\text{cm}}$$ Ans

Q.③ The CO₂ out

The CO₂ conv

22.4

0.6

Let the

=> αx

=> α =

Thus frac

= 0.6

Q.③ The CO_2 output = 1 mol/hour.

The CO_2 conversion rate = 600 ml STP/mi.

$$22.4\,l \xrightarrow{STP} 1\,mol$$

$$0.6\,l \longrightarrow \frac{0.6}{22.4}\,mol/mi$$

Let the time for converted operation be x

$$\Rightarrow x \times \frac{0.6}{22.4} = 1\,(mol/h).$$

$$\Rightarrow x = 37.33\,mol/mi$$

Thus fraction of time to be operated = $\frac{37.33}{60}$

$= \underline{0.622}$ Ans

Q(4)

$2A \rightleftharpoons A_2$

total wt will remain constant = 96

since at equilibrium 50% by wt of both compounds are present.

wt of $A_2 = \frac{96}{2} = 48 =$ wt of A

Thus moles of $A_2 = \frac{48}{(48\times2)}$. [∵ mol wt of $A_2 = 48\times2$]

" " " $A = \frac{48}{48}$.

Thus total moles = $1 + 0.5 = 1.5$

∴ ~~P~~ $V = 33.6\,l$ $T = 546$ $R = 0.082$

$\Rightarrow P = \frac{1.5\times0.082\times546}{33.6} = 2$

$\Rightarrow \boxed{P = 2\,atm}$.

Q5 Finally m

⇒ PV=

⇒ $\frac{0.}{76}$

⇒ $\boxed{n_N}$

At −75°C

CO₂ and H

⇒ PV= n

$\frac{1.32}{760}\times\frac{0.}{10}$

⇒ $n_{H}+$

⇒ $\boxed{n_c}$

At 296

⇒ $\frac{1.74}{760}\times$

⇒ n_{H+c}

⇒ $\boxed{n_H}$

$\boxed{Q.5}$ Finally moles of N_2 will be by/

$\Rightarrow PV = n_{N_2} RT$

$\Rightarrow \frac{0.53}{760} \times \frac{0.731}{1000} = n_{N_2}\, 0.082 \times 296$

$\Rightarrow \boxed{n_{N_2} = 2.1 \times 10^{-8}}$ A

At $-75°C$ the vessel will contain only CO_2 and N_2

$\Rightarrow PV = n_{(N_2+CO_2)} RT.$

$\frac{1.32}{760} \times \frac{0.731}{1000} = n_{(N_2+CO_2)}\, 0.082 \times 296$

$\Rightarrow n_{(N_2+CO_2)} = 5.2 \times 10^{-8}.$

$\Rightarrow \boxed{n_{CO_2} = 3.1 \times 10^{-8}}$ A

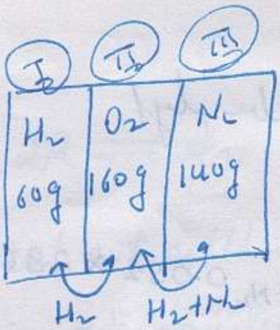
At 296 vessel will contain all CO_2, N_2 and $H_2O(g)$

$\Rightarrow \frac{1.74}{760} \times \frac{0.731}{760} = n_{(N_2+CO_2+H_2O)} \times 0.082 \times 296$

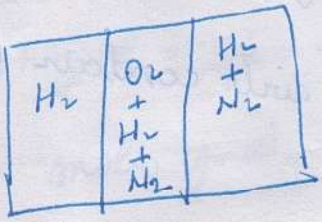
$\Rightarrow n_{(N_2+O_2+H_2O)} = 6.8 \times 10^{-8}.$

$\Rightarrow \boxed{n_{H_2O} = 1.7 \times 10^{-8}}$ A

$\boxed{Q.⑥}$



Initially



Finally

Diffusion of a gas will stop when its partial pressure is same on both sides

Final pressure of H_2 = $\frac{30\times\overset{R}{\cancel{0.082}}\times T}{50} = \frac{30RT}{50} = \frac{60RT}{100}$

