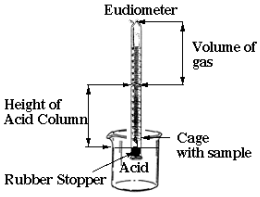
% Magnesium Experiment

$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$

$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

Using the Ideal Gas Law
& Partial Pressures

Dr. Ron Rusay



What is wrong with this set up?

$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$

$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

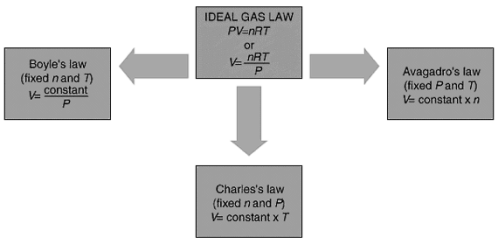
Ideal Gas Law

PV = n RT

- **R = proportionality constant = 0.08206 L atm K^{-1} mol^{-1}**
- **P = pressure in atm**
- **V = volume in liters**
- **n = moles**
- **T = temperature in Kelvins**

Standard Temperature and Pressure

- "STP"
- For 1 mole of a gas at STP:
- P = 1 atmosphere
- T = **0°C**
- The molar volume of an ideal gas is ***22.42*** liters at STP



% Mg & the Ideal Gas Law

$n_{H_2(g)} = PV / RT$

- **n = moles $H_{2(g)}$**
- **P $H_{2(g)}$ = pressure of H_2(g) in atm (mm Hg → atm)**
- **V = experimental volume (mL→ L)**
- **T = experimental temperature (°C → K)**

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

total moles $H_{2(g)}$ = moles $Mg_{(s)}$ + moles $Zn_{(s)}$

Dalton's Law of Partial Pressures

- For a mixture of gases, the total pressure is the sum of the pressures of each gas in the mixture.

$$P_{Total} = P_1 + P_2 + P_3 + \ldots$$

$$P_{Total} \propto n_{Total}$$

$$n_{Total} = n_1 + n_2 + n_3 + \ldots$$

- **P H_2(g) = P Total (barometric) - P H_2O (g) [*TABLE*] - P HCl (g)**

P HCl (g) =

HCl Height (mm) ÷ 12.95

Density Hg is 12.95 times > density HCl(aq)

% Mg: Ideal Gas Law & Partial Pressure

$$n_{H_2(g)} = PV / RT$$

- **n = moles H_2(g)**
- **P H_2(g) = pressure of H_2(g) in atm (mm Hg → atm)**
- **P H_2(g) = P Total (barometric) - P H_2O (g) [*TABLE*] - P HCl (g)**
- **V = experimental volume (mL→ L)**
- **T = experimental temperature (°C → K)**

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

total moles H_2(g) = moles Mg(s) + moles Zn(s)

% Mg: Calculations

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

total moles H_2(g) = moles Mg(s) + moles Zn(s)

mass (g) Zn(s) = mass sample (g) – ? mass Mg(s) (g)

$$\text{total moles } H_2(g) = \frac{\text{? mass Mg(s) (g)}}{\text{Molar Mass Mg(s)}} + \frac{\text{(mass sample (g) – ? mass Mg(s) (g))}}{\text{Molar Mass Zn(s)}}$$

Solve → ? grams Mg(s) → % Mg(s)

Applications of the Ideal Gas Law

- PV = n RT
- n = g of gas/ MM_{gas} [MM_{gas} =g/mol]
- PV = (g of gas/ MM_{gas})RT
- MM_{gas} = g of gas(RT)/PV
- MM_{gas} = g of gas/V (RT/P)
- MM_{gas} = density of gas (RT/P)

QUESTION

Freon-12 had been widely used as a refrigerant in air conditioning systems. However, it has been shown to be a greenhouse gas and destroy the ozone layer. What is the molar mass of Freon-12 if 9.27 grams was collected **by water displacement**, in a 2.00 liter volume at 30.0°C and 764 mmHg. Water's vapor pressure at this temperature is approximately 31.8 mmHg.

A) 120. g/mol
B) 12.0 g/mol
C) 115 g/mol
D) 92.7 g/mol