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civil engineering

lab Chemistry 108

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Exp. 7 Determination of the Molar Volume of H_2 Gas.

* Molar Volume $= \bar{V} = \dfrac{\text{Vol. of gas (L)}}{\text{moles of gas (mol)}} = \dfrac{V_2}{\text{moles}}$ $\underline{\text{L/mol}}$

* One Mole of an ideal gas at STP will occupy a volume $= 22.4\ \underline{\underline{L}}$ $\therefore \bar{V}_{stp} = 22.4$ L/mole

* STP: Standard Temp. & Pressure
  - $T = 0^\circ c = 273\ k$
  - $P = 1$ atm $= 760$ torr

② * In This exp. : The following rxn will be done:

$$1\,Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2\,(aq)} + 1\,H_2 \text{[redacted]}_{(g)}$$

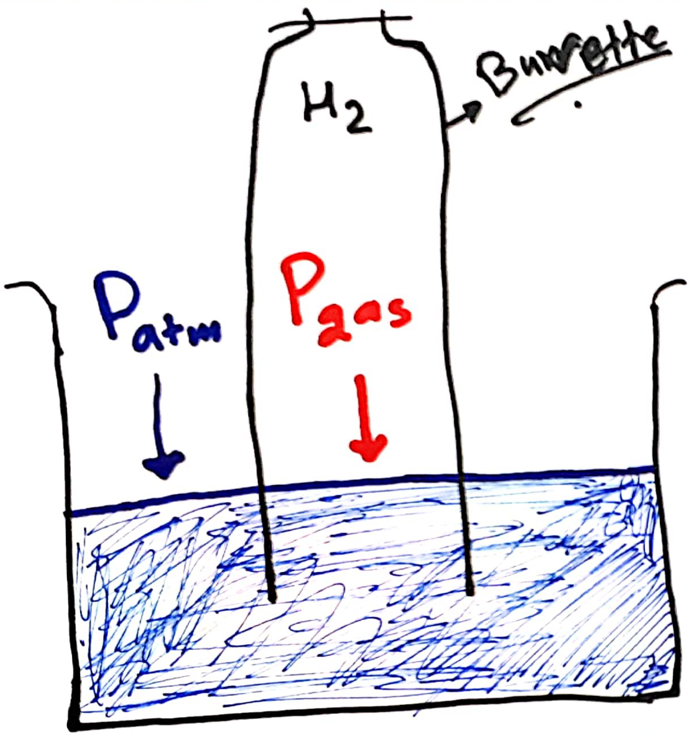
⇒ H_2 gas will be collected over water, So that the Pressure in the container (Burette) will be :

$$P_{tot} = P_{gas} + P_{H_2O} \Rightarrow P_{gas} = P_{H_2} = P_{tot} - P_{H_2O}$$

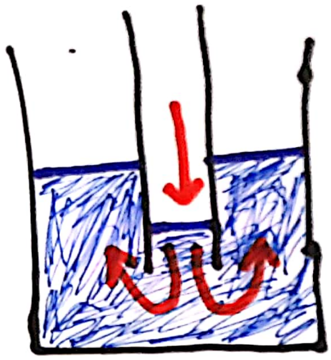
↳ P_{tot} = Atmospheric Pressure (P_{atm})

* $\boxed{n_{Mg} = n_{H_2}}$

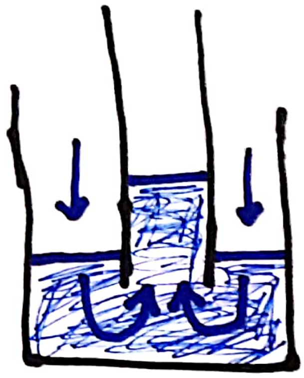
③



$P_{tot} > P_{atm}$



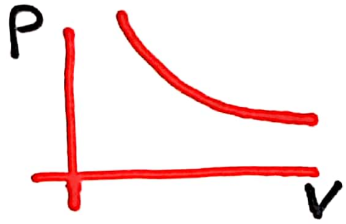
$P_{atm} > P_{tot}$



* $P_{atm} = P_{tot} = P_{gas} + P_{H_2O}$

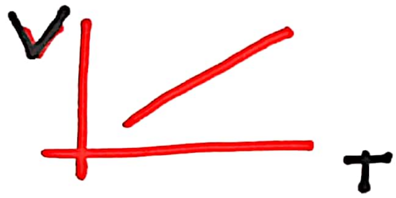
Gases law :-

1 Boyle's law: $P \propto \frac{1}{V}$



$P_1 V_1 = P_2 V_2$ (Temp. is constant)

2 Charle's law: $V \propto T$



$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ (Pressure is Constant)

3 The combined gas law:

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad \Big| \quad \overline{V} = \frac{V_2}{n} = \dots \text{ L/mol}$$

(5) ex A student wants to determine experimentally The volume occuped by one mole of H_2 gas at STP. She reacts 0.1471 g of Zn with excess $HCl_{(aq)}$ & collects 56.09 ml of gas over water at 22°c & 757.8 torr. The V.P of water at 22°c is 19.8 torr

$\boxed{I}$ Use data given above to calculate:

I] The vol. occupied by one Mole of dry H_2 at 22°c (T_2), 760 torr (P_2).

(6)

sol

I

$* \text{mass}_{Zn} = 0.1471 \text{ g}$

$M.m = 65.4 \text{ g/mol}$

$* V_1 = 0.05609 \text{ L}$

$* T_1 = 22 + 273 = 295 \text{ k}$

$* P_{H_2O} = \frac{19.8}{760} = 0.026 \text{ atm}$

$* P_{tot} = \frac{757.8}{760} = 0.997 \text{ atm}$

$$\frac{P_{1gas} V_{1gas}}{T_1} = \frac{P_{2gas} V_{2gas}}{T_2}$$

$\Rightarrow P_{1gas} = P_{tot} - P_{H_2O} = 0.997 - 0.026 = 0.971 \text{ atm}$

$* P_2 = \frac{760}{760} = 1 \text{ atm}$ $\quad * T_2 = 22 + 273 = 295 \text{ k}$

$$\Rightarrow \frac{0.971 * 0.05609}{\cancel{295}} = \frac{1 * V_2}{\cancel{295}}$$

$\Rightarrow V_2 = 0.054 \text{ L}$

$n_{H_2} = n_{Zn} = \frac{0.1471}{65.4} = 2.25 * 10^{-3} \text{ mol}$

(7) Sol $\Rightarrow \overline{V} = \frac{V_2\,gas}{n_{gas}} = \frac{0.054}{2.25 * 10^{-3}} = 24$ L/mol

II The vol. occupied by one Mole of dry H_2 at STP? $T_2 = 273\,k$ $P_2 = 1\,atm$

Sol $\frac{0.971 * 0.05609}{295} = \frac{1 * V_2}{273}$

$\Rightarrow V_2 = 0.0504$ L

$\overline{V} = \frac{V_2}{n} = \frac{0.0504}{2.25 * 10^{-3}} = 22.4$ L/mol

(18)

Q] One mole of an ideal gas at STP will occupy volume equals :

1) 8.314 L

2) $6.023 * 10^{23}$ L

3) 0.0821 L

4) 22.4 ml

5) 22.4 L