Final pressure of N_2 = $\frac{5\times\overset{R}{\cancel{0.082}}\times T}{2\times\frac{50}{3}} = \frac{15}{100}RT$

" " " O_2 = $\frac{5\times R\times T}{\frac{50}{3}} = \frac{15RT}{50} = \frac{30RT}{100}$

∴ Pressure in chamber Ⓘ = $\frac{60RT}{100}$

" " " Ⓘⓘ = $\frac{105RT}{100}$

ⒾⒾⒾ = $\frac{\overset{75}{\cancel{80}}RT}{100}$

∴ Ratio = $\overset{4}{\cancel{60}} : \overset{7}{\cancel{105}} : \overset{5}{\cancel{75}}$

$\boxed{4:7:5}$ Ans.

Q.⑦

$\frac{4V}{5}$ P

n=1

$\frac{V}{5}$

n=1

$P_2 = \frac{mg}{A}$

$\frac{1\times RT}{(\frac{V}{5})}$ =

$\frac{5RT}{2}$ −

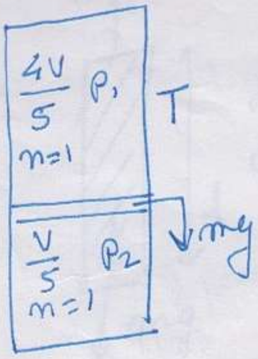
5T −

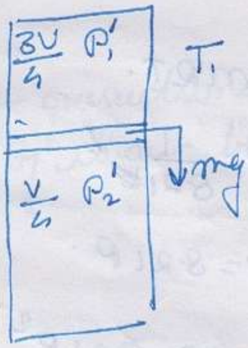
$5\times\frac{3}{4}$

$\frac{5\times3\times3}{4\times2\times4}$

$T' =$

.⑦





$$P_2' = \frac{mg}{A} + P_1'$$

$$P_2 = \frac{mg}{A} + P_1$$

①

$$\boxed{\overset{P}{\frac{1 \times RT}{\left(\frac{V}{5}\right)}} = \frac{mg}{A} + \frac{1 \times R \times T}{\frac{4V}{5}}}$$

Ⅱ

$$\boxed{\frac{1 \times RT'}{\frac{V}{4}} = \frac{mg}{A} + \frac{1 \times R \times T'}{\frac{3V}{4}}}$$

$$\frac{5\cancel{R}T}{\cancel{V}} - \frac{4RT}{\cancel{V}} = \frac{5\cancel{R}T'}{4\cancel{V}} - \frac{4RT'}{3\cancel{V}}$$

$$5T - \frac{5}{4}T = 4T' - \frac{4T'}{3}$$

$$5 \times \frac{3}{4}T = 4 \times \frac{2}{3}T'$$

$$\frac{5 \times 3 \times 3}{4 \times 2 \times 4}\cancel{T} = T'$$

$$\boxed{T' = 421.9K}$$

$PV = nRT$.

since $P = \frac{1}{8.21} V$

$\Rightarrow V = 8.21P$.

$\Rightarrow nRT = 8.21P^2$

$\Rightarrow T = \frac{8.21P^2}{nR}$.

⇒ since operating pressure is 1 to 10 and its a continuously increasing function max. will occur at Tmax 'p'

$\Rightarrow T_{max} = \frac{8.21 \times 10^2}{1 \times 8.21 \times 10^{-2}} = \underline{\underline{10000K}}$ ✓

Q ② ⑪ $V = 1l$.

$w = 5g$.

$M = 17 (NH_3)$.

$T = 294K$

$\therefore \Rightarrow P = \frac{5}{17} \times 0.082 \times 294 = 7.1atm = 7.1 \times 1.01 \times 10^5 Pa$

since $P = \frac{F}{A}$

$\Rightarrow F = 7.1 \times 1.01 \times 10^5 \times \pi \times (10^{-2})^2 \simeq 226 N$

since ~~bottle~~ cork can handle max pressure of 200 N

thus <u>Yes</u>: cork will be blown out.

