62) Acc to Kinetic theory of gases, in an ideal gas, the b/w two successive collision, gas molecule, travel in a straight line

63) $PV = nRT$

से Volume find किया

Now $BCl_3 + \frac{3}{2}H_2 \longrightarrow B + 3HCl$

21.6 gm

no of moles $= \frac{21.6}{10.8} = 2\ mol$

$n = \frac{V}{22.4}$

$\Rightarrow \cancel{2} = \frac{V}{22.4}$ $1 \longrightarrow \frac{3}{2}$

$\Rightarrow$ $2 \longrightarrow \frac{3}{2} \times 2$

$\Rightarrow 3 = \frac{V}{22.4}$

$\boxed{V = 67.2\ lit}$

64)

$K.E._1 = \frac{3}{2}R \times 293$

$KE_2 = \frac{3}{2}R \times 313$

Ratio $\frac{KE_2}{KE_1}$ = $\boxed{\frac{313}{293}}$

65) Three gases with rms speed $1 : \frac{1}{\sqrt{2}} : \frac{1}{\sqrt{3}}$

then their molar masses will be inversely proportional to the square of their mass

so $\boxed{1:2:3}$

66) The similar conditions for T, P & V so the longest mean free path will be of H_2

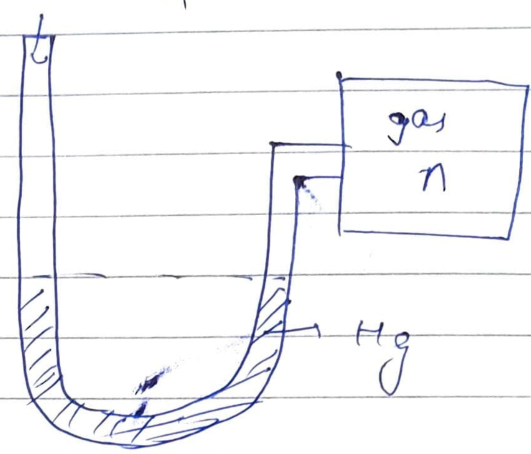
67) $\frac{Z_{11}}{\sqrt{P}}$ is directly proportional to

(Q-2) (Q-2-II)

(1) $2A \longrightarrow 3B + 2C$

Initial $P_{atm} = P_{gas}$

76 atm



$$2A \longrightarrow 3B + 2C$$
$$1-2\alpha \qquad 3\alpha \qquad 2\alpha$$

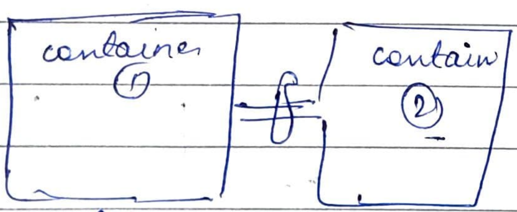
Total $P = 1 - 2\alpha + 3\alpha + 2\alpha$
$\Rightarrow 1 + 3\alpha$

$1 - 2\alpha = 0.8$ $\qquad \alpha = 0.1$
$2\alpha = 0.2$

so final $P = 1 + 0.3 = 1.3$
so P increases by 0.3 atm

diff in mercury level $= 0.3 \times 760$
$\Rightarrow 228$ mm

(2)



300 K	400 K
2 mol H_2	1 mol H_2
16.42 li	8.21 li

Before opening valve

$PV = nRT$

$$P = \frac{2 \times 0.0821 \times 300}{16.42}$$
$\Rightarrow$ 3-atm

Pressure after opening valve will remain same

$$\frac{n_1 T_1}{V_1} = \frac{n_2 T_2}{V_2}$$

$$\frac{x \times 300}{\frac{16.42}{2}} = \frac{(3-x) \times 400}{8.21}$$

$$3x = 24 - 8x$$

$$11x = 24$$

$$x = \frac{24}{11}$$

$$\Rightarrow \frac{\frac{300 \times 24}{11} \times 0.0821}{16.42 \text{ li}} \Rightarrow \frac{36}{11} \Rightarrow 3.2$$

