Chemistry 11

Stoichiometry II

Name:
Date:
Block:

1. **Mole Ratio**
2. **Gram to Gram Conversions**

Mole Ratio

Predict the product and balance the following reaction.
Fill in the boxes below with the mole ratio.

3 $MgBr_2$	+	Fe_3N_2	→	Mg_3N_2	+	3 $FeBr_2$
24.0 mol	Mole Ratio	8.00 mol		8.00 mol		24.0 mol

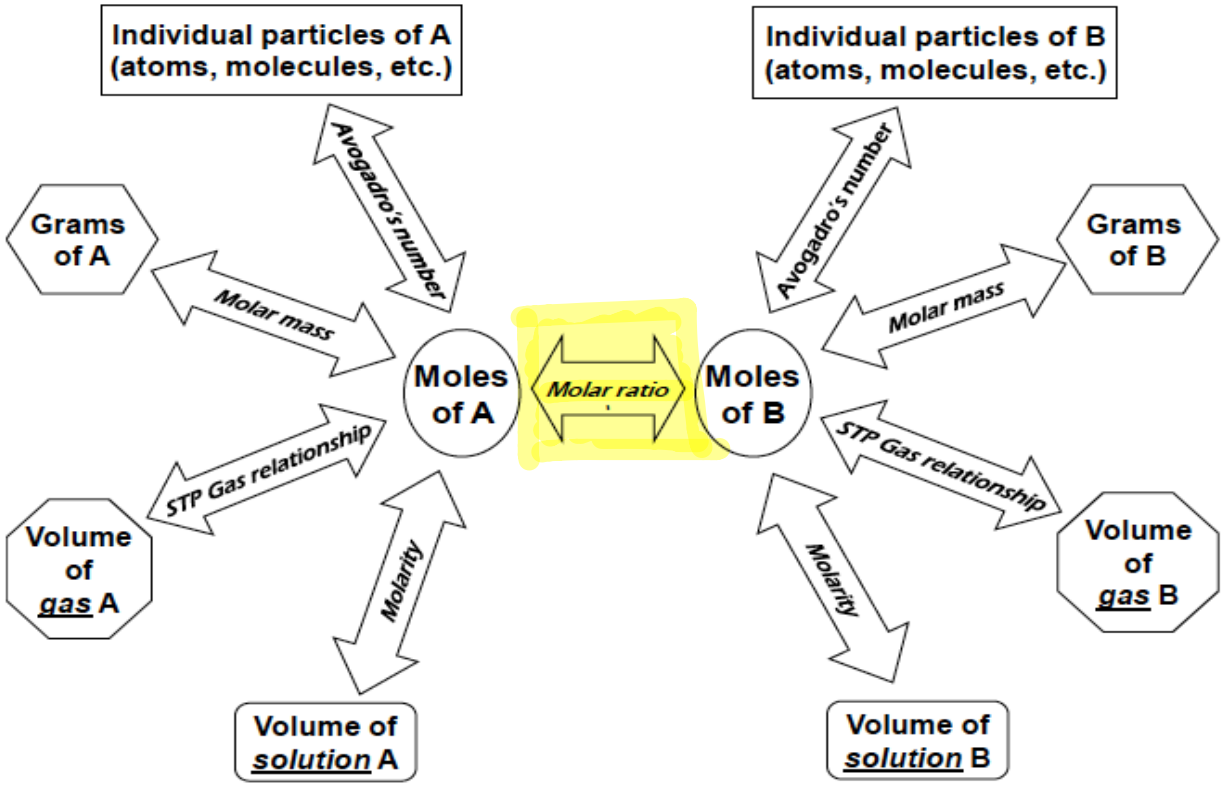
$$24.0\,mol_{FeBr_2} \times \frac{1\,mol\,Fe_3N_2}{3\,mol\,FeBr_2} = 8.00\,mol_{Fe_3N_2}$$

* For every 1 mol of Fe_3N_2, there are 3 mols of $FeBr_2$

4 HF	+	$Mn(OH)_4$	→	MnF_4	+	4 H_2O
29.0 mol		7.25 mol		7.25 mol		29.0 mol

$$7.25\,mol_{Mn(OH)_4} \times \frac{4\,mol\,HF}{1\,mol\,Mn(OH)_4} = 29.0\,mol_{HF}$$

The Mole Wheel



Example 1.
Aluminum chloride reacts with potassium metal. If 3.25 mol potassium metal reacted, how many moles of each product were formed?

