Stoichiometry

"stochio" = element (Greek)
"metry" = measurement

Stoichiometry is about measuring the amounts of elements and compounds involved in a reaction

* stoichiometric coefficients:
numbers to balance reaction

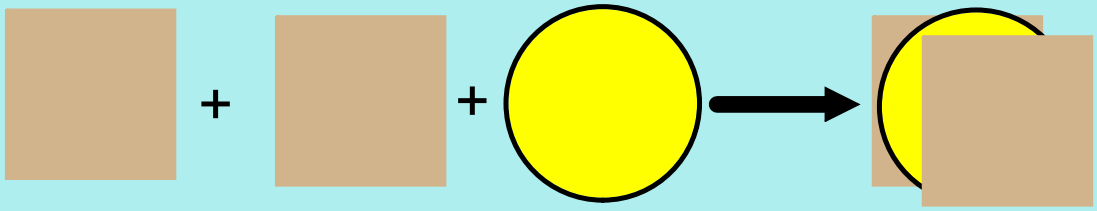
4 Fe + **3** O_2 ⟶ **2** Fe_2O_3

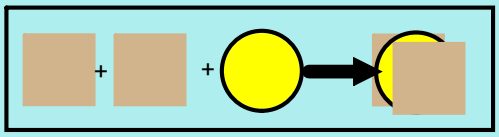
Suppose you are preparing cheese sandwiches.
Each sandwich requires
2 pieces of bread and 1 slice of cheese.

You have:

1. **4 slices of cheese --**how many sandwiches can I make, if I have enough bread? 4 (excess)
2. **10 pieces of bread --**how many sandwiches can I make, if I have enough cheese? 5 (excess)

Cheese Sandwich Products





need balanced equation

$$2\ Br + 1\ Ch \longrightarrow 1\ Br_2Ch$$

Stoicheometric change (+ or -)

Steps

1. **Balance Equation**
2. **Determine amounts of other reactants and products based on amount given**

1. 4 slices of cheese --
How many sandwiches can I make, if I have enough bread?

$$4\ \text{pieces } \cancel{Ch} \left| \begin{matrix} 1\ Br_2Ch \\ 1\ \cancel{Ch} \end{matrix} \right. = 4\ Br_2Ch$$

coefficient

$$4\ \text{pieces } \cancel{Ch} \left| \begin{matrix} 2\ Br \\ 1\ \cancel{Ch} \end{matrix} \right. = 8\ Br$$

2. 10 pieces of bread --
How many sandwiches can I make, if I have enough cheese?

$$10\ \text{pieces Br} \left| \begin{matrix} 1\ Br_2Ch \\ 2\ Br \end{matrix} \right. = 5\ Br_2Ch$$

$$10\ \text{pieces Br} \left| \begin{matrix} 1\ Ch \\ 2\ Br \end{matrix} \right. = 5\ Ch$$

Jan 25-2:15 AM

5.3 moles of Fe react with excess O_2

1. Balance Equation

$$\underset{5.3\,mol}{4\,Fe} + \underset{3.98\,mol}{3\,O_2} \rightarrow \underset{2.65\,mol}{2\,Fe_2O_3}$$

coeff.

$$5.3\ \text{mol Fe} \left| \frac{3\ \text{mol } O_2}{4\ \text{mol Fe}} \right. = 3.98\ \text{mol } O_2$$

mole to mole step

$$5.3\ \text{mol Fe} \left| \frac{2\ \text{mol } Fe_2O_3}{4\ \text{mol Fe}} \right. = 2.65\ \text{mol } Fe_2O_3$$

If I have 2.5 mol Al, how much aluminum sulfide will be produced? Assume there is excess sulfur.

$$2\,Al + 3\,S \longrightarrow 1\,Al_2S_3$$

2.5 mol ? ? 1.25 mol

$$2.5\ \text{mol Al} \times \frac{1\ \text{mol } Al_2S_3}{2\ \text{mol Al}} = 1.25\ \text{mol } Al_2S_3$$

$$2.5\ \text{mol Al} \times \frac{3\ \text{mol S}}{2\ \text{mol Al}} = 3.75\ \text{mol S}$$

$1\,CH_4 + 2\,O_2 \rightarrow 1\,CO_2 + 2\,H_2O$

8.6 8.6

How many moles of CH_4 and O_2 will react to form 8.6 moles of CO_2?

$$8.6\ \text{mol}\ CO_2 \times \frac{1\ \text{mol}\ CH_4}{1\ \text{mol}\ CO_2} = 8.6\ \text{mol}\ CH_4$$

$$8.6\ \text{mol}\ CO_2 \times \frac{2\ \text{mol}\ O_2}{1\ \text{mol}\ CO_2} = 17.2\ \text{mol}\ O_2$$

Review for Quiz

1. What is the molar mass of $Sn_3(PO_3)_2$?
2. How many grams are in 2.9 moles of $Sn_3(PO_3)_2$
3. If I have 9,030g of $Sn_3(PO_3)_2$, how many moles do I have?
4. How many grams of tin can be extracted from 9030 grams of $Sn_3(PO_3)_2$?

Use the following equation for the next questions

$$2\ C_5H_{10} + 15\ O_2 \longrightarrow 10\ CO_2 + 10\ H_2O$$

5. If this reaction produces 2.67 moles H_2O:
   a. How much carbon dioxide was produced?
   b. How much pentane was reacted?
   c. How much oxygen was reacted?

Review for Quiz

1. What is the molar mass of $Sn_3(PO_3)_2$?

Sn 3 x 119 = 357
P 2 x 31 = 62
O 6 x 16 = 96
→ 515 g/mol

2. How many grams are in 2.9 moles of $Sn_3(PO_3)_2$

$$2.9\ mol\ Sn_3(PO_3)_2 \left| \frac{515\ g\ Sn_3(PO_3)_2}{1\ mol\ Sn_3(PO_3)_2} \right. = 1493\ g\ Sn_3(PO_3)_2$$

3. If I have 9,030g of $Sn_3(PO_3)_2$, how many moles do I have?

$$9030\ g\ Sn_3(PO_3)_2 \left| \frac{1\ mol\ Sn_3(PO_3)_2}{515\ g\ Sn_3(PO_3)_2} \right. = 17.5\ mol\ Sn_3(PO_3)_2$$

4. How many grams of tin can be extracted from 9030 grams of $Sn_3(PO_3)_2$?

part/total = part/total

$$\frac{357}{515} = \frac{X}{9030}$$

6,260g Sn

Use the following equation for the next questions

$$2\ C_5H_{10} + 15\ O_2 \longrightarrow 10\ CO_2 + 10\ H_2O$$

5. If this reaction produces 2.67 moles H_2O:

a. How much carbon dioxide was produced?

$$2.67\ mol\ H_2O \left| \frac{10\ mol\ CO_2}{10\ mol\ H_2O} \right. = 2.67\ mol\ CO_2$$

b. How much pentane was reacted?

$$2.67\ mol\ H_2O \left| \frac{2\ mol\ C_5H_{10}}{10\ mol\ H_2O} \right. = 0.53\ mol\ C_5H_{10}$$

c. How much oxygen was reacted?

$$2.67\ mol\ H_2O \left| \frac{15\ mol\ O_2}{10\ mol\ H_2O} \right. = 4.0\ mol\ O_2$$