① Given: 49 Torr = ? Atm

Soln. = ? Pascals

$$\left(\frac{49\text{ Torr}}{1}\right)\left(\frac{1.0\text{ Atm}}{760.00\text{ Torr}}\right) = 0.064\text{ ATm}$$

$$\left(\frac{49\text{ Torr}}{1}\right)\left(\frac{101.325\text{ KPa}}{760.00\text{ Torr}}\right)\left(\frac{1000\text{ Pa}}{1\text{ KPa}}\right) = 6.5\times10^3\text{ Pa}$$

② Rank Different Pressures

1st 75 KPa → 75 KPa

4th $\left(\frac{300.\text{ Torr}}{1}\right)\left(\frac{101.325\text{ KPa}}{760.00\text{ Torr}}\right) = 40.0\text{ KPa}$

2nd $\left(\frac{0.60\text{ Atm}}{1}\right)\left(\frac{101.325\text{ KPa}}{1.00\text{ Atm}}\right) = 60.8\text{ KPa}$

3rd $\left(\frac{350.00\text{ mmHg}}{1}\right)\left(\frac{101.325\text{ KPa}}{760.00\text{ mmHg}}\right) = 46.6\text{ KPa}$

③ Given

$V_1 = 1.53L$ $V_2 = ?$

$P_1 = 5.6\times10^3\text{ Pa}$ $P_2 = 1.5\times10^4\text{ Pa}$

T constant

$PV = n\cancel{R}T$

$P_1V_1 = P_2V_2$

$$V_2 = \frac{P_1V_1}{P_2}$$

$$= \frac{(5.6\times10^3\text{ Pa})(1.53L)}{1.5\times10^4\text{ Pa}}$$

$$\boxed{V_2 = .57L}$$

④

Given	P Atm	Volume L	PV	Ideal	D
1	.13	172.1	(.13)(172.1) = 22.373	22.40	.029
2	.25	89.28	22.32	22.40	.08
3	.30	74.35	22.305	22.40	.095

etc

Ideal $PV = nRT$

$= (0.08206 \frac{L\,atm}{K\,mol})(1.0 \text{ mole } NH_4)(273)$

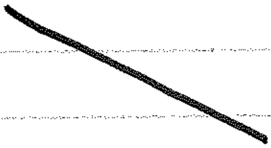
$= 22.40$

Deviation

$$\begin{array}{r} 22.40 \\ -22.373 \\ \hline .029 \end{array}$$

From Exp 1 to 6 P↑ V↓. As volume decreases it decreases the distance Btwn molecules Resulting in an increase in molecular proximity, ∴ ↑ in intermolecular Attractive Forces which ↓ ideal behavior

⑤ Graph PV



Y intercept = 22.41

⑥ <u>Given:</u>

$T_1 = 15°C = 288K$ $T_2 = 38°C + 273 = 311K$

$V_1 = 2.58L$ $V_2 = ?$

$P_1 = P_2 = 1\text{Atm}$ costant

<u>soln.</u>

$$PV = nRT$$

$$\frac{V}{T} = \frac{n\cancel{R}}{\cancel{P}}$$

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

$$V_2 = \frac{V_1}{T_1} T_2 = \frac{(2.58L)(311K)}{288K}$$

$$\boxed{V_2 = 2.79L}$$

⑦ <u>Given:</u> $3O_2 \longrightarrow 2O_3$

P = constant .50mol ? mole

T = constant 12.2L ? L

<u>Soln.</u> $\left(\frac{.50 \text{ mole } O_2}{1}\right)\left(\frac{2 \text{ mole } O_3}{3 \text{ mole } O_2}\right) = .33 \text{ mole } O_3$

$$PV = nRT$$

$$\frac{V}{n} = \frac{R\cancel{T}}{\cancel{P}}$$

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

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

$$= (12.2L)\left(\frac{.33 \text{ mole}}{.50\text{mole}}\right)$$

$$\boxed{V_2 = 8.1L}$$

⑧ <u>Given:</u> $H_2(g)$

$V = 8.56L$

$T = 0°C = 273K°$

$P = 1.5$ Atm

$n = ?$ moles H_2

<u>Soln:</u> $PV = nRT$

$$n = \frac{PV}{RT} = \frac{(1.5\text{Atm})(8.56L)}{(0.08206\frac{L\,\text{Atm}}{\text{mol}\cdot K})(273K)}$$