Q ③

⑨

⑫

⇒ To

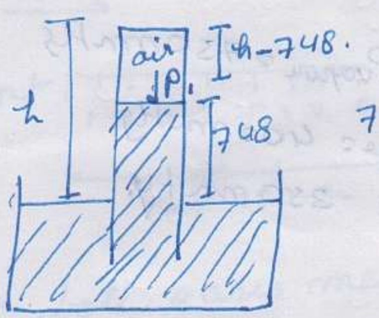
P

P

P

Ac

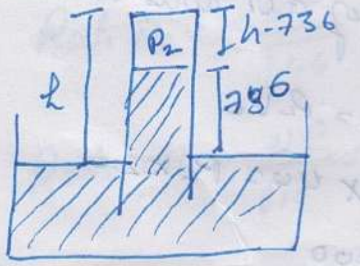
Q. ⑨



755

$\Rightarrow P_1 + 748 = 755$

$P_1 = 7.$



$\Rightarrow P_2 + 736 = 740.$

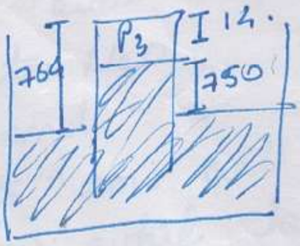
$P_2 = 4.$

since moles of air remains same

$P_1 V_1 = P_2 V_2$

$\Rightarrow \cancel{P}\, 7 \times (h-748) \cancel{A} = P.4 \times (h-736) \cancel{A}.$

$\Rightarrow \boxed{h = 764}.$



$P_2 V_2 = P_3 V_3$

$\Rightarrow 4 \times (28) \cancel{A} = P_3 \times 14 A$

$P_3 = 8$ mmHg.

$\Rightarrow$ atmospher pressure $= 750 + 8 = \underline{758 \text{ mmHg}}$ ✓

NOTE

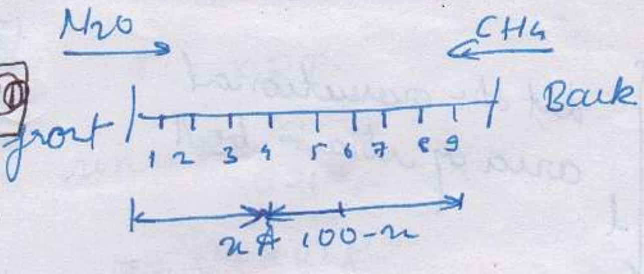
Q. 9 answe

but g

Kindly

Q. 10 Plz chec

Q 10



Let both gases meet at point A. (x feet from front and 100-x from back).

$$\therefore \text{Rate } N_2O = \frac{KP}{\sqrt{44}} = \frac{x}{t}$$

$$\text{Rate } CH_4 = \frac{KP}{\sqrt{16}} = \frac{100-x}{t}$$

$$\Rightarrow \frac{100-x}{x} = \sqrt{\frac{44}{16}}$$

$$\Rightarrow \boxed{x = 37.5 \text{ yd}}$$

~~there~~ this point lies between 3rd and 4th row, thus 4th row will be the first to experience laugh due to N_2O.

and.
3rd row will be the first to experience tears while laughing.

~~Q 14~~
⑬

The pr
and vap
thus tot

Q ⑬

⑩

⑫

Let the crossectional area of straw be A.

$\Rightarrow$ To pull in the drink

$$P \times A = mg$$

$$P \times A = \rho \times A \times l\,g$$

$$P = 1\,g/cm^3 \times 15\,cm \times 10\,m/s^2$$

$$= 10^3\,kg/m^3 \times \frac{15}{100}\,m \times 10\,m/s^2$$

$$= \underline{1500\ Pa}$$ Ans

~~Q 14~~ ⑬

$\Rightarrow P_{air} + P_{vapour} = 750$ mm Hg

$\because P_{vapour} = 400$ mm Hg

$\Rightarrow P_{air} = 350$ mm Hg.

dented and sealed.

since moles of air will remain contant

~~350~~ $P_1V_1 = P_2V_2$

$\Rightarrow 350 \times 40 = P_2 \times 20$

$P_2 = 700$.