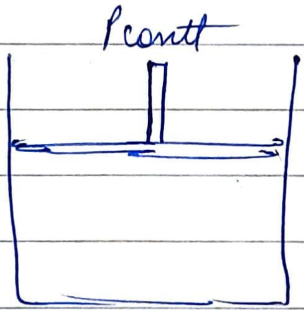
③ $m_x < m_y$

So rms speed$_x$ < speed$_y$

(B) (C) (D)

(C) → Due to higher rms

Q 4



(A) Average distance b/c travelled b/w successive collision

इसलिए

X ε /

$$\boxed{\lambda = \frac{kT}{\sqrt{2}\pi\sigma^2 P}}$$

T ↑ distance will increase

(B) collision frequency

$Z_{11} \propto \frac{P^2}{T^{3/2}}$ will decrease ~~with increase~~ as inversely prop

c) $u_{rel} = \sqrt{2}\, u_{av}$

$$u_{av} = \sqrt{\frac{8RT}{\pi m}}$$

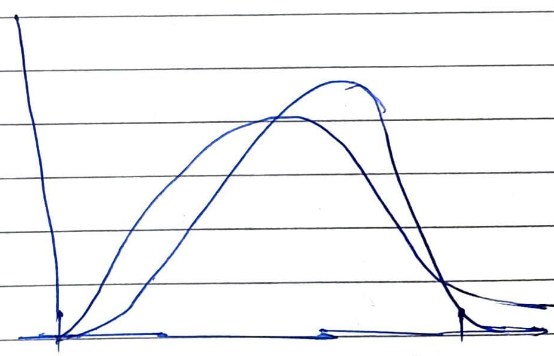
$T \uparrow$ $u_{avg} \uparrow$

d) Angle of approach

(5) Choose the correct statement among the following

A ✓

B) $\frac{P N_A}{\sqrt{2\pi MRT}}$ But for closed rigid container



collision frequency $\propto \frac{P}{T^{3/2}}$

yes it will increase
at $T\downarrow$ collision frequency
So Rate effusion

c) $R \propto \frac{1}{\sqrt{m}}$

d) It changes

$\boxed{\lambda \propto T}$

(C) Which of the follow quantities is same for all ideal gas at same temp

A) $\frac{3}{2}RT$ ✓

(B) ~~4~~ does not change since mole will change due to diff MM

c) ✓ does not change

D) 1 g no of moles does change due to diffusion

(7) constt volume = Rigid containers
(C, D)

λ = constt .

B ×

C ✓ $\propto T/P$ $PV = nRT$

D ✓

POCO
SHOT ON POCO M2 PRO

(8) (A) ✓ negligible gas molecula volume
(B) ✓ Random Motion in straight line
(C) ✗ Perfectly elastic

(D) 3/2 KT ✓

Paragraph (9-11)

(9) Rate of Effusion

(B) $\frac{He}{SO_2} = \sqrt{\frac{M_{SO_2}}{M_{He}}}$

$\frac{r_{He}}{r_{SO_2}} = \frac{1}{2}\sqrt{\frac{64}{4}} \Rightarrow \frac{4}{2} = 2$

50 cm as half of distance will be travelled

(10) 4 gm of H_2 = 10 sec

rate, = 2 mole / 10 sec = 0.2 mol / sec

amount of oxygen effused

$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{32}{2}} = 4$

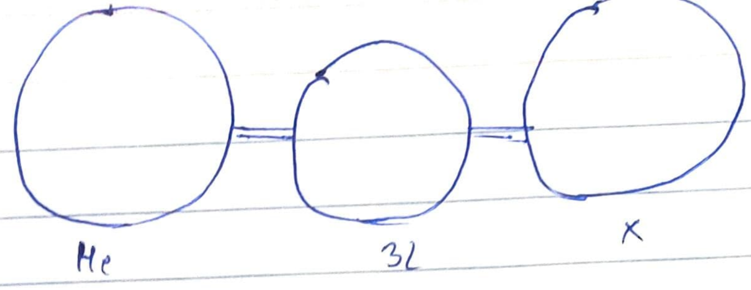
$r_2 = \frac{0.2}{4}$

$\Rightarrow \frac{0.2}{4} \times 32 \times 10$

$\Rightarrow$ 16 gm

ON POCO X2 PRO

(9)



