Key

# Stoichiometry: Mole to Mass Problems

1. $Mg + 2HCl \rightarrow MgCl_2 + H_2$

a. How many **grams of HCl** are consumed by the reaction of **2.50 moles of magnesium**?

Step 1 Mole-Mole: $2.5 \text{ mol Mg} \times \frac{2 \text{ HCl}}{1 \text{ Mg}}$ (Mole Ratio) $= 5 \text{ mol HCl}$

Step 2: Mole → Gram: $5 \text{ mol HCl} \times \frac{36 \text{ g HCl}}{1 \text{ mol HCl}}$ (Molar mass) $= \boxed{180 \text{ g HCl}}$

b. What is the **mass in grams of $H_2$** gas when **4.0 moles of HCl** is added to the reaction?

Step 1: Mole → Mole: $4 \text{ mol HCl} \times \frac{1 H_2}{2 \text{ HCl}}$ (Mole Ratio) $= 2 \text{ mol } H_2$

Step 2: Mole → Gram: $2 \text{ mol } H_2 \times \frac{2 \text{ g } H_2}{1 \text{ mol } H_2}$ (Molar Mass $H_2$) $= \boxed{4 \text{ g } H_2}$

2. Acetylene gas ($C_2H_2$) is produced as a result of the following reaction.

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$$

a. If **3.20 moles of $CaC_2$** are consumed in this reaction, how many **grams of $H_2O$** are needed?

$3.2 \text{ mol } CaC_2 \times \frac{2 H_2O}{1 CaC_2} = 6.4 \text{ mol } H_2O$

$6.4 \text{ mol } H_2O \times \frac{18 \text{ g } H_2O}{1 \text{ mol } H_2O} = \boxed{115.2 \text{ g } H_2O}$

b. How many **grams of $Ca(OH)_2$** would be formed with **3.20 moles of $CaC_2$**?

$3.2 \text{ mol } CaC_2 \times \frac{1 Ca(OH)_2}{1 CaC_2} = 3.2 \text{ mol } Ca(OH)_2$

$3.2 \text{ mol } Ca(OH)_2 \times \frac{74 \text{ g } Ca(OH)_2}{1 \text{ mol}} = \boxed{236.8 \text{ g } Ca(OH)_2}$

3. Acetylene gas, $C_2H_2$, is used in welding, produces an extremely hot flame when it burns in pure oxygen according to the following reaction.

$$2\,C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$$

How many **moles of water ($H_2O$)** are produced when **25.0 grams of $C_2H_2$** burns completely?

$$\frac{25\text{ g } C_2H_2}{26\text{ g } C_2H_2}\left(\frac{1\text{ mol } C_2H_2}{\text{Molar Mass}}\right) = 0.96\text{ mol } C_2H_2 \left(\frac{2\text{ mol } H_2O}{2\text{ mol } C_2H_2}\right) = \boxed{0.96\text{ mol } H_2O}$$

Mole Ratio

Step 1: gram → mole

Step 2: Mole A → Mole B

4. $3\,Mg + 1\,Fe_2O_3 \rightarrow 2\,Fe + 3\,MgO$

How many **moles of iron, Fe**, are produced with **25.0 grams of magnesium**, Mg?

$$25\text{ g Mg}\left(\frac{\text{mol Mg}}{24\text{ g Mg}}\right) = 1.04\text{ mol Mg}\left(\frac{2\text{ mol Fe}}{3\text{ mol Mg}}\right) = \boxed{0.69\text{ mol Fe}}$$

5. Laughing gas (nitrous oxide, $N_2O$) is sometimes used as an anesthetic in dentistry.

$$NH_4NO_3(s) \rightarrow N_2O(g) + 2H_2O(l)$$

a. How many **moles of $NH_4NO_3$** are required to produce **33.0g of $N_2O$**?

$$33\text{ g } N_2O\left(\frac{1\text{ mol } N_2O}{44\text{ g } N_2O}\right) = 0.75\text{ mol } N_2O\left(\frac{1\text{ mol } NH_4NO_3}{1\text{ mol } N_2O}\right) = \boxed{0.75\text{ mol } NH_4NO_3}$$

b. How many **moles of water** are produced with **45.0g of $N_2O$**?

$$45\text{ g } N_2O\left(\frac{1\text{ mol}}{44\text{ g } N_2O}\right) = 1.02\text{ mol } N_2O\left(\frac{2\text{ mol } H_2O}{1\text{ mol } N_2O}\right) = \boxed{2.04\text{ mol } H_2O}$$