The pressure due to air finally = 700 mmHg

and vapour pression = 400 mmHg

thus total pressure = $\boxed{1100 \text{ mm Hg}}$ Ans

Assuming H_2 is limiting

$$C_5H_8 + 2H_2 \longrightarrow C_5H_{12}$$

i x $10-x$ 0

f $\frac{3x}{2}-5$ 0 $5-\frac{x}{2}$

$10 - x = 6 \Rightarrow x = 4$

Now combustion

$$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O(l)$$

reacted 3 24 15

$$C_5H_8 + 7O_2 \rightarrow 5CO_2 + 4H_2O(l)$$

reacted 1 7 5

~~deac~~ decrease $= 27 + 8 - 15 - 5$

$= 15$ ml

so. $V_{C_5H_8} = 4$ ml

$V_{H_2} = 6$ ml.

$X_{C_5H_8} = \frac{4}{10} = 0.4$

(14) Assuming C_5H_8 is limiting.

$C_5H_8 + 2H_2 \rightarrow C_5H_{12}$

	C_5H_8	$2H_2$	C_5H_{12}
i	x	$10-x$	0
f.	0	$10-3x$	x

~~10=2~~ $2x = 6 \Rightarrow x = 3$

Now combustion.

$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O(l)$

reacted 3 24 15 —

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O(l)$

r 1 0.5 —

decrease = 27 − 15 + 1.5
= 13.5

so not possible

Assuming

C_5H_8 +

i x

f. $\frac{3x}{2}-5$

$10-x$

Now com

C_5H_{12} +

reacted 3

C_5H_8 +

reacted 1

~~desc~~

so. V

V

X_{C_5}

[redacted]

15

$$P = 1034\ kg/m^3 \times \frac{37}{1000} \times 10$$

$$= 382.58\ atm.$$

$$n_{O_2} \text{ consumed in } 30\,min = \frac{382.58 \times 16}{8.314 \times 310 \times 1000}$$

$$= 2.375 \times 10^{-3}$$

$$n_{O_2} \text{ consumed in } 1\,hr = 4.75 \times 10^{-3}$$

$$V_{O_2} \text{ consumed in } 1\,hr \text{ ~~at~~ } STP = 1.064 \times 10^{-1}\ lt$$

$$= 1.064 \times 10^{-4}\ lt/hr$$

16

$$P = \frac{RT}{V} - \frac{A}{V^2} + \frac{2B}{V^3}$$

$$\frac{dP}{dV} = -\frac{RT}{V^2} + \frac{2A}{V^3} - \frac{6B}{V^4}$$

$$\frac{d^2P}{dV^2} = \frac{2RT}{V^3} - \frac{6A}{V^4} + \frac{24B}{V^5}$$

At critical conditions

$$\frac{dP}{dV} = 0 \quad \& \quad \frac{d^2P}{dV^2} = 0$$

So.

$$6B = -RT_cV_c^2 + 2AV_c$$

$$24B = -2RT_cV_c^2 + 6AV_c$$

$$\Rightarrow 12B = -RT_cV_c^2 + 3AV_c$$

dividing

$$\cancel{\Phi}\ \cancel{b}\ 2 = \frac{-2RT_cV_c + 3A}{-RT_cV_c + \cancel{6A}\,2A}$$