$3 \times 4.1 = n \times R \times 300$

$n = \dfrac{3 \times 4.1}{0.0821 \times 300}$ $\quad n = \dfrac{4.1}{8.21} \approx \dfrac{1}{2}$

total mole $= 0.5$

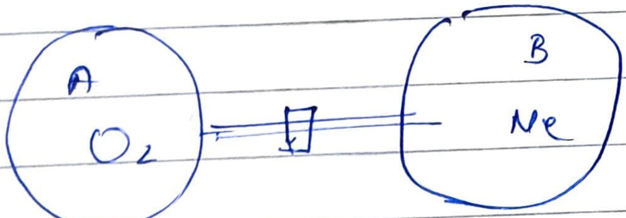
$\Rightarrow$ 0.1 mole of x gas

$$\frac{\dfrac{0.1}{10 \times 60}}{\dfrac{0.4}{10 \times 60}} = \sqrt{\frac{4}{X}}$$

$$\frac{1}{16} = \frac{4}{X}$$

$$X = 64$$

(12)



$\dfrac{n_1 + n_2}{2} - x$ $\quad \dfrac{n_1 + n_2}{2} + x$

300K $\quad$ 300K

950 mm of Hg $\quad$ 950 mm of Hg

$$\frac{950 \times V_A}{R \times 300} + \frac{900 \times V_B}{R \times 300} = \frac{910 \times (V_A + V_B)}{R \times T}$$

POCO

if $T = 300$

$$40 V_A = 10 V_B$$

$$\boxed{V_B = 4 V_A}$$

$$n_1 \times R \times 300 = 950 \times V_A$$

$$n_2 \times R \times 300 = 900 \times V_B$$

$$\left(\frac{n_1 + n_2}{2} - x\right) RT = P \cdot V_A$$

$$\left[\frac{n_1 + n_2}{2} + x\right] RT = P \cdot V_B$$

$$\frac{\frac{n_1 + n_2}{2} - x}{\frac{n_1 + n_2}{2} + x} = \frac{n_1 \times 900}{n_2 \times 950}$$

$$\frac{n_1 + n_2}{2} - x = \frac{18 n_1}{19 n_2}\left(\frac{n_1 + n_2}{2} + x\right)$$

$$\Rightarrow \left(\frac{n_1 + n_2}{2}\right)\left(1 - \frac{18 n_1}{19 n_2}\right) = \left(1 + \frac{18 n_1}{19 n_2}\right) x$$

(13) mole of gas are present in flask A

(B) $V_B = 304$

$V_A = 76$ litre

$$n_1 = \frac{950 \times 76}{0.0821 \times 300} \times \frac{1}{760} = 4$$

$$n_2 = \frac{900 \times 304 \times 1}{0.0821 \times 300 \times 760} = 15$$

$$\frac{n_1}{n_2} = \frac{95}{90 \times 4} \Rightarrow$$

$$\frac{18}{19} \times \frac{95}{90 \times 4} \Rightarrow \frac{1}{4}$$

$$\left(\frac{n_1+n_2}{2}\right) \frac{3}{5} = x$$

$$x = \frac{3}{5}\left(\frac{n_1+n_2}{2}\right)$$

$$= \frac{2}{5}\left(\frac{n_1+n_2}{2}\right) \qquad \frac{4}{5}\left(\frac{n_1+n_2}{2}\right)$$

$$\Rightarrow \frac{2}{5}\left(950 + 900 \times 4\right) \times \frac{1}{760 \times 300 \times 0.08}$$

$$\Rightarrow \frac{19}{5} = 3.8$$

Table type question:

column - 1

a) CH_4 at 300K

column - 2

$$\sqrt{\frac{3RT}{m}}$$

column - 3

$$\Rightarrow \sqrt{\frac{3 \times 8.314 \times 300}{1.6 \times 10^{-2}}}$$

(R) (iv)