$$\boxed{n = .57 \text{ moles}}$$

⑨ <u>Given:</u> $NH_4(g)$

$V_1 = 3.5L$ $V_2 = 1.35L$

$P_2 = 1.68$ Atm $P_2 = ?$

Temp constant

<u>Soln:</u> $PV = n\cancel{RT}$

$P_1V_1 = P_2V_2$

$$P_2 = \frac{P_1V_1}{V_2} = \frac{(1.68\text{ Atm})(3.5L)}{(1.35L)}$$

$$\boxed{P_2 = 4.4 \text{ Atm}}$$

⑩ <u>Given:</u> $CH_4(g)$

$V_1 = 3.8L$ $V_2 = ?$

$T_1 = 5°C = 278K$ $T_2 = 86 + 273 = 359K$

P constant

<u>Soln:</u> $PV = nRT$

$$\frac{V}{T} = \frac{n\cancel{R}}{\cancel{P}} \qquad \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V_2 = \frac{V_1}{T_1}T_2 = \frac{(3.8L)(359K)}{278K}$$

$$\boxed{V_2 = 4.9L}$$

⑪ <u>Given:</u> B_2H_6

$P_1 = 345$ Torr $P_2 = 468$ Torr

$T_1 = -15°C + 273 = 258$ K $T_2 = 36 + 273 = 309$ K

$V_1 = 3.48$ L $V_2 = ?$

<u>Soln:</u> $PV = nRT$ $\frac{PV}{T} = nR$ $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$$V_2 = \frac{P_1V_1}{T_1}\frac{T_2}{P_2} = \frac{(345\,\text{Torr})(3.48\,\text{L})(309\,\text{K})}{(2.58\,\text{K})(468\,\text{Torr})}$$

$$\boxed{V_2 = 3.07\ \text{L}}$$

⑫ <u>Given:</u> $Ar_{(g)}$ $\Delta V = ?$ ∴ we need V_1 & V_2

$n = .35$ mol $n = .35$ mol

$T_1 = 13°C = 286$ K $T_2 = 56°C + 273 = 329$ K

$P_1 = 568\,\text{Torr}\left(\frac{1\,\text{Atm}}{760\,\text{Torr}}\right) = .747$ Atm $P_2 = 897\,\text{Torr}\left(\frac{1\,\text{Atm}}{760\,\text{Torr}}\right) = 1.18$ Atm

<u>Soln:</u>

$PV = nRT$

$$V_1 = \frac{nRT_1}{P_1} = \frac{(.35\,\text{mol})(0.08206\,\frac{\text{L Atm}}{\text{K mol}})(286\,\text{K})}{(.747\,\text{Atm})} = 11\ \text{L}$$

$$V_2 = \frac{nRT_2}{P_2} = \frac{(.35\,\text{mol})(0.08206\,\frac{\text{L Atm}}{\text{K mol}})(329\,\text{K})}{(1.18\,\text{Atm})} = 8.0\ \text{L}$$

$$\Delta V = V_2 - V_1 = 8.0\ \text{L} - 11\ \text{L}$$

$$\Delta V = -3\ \text{L}$$

⑬ $N_{2(g)}$

Given:

V= 1.75 L @ stP

Soln: $\left(\frac{1.75L}{1}\right)\left(\frac{1\text{ mole }N_2}{22.4L}\right) = \boxed{7.81\times10^{-2}\text{ mole }N_2}$

⑭ Given: $CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(s)} + CO_{2(g)}$