$\Rightarrow$ ~~$-4RT_cV_c + 24A = -2RT_cV_c + 2A$~~

$$-2RT_cV_c + 4A = -RT_cV_c + 3A$$

$$RT_cV_c = A$$

subsititing

$$6B = -A(V_c) + 2AV_c$$

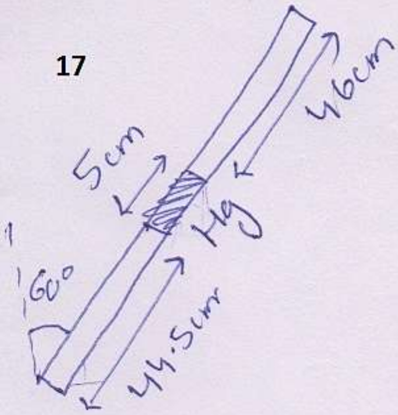
$$V_c = \frac{6B}{A}.$$

$$T_c = \frac{A^2}{6RB}$$

$$P_c = \frac{A^3}{108B^2}$$

$$Z_c = \cancel{RT}_c\,\frac{P_cV_c}{RT_c} = \frac{1}{3}.$$

17



moles in both upper and lower part are same.

$$P_{upper} + \frac{5}{2} = P_{lower} \quad \text{—①}$$

$$\Rightarrow \quad P_{upper} = \frac{nRT}{46A} \quad , \quad P_{lower} = \frac{nRT}{44.5A}$$

Originally $P_0 = \dfrac{nRT}{45.25A}$

So by ①

$$P_0 \times \frac{45.25}{46} + \frac{5}{2} = \frac{P_0 \times 45.25}{44.5}$$

$$45.25\, P_0 \left(\frac{1}{44.5} - \frac{1}{46} \right) = \frac{5}{2}$$

$P_0 =$ ~~771~~.75.4 cm

initial ratio $= \frac{n_{CH_4}}{n_{O_2}} = \frac{1}{192}.$

desired ratio $\frac{n_{CH_4}}{n_{O_2}} = \frac{1}{6}$

$$\frac{1}{6} = \frac{1}{192}\left(\frac{32}{16}\right)^{\frac{n-1}{2}}$$

$$32 = 2^{\frac{n-1}{2}} \Rightarrow 2^{5} = 2^{\frac{n-1}{2}}$$

$\Rightarrow$ $n-1 = 10$ $\Rightarrow$ 10 steps.

For 1000 cal, n_{CH_4} required $= \frac{1000}{100} = 10$

$$n_{i,CH_4} \times (0.9)^{10} = 10$$

$$\Rightarrow n_{i,CH_4} = \frac{10}{0.36} = 27.78$$

$$\Rightarrow n_{i,O_2} = 5333.3$$

[redacted]

$$\frac{1}{2}mv^2 = E = \frac{3}{2}kT \Rightarrow v^2 = \frac{3kT}{m}$$

$$dv = \frac{0.01E}{mv}$$

By Maxwell's eq.

$$\frac{dN}{N} = 4\pi\left(\frac{m}{2\pi kT}\right)^{3/2} e^{-\frac{mv^2}{2kT}} \quad v^2\,dv$$

$$= 4\pi\left(\frac{m}{2\pi kT}\right)^{3/2} e^{-\frac{3}{2}} \cdot \frac{3kT}{m} \cdot \frac{0.01\times\frac{3}{2}kT}{m\cdot\sqrt{\frac{3kT}{m}}}$$

$$= \frac{4\pi}{\pi^{3/2}} \cdot \frac{\cancel{m^{3/2}}}{(2\cancel{kT})^{3/2}}\, e^{-3/2} \cdot \frac{(3\cancel{kT})^{\cancel{3/2}}\times 0.01}{\cancel{(m)^{3/2}}\cdot \times 2}$$

$$= \frac{4}{\sqrt{\pi}} \cdot \left(\frac{3}{2}\right)^{3/2} \cdot \frac{1}{2}\times 0.01\times e^{-3/2}$$

$$= 4.6\times 10^{-3}$$

$$= 0.46\%$$

21

$$\left(P+\frac{a}{V^2}\right)(V)=RT$$

$$PV+\frac{a}{V}=RT$$

$$PV^2-RTV+a=0$$

V can have only one value

so $(RT)^2-4aP=0$

$$\Rightarrow P=\frac{(RT)^2}{4a}=34.96 \text{ atm}$$