$U_{rms} = 685$ $\qquad$ $U_{mp} = 558$

(B) SO_2 at $27°C$

$$\sqrt{\frac{RT}{m}} = 197.6$$

$U_{mp} = 279.4$

$rms = 342$

c) 4 gm He at 1 atm and 24.64 li

$$U_{rms} = \sqrt{\frac{3RT}{m}} \qquad = \quad PV = nRT$$

$$\frac{1 \times 24.6}{R} = T$$

$$U_{mp} \quad \sqrt{\frac{2RT}{m}} \Rightarrow$$

$$\Rightarrow \sqrt{\frac{3 \times R \times 1 \times 24.6}{R \times m}}$$

$$U_{rms} = \sqrt{\frac{3 \times 1 \times 24.6}{4}} = 4.29 \sqrt{1000}$$

$$\Rightarrow 135.66 \times \sqrt{\frac{25}{3 \times 0.0821}}$$

$$U_{mp} = \sqrt{\frac{2 \times 1 \times 24.6}{4}} = 3.50 \sqrt{1000}$$

$$= 110.68 \sqrt{\frac{25}{3 \times 0.082}} = 110 \text{ min}$$

c) $\frac{3}{2}RT = 3730$ Joule

D) Average K.E. per gram $= 973.5$

$\angle$ — I, II.

(B) SO_2 at $27°c$

(P) $\sqrt{\frac{3RT}{m}} = \sqrt{\frac{3 \times 25/3 \times 300}{64 \times 10^{-3}}} = \frac{5}{8}\sqrt{3 \times 10^5}$

$\Rightarrow \frac{500}{8} \times 5.48$

$\Rightarrow \frac{548 \times 5}{8} = 342.5$

$\sqrt{\frac{2RT}{m}} \Rightarrow 342.5\sqrt{\frac{2}{3}}$

$\Rightarrow 342.5 \times \sqrt{\frac{2}{3}}$

$\Rightarrow 274$

$\frac{3}{2}RT \Rightarrow \frac{3}{2} \times \frac{25}{3} \times 300$

$\Rightarrow \frac{7500}{2} = 3750m$

(17) $PV = $ contt

$\frac{1}{V^2}$ vs P

P^2 vs P

y vs x

$y = x^2$

A - R

(B) V vs $1/T$

at contt P

B - S

$V \propto T$

T vs $1/T$

y vs x

$xy = 1$

c) = $\log P$ vs $\log V$ contt T & n

$PV = nRT$

with -ve slope

$\log P + \log V = \log C$

D V vs $\frac{1}{P^2}$ for ideal gas

contt T & n

$PV = $ contt

$\frac{1}{P}$ vs $\frac{1}{P^2}$

D - Q

$y^2 = x$

JEE - MAINS

(1) Molecular velocity of the temp is always directly proportional to the square root of temperature

(2) α, u & V represent
$\alpha \Rightarrow$ most probable
u = average
$v \Rightarrow$ rms velocity

the correct order of u, a & v is
rms > av > mp

$\Rightarrow$ $\boxed{V > u > \alpha}$

(3) $n_1 = n_i$ $\qquad n_2 = 1 - \frac{2}{5} = \frac{3}{5} n_i$

$T_1 = 300$ $\qquad T_2 = ??$

$n_1 T_1 = n_2 T_2$

$\Rightarrow n_i \times 300 = \frac{3}{5} n_i \times T_2$

$\boxed{T_2 = 500\,k}$

(4) For 1 mol of ideal gas at contt T, $(\log P)$ against $(\log V)$ is a

$PV = \frac{nRT}{F}$ $\qquad PV = RT$

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

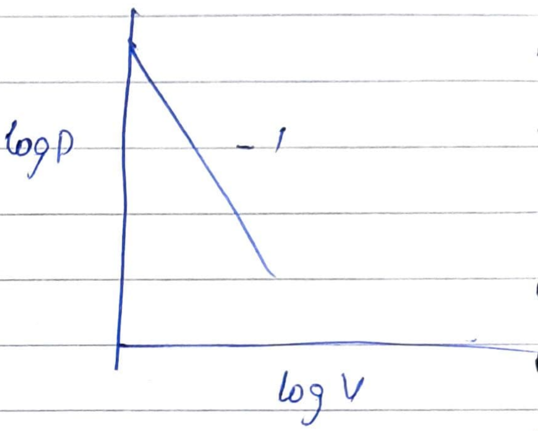
$y = m \quad PV = RT$

$\log P + \log V = \log RT$

$$\underbrace{\log P}_{y} = \underbrace{\log RT}_{c} - \underbrace{\log V}_{x}$$

$\boxed{m = -1}$

straight line with slope $= -1$



(5) $u_{mp} \propto u_{av} \propto u_{rms}$

$\Rightarrow \sqrt{\frac{2RT}{m}} \propto \sqrt{\frac{8RT}{\pi m}} \propto \sqrt{\frac{3RT}{m}}$