152g ? L @ stP

Soln:

$$\left(\frac{152g\ CaCO_3}{1}\right)\left(\frac{1\text{ mole }CaCO_3}{100.09\text{ g }CaCO_3}\right)\left(\frac{1\text{ mole }CO_2}{1\text{ mole }CaCO_3}\right)\left(\frac{22.4L\ CO_2}{1\text{ mole }CO_2}\right)$$

$$\boxed{= 34.0\text{ L }CO_2\text{ @ stP}}$$

⑮ $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

V= 2.80 L	V= 35.0L	V= ? L
T= 25°C = 298K	T= 31°C = 304K	T= 125°C + 273 = 398K
P= 1.65 Atm	P. 1.25 Atm	P= 2.50 Atm

? moles CH_4 + O_2 $PV = nRT$ $n = \frac{PV}{RT}$

CH_4 $n = \frac{PV}{RT} = \frac{(1.65\text{ Atm})(2.80L)}{(0.08206\ \frac{L\ Atm}{K\ mol})(298K)} = 0.189\text{ mol}$

O_2 $n = \frac{(1.25\text{ Atm})(35.0L)}{(0.08206\ \frac{L\ Atm}{K\ mol})(304K)} = 1.75\text{ mol}$

⑮ cont:

CH_4	$2O_2$	CO_2
0.189	1.75	0
-X	-2X	X
(-0.189)	-.378	.189
0	1.372	.189 mole CO_2 produced
Limiting	Excess	

PV = nRT   volume CO_2?

$$V = \frac{nRT}{P} = \frac{(.189 \text{ mole } CO_2)(0.08206 \frac{L\,Atm}{mole\,K})(398K)}{2.50 \text{ Atm}}$$

$$\boxed{V = 2.47 \text{ L } CO_2}$$

⑯ Given:

$P_1 = 1.50$ Atm

T = 27°C = 300.K

d = 1.95 g/L

molar mass = ?

Soln:

$$mm = \frac{dRT}{P}$$

$$= \frac{(1.95 \text{ g/L})(1.50 \text{ Atm})(300.K)}{1.50 \text{ Atm}}$$

$$\boxed{mm = 32.0 \text{ g/mole}}$$

⑰ Given:

He	O_2	TANK
V= 16L	V=12L	V = 5.0L
T= 25°C=298K	T= 25°C=298K	T= 25°C=298K
P=1.0 Atm	P=1.0 Atm	P= ?

$$\overset{?}{P_T} = \overset{?}{P_{He}} + \overset{?}{P_{O_2}}$$

Need moles in Each Tank $PV = \overset{?}{n}RT$ $n = \frac{PV}{RT}$

$$n_{He} = \frac{TR}{PV} = \frac{(0.08206 \frac{L\,Atm}{K\,mol})(298\,K)}{(1.0\,Atm)(16L)} = 1.9 \text{ mole He}$$

$$n_{O_2} = \frac{(0.08206 \frac{L\,Atm}{K\,mol})(298K)}{(1.0\,Atm)(12L)} = .49 \text{ mole } O_2$$

Partial P $(P_{O_2} + P_{He} = P_T)$ for each Gas in Tank $P = \frac{nRT}{V}$

$$\underline{\underline{V_T = 5.00L}}$$

$$P_{He} = \frac{(0.08206\, L\,Atm/K\,mol)(1.9 \text{ mole He})(298K)}{5.0L} = 9.3\,Atm$$

$$P_{O_2} = \frac{(0.08206 \frac{L\,Atm}{K\,mol})(.49 \text{ mole } O_2)(298K)}{5.0L} = 2.4\,Atm$$

$$P_T = P_{O_2} + P_{He} = 9.3\,Atm + 2.4\,Atm$$

$$\boxed{P_T = 11.7\,Atm}$$

⑱ Given:

Partial P_{O_2} = 156 Torr

P_T = 734 Torr

? mole Fraction

Soln. $X_{O_2} = \frac{P_{O_2}}{P_{Total}}$

$= \frac{156 \text{ Torr}}{734 \text{ Torr}}$

$\boxed{X_{O_2} = .210}$

mole Fraction has no units

⑲ Given:

mole Fraction N_2 in Air = .7808

P_{N_2} = ?