$\Rightarrow \sqrt{2} \propto \sqrt{8/\pi} \propto \sqrt{3}$

(6) Wrong assumption of kinetic theory of gases

Molecules move in the straight line but not with the same velocity.

(7) $u_{rms_1} = \sqrt{\frac{3RT}{m}}$ $\quad \frac{5 \times 10^4}{10 \times 10^4} = \sqrt{\frac{T_1}{T_2}}$

$u_{rms_2} = \sqrt{\frac{3RT}{m}}$ $\quad \left(\frac{1}{2}\right)^2 = \frac{T_1}{T_2}$ $\quad \boxed{T_2 = 4T_1}$

(8) $U_{mp} \rightarrow c$ $U_{rms} = c$ then
$U_{av} = \bar{c}$

the ratio will be U_{rms}

$c : \bar{c} : c$ $\boxed{1 : 1.28 : 1.225}$

$U_{rm} > U_{av} > U_{mp}$

(9) N_xH_y

100 gm $\xrightarrow{H^o}$ 12.5 gm H
$\Rightarrow$ 12.5

$VD = 16$
$MM = 32$

$32 = n_1 \times 14 + n_2 \times 1$

12.5 % by mass

$$\frac{n_2 \times 1}{14 n_1 + n_2} = \frac{12.5}{100} = \frac{1}{8}$$

$$\frac{n_2}{32} = \frac{1}{8}$$

$\boxed{n_2 = 4}$ $\boxed{n_1 = 2}$

So $\boxed{\cancel{N_2H}}$ N_2H_4

(10) $V_1 = 750$ ml $P_1 = 840$
$V_2' = ??$ $P_2 = 360$

$P_1V_1 = P_2V_2$

$750 \times 840 = V_2 \times 360$

$V_2 = \frac{750 \times 840}{360}$

$\Rightarrow \frac{750 \times 210}{90} \Rightarrow \frac{7}{3} \times 750$

$\Rightarrow 7 \times 250$

$\Rightarrow \boxed{1.750 \text{ litre}}$

(11) $U_{rms_1} = U_{rms_2}$

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

$\Rightarrow \sqrt{\frac{300}{4}} = \sqrt{\frac{T}{16 \times 2}} \Rightarrow \frac{300}{4} = \frac{T}{\cancel{16}\ 4 \times 2}$

$\boxed{T = 2400 K}$

(12) Not an assumption of kinetic theory of gas →

(i) They have negligible volume

→ The particles are not always identical $Z = 1$

→ They do not compressed

→ they ~~as~~ have elastic collision

(3) $n_i = \dfrac{P_1 V}{T_1 \times R}$

$n_1 - x \qquad\qquad n_1 + x$

$n_1 - x = \dfrac{P_f \cdot V}{T_1 \times R}$

$n_1 + x = \dfrac{P_f \cdot V}{T_2 \times R}$

$\Rightarrow \quad 2n_1 = P_f V \left[\dfrac{1}{T_1 R} + \dfrac{1}{T_2 R} \right]$

$\Rightarrow \quad \dfrac{2 P_f V}{R} \left(\dfrac{1}{T_1} + \dfrac{1}{T_2} \right)$

$\Rightarrow \quad 2 \times \dfrac{P_i V}{T_1 R} \times \dfrac{R}{V} \left(\dfrac{T_1 T_2}{T_1 + T_2} \right)$

$$\boxed{P_f \Rightarrow \dfrac{2 P_i T_2}{T_1 + T_2}}$$

(14) $T = 300\,K$, $\quad P = 2$ bar $\quad d = 2\, d(N_2) \quad P = 4$ bar

molar mass

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

$\dfrac{P_1 M_1}{R_6 T} = \dfrac{P_2 M_2}{R_1 T}$

$\Rightarrow \quad \dfrac{P_1 M_1}{P_2 M_2} = 2$

$$\frac{2 \times M}{4 \times 28} = 2$$

$$M = 112 \text{ gm/mol}$$

15

α $M(NH_3) = 17$

$M(HCl) = 36.5$

$$\frac{d_1}{d_2} = \frac{m_1}{m_2} = \frac{17}{36.5} < 0.5 = 0.46$$

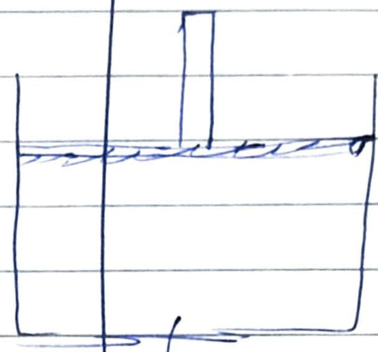
JEE - ADVANCED

① 1 atm 0.1 mol He 1.0 mol of X (vp = 0.68 at 0°C)

$PV = nRT$

$1 \times V = (0.1 + 1) \times 0.082 \times 273$

$V = 1.1 \times 0.082 \times 273$



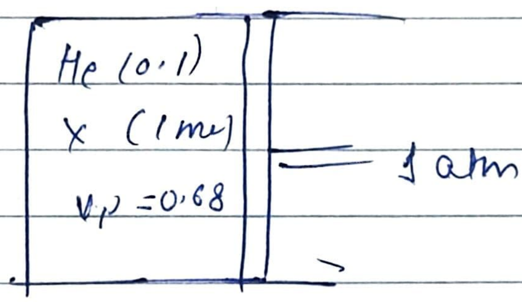
$n = 0.1 + 1$

① $P_T = 1$ atm at eqm

$P_{He} = P_T - VP = 1 - 0.68 = 0.32$ atm

$V = \frac{nRT}{P} = \frac{0.1 \times 0.0821 \times 273}{0.32}$

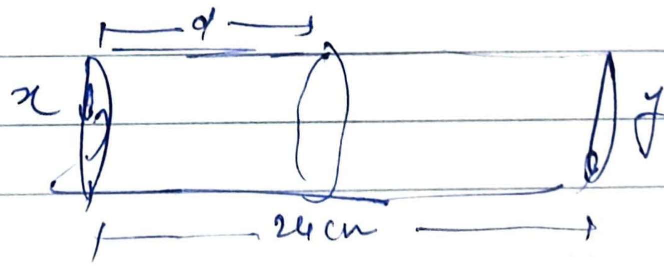
$V = 7L$.



② Thus distance travelled by x = d cm

by y = 24 - d cm

P = 1 atm.



initial product

Thus $r_d \propto \frac{1}{\sqrt{m}}$

$$\frac{r_x}{r_y} = \sqrt{\frac{M_y}{M_x}} = \sqrt{\frac{40}{10}} = 2$$

$$\frac{d_x}{t} \times \frac{t}{d_y} = 2$$

$$\frac{d}{24 - d} = 2 \Rightarrow d = 16 \text{ cm}$$

option C

Ans 3 Experimentally d is the smaller b/c

$$Z_{11} = \frac{1}{\sqrt{2}} \pi \sigma^2 V_{avg} N^*$$

$$= \frac{1}{\sqrt{2}} \pi \sigma^2 \sqrt{\frac{8RT}{\pi m}} N^*$$

$$Z_{11} \propto \frac{1}{\sqrt{m}}$$

$\Rightarrow$ since M of X is low thus its collision freq is high

[option D]

Ans (4) $n_A = \frac{1\times5}{400}$

A	A
$1m^3$ 5 bar	$3m^3$ 1 bar
400K	300K

$n_B = \frac{3\times1}{300}$

After eqm $P_A = P_B$ & $T_A = T_B$

V	4 - V
P	P
T	T
A	B

$$\frac{n_A RT}{V} = \frac{n_B RT}{4-V}$$

$$\Rightarrow \frac{5}{400V} = \frac{3}{300(4-V)}$$

$$\Rightarrow V = \frac{2000}{900} \Rightarrow 2.22$$