P_{Air} = 760. Torr

Soln. $X_{N_2} = \frac{P_{N_2}}{P_{Air}}$

$P_{N_2} = X_{N_2} P_{Air}$

$= (.7808)(760. \text{ Torr})$

$\boxed{P_{N_2} = 593 \text{ Torr}}$

⑳ Given: $2KClO_{3(s)} \rightarrow 2KCl_{(s)} + 3O_{2(g)}$

T = 22°C = 295K

P_T = 754 Torr

?g

V = 0.650 L

P_{H_2O} = 21 Torr

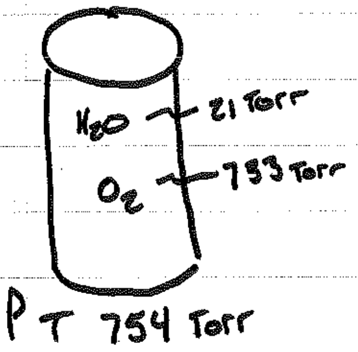
T = 295K

P_{O_2} = ?

① $P_{O_2} = P_T - P_{H_2O}$

$= 754 - 21 \text{ Torr}$

$\boxed{P_{O_2} = 733 \text{ Torr}}$



② $P_{O_2} = 733 \text{ Torr}\left(\frac{1 \text{ Atm}}{760 \text{ Torr}}\right) = .964 \text{ Atm}$

Need moles O_2 for ?g $KClO_3$

$P_{O_2} V = n_{O_2} RT$

$n_{O_2} = \frac{PV}{RT} = \frac{(.964 \text{ Atm})(0.650 \text{ L})}{(0.08206 \frac{\text{L Atm}}{\text{K mol}})(295 \text{ K})}$

$n_{O_2} = 0.0259$ mole O_2

20 cont: $2KClO_3 \longrightarrow 2KCl + 3O_2$

? g 0.0259 mole

$$\left(\frac{0.0259\text{ mole } O_2}{1}\right)\left(\frac{2\text{ mole } KClO_3}{3\text{ mole } O_2}\right)\left(\frac{122.55g\ KClO_3}{1\text{ mole } KClO_3}\right) = \boxed{2.12g\ KClO_3}$$

(21) Given: $He_{(g)}$

$T = 25°c = 298K$

$R = 8.3145 \frac{J}{K\cdot mol}$

$He = 4.00g/mole \left(\frac{1kg}{1000g}\right)$

$= 4.0\times10^{-3}\ kg/mole$

Soln:

$$U_{rms} = \sqrt{\frac{3RT}{mm}}$$

Note $J = kg\frac{m^2}{s^2}$

$$= \sqrt{\frac{3(8.3145 \frac{\overset{kg\frac{m^2}{s^2}}{\cancel{J}}}{K\,mol})(298K)}{4.0\times10^{-3}\ kg/mole}}$$

$$\boxed{U_{rms} = 1.36\times10^{3}\ m/s}$$

(22) Given:

Ratio Effusion Rate

H_2 / UF_6

Soln: molar mass

$H_2 = 2.016\ g/mole$

$UF_6 = 238.03 + 6\times19.00 = 352.03\ g/mol$

$$\frac{H_2}{UF_6} = \sqrt{\frac{UF_6\ mm}{H_2\ mm}} = \sqrt{\frac{352.03\ g/mole}{2.016\ g/mole}}$$

$$\boxed{= 13.2}$$

∴ The Effusion Rate of the very light H_2 gas is about 13X that of the massive UF_6 molecule

(23) <u>Given:</u>

CH_4 effuse 1.50 min } same # of molecules
GAS X effuse 4.73 min }
? molar mass GAS X

<u>Soln:</u>

CH_4 = 16.04 g/mole

$$\frac{T_{CH_4}}{T_{GAS\,X}}^2 = \left(\sqrt{\frac{MM_{GAS\,X}}{MM_{CH_4}}}\right)^2$$ * square Both side

$$MM_{GAS\,X} = MM_{CH_4}\left(\frac{T_{CH_4}}{T_{GAS\,X}}\right)^2$$

$$= 16.04\,g/mole\left(\frac{4.73\,min}{1.50\,min}\right)^2$$

$$\boxed{GAS_x = 159\,g/mole}$$