⇒ What is the balanced equation?

$$AlCl_3 + 3K \rightarrow 3KCl + Al$$

⇒ What is your given? 3.25 mol K

⇒ What do you want to convert it to? mol Al and KCl and $AlCl_3$

⇒ What is the mole ratio? 3 mol K : 3 mol KCl : 1 mol Al : 1 mol $AlCl_3$

⇒ Calculate: (proper SF and units!)

$$3.25\,mol\,K \times \frac{1\,mol\,AlCl_3}{3\,mol\,K} = 1.08\,mol\,AlCl_3$$

1.08 mol Al

3.25 mol KCl

Example 2.
Sodium metal reacts with oxygen gas. 0.600 mol of oxygen gas was used up. How many moles of sodium metal reacted?

⇒ What is the balanced equation?

$$4Na + O_2 \rightarrow 2Na_2O$$

⇒ What is your given? 0.600 mol O_2

⇒ What do you want to convert it to? mol Na

⇒ What is the mole ratio? 1 mol O_2 : 4 mol Na

⇒ Calculate: (proper SF and units!)

$$0.600\,mol\,O_2 \times \frac{4\,mol\,Na}{1\,mol\,O_2} = 2.40\,mol\,Na$$

Practice 1.
Nitrogen gas and hydrogen gas react together. If 9.43 mol of the product was formed, how many moles of nitrogen gas and hydrogen gas were used up?

$$N_2 + 3H_2 \rightarrow 2NH_3$$

?mol ?mol 9.43 mol

$$9.43\,mol\,NH_3 \times \frac{1\,mol\,N_2}{2\,mol\,NH_3} = 4.72\,mol\,N_2$$

$$9.43\,mol\,NH_3 \times \frac{3\,mol\,H_2}{2\,mol\,NH_3} = 14.1\,mol\,H_2$$

Practice 2.
Copper(II)oxide reacts with phosphorus. What product is formed? If 5.692 mol of copper (II) oxide reacts, how many moles of phosphorus also react? How many moles of the product are formed?

$$\underset{5.692\,mol}{6\,CuO} + \underset{?\,mol}{P_4} \longrightarrow \underset{?\,mol}{2\,Cu_3P_2} + \underset{?\,mol}{3\,O_2}$$

$$5.692\,mol_{CuO} \times \frac{1\,mol_{P_4}}{6\,mol_{CuO}} = \boxed{0.9487\,mol_{P_4}} \qquad 5.692\,mol_{CuO} \times \frac{3\,mol_{O_2}}{6\,mol_{CuO}} = \boxed{2.846\,mol_{O_2}}$$

$$5.692\,mol_{CuO} \times \frac{2\,mol_{Cu_3P_2}}{6\,mol_{CuO}} = \boxed{1.897\,mol_{Cu_3P_2}}$$

Practice 3.
7.11 g of H_2SO_4 reacts with sodium hydroxide. How many mol of the base is necessary for this reaction?

$$\underset{7.11g}{H_2SO_4} + 2\,\underset{?\,mol}{NaOH} \rightarrow 2\,H_2O + Na_2SO_4$$

$$7.11\,g_{H_2SO_4} \times \frac{1\,mol_{H_2SO_4}}{98.09\,g_{H_2SO_4}} \times \frac{2\,mol_{NaOH}}{1\,mol_{H_2SO_4}} = \boxed{0.145\,mol_{NaOH}}$$

Gram to Gram Conversions

Example 1:
Consider the reaction of magnesium metal with oxygen. If 3.26 g of Mg reacted, how many **grams of oxygen** reacted?

⇒ What is the balanced equation?

$$2\,Mg + O_2 \longrightarrow 2\,MgO$$

⇒ What is your given? $3.26\,g\,Mg$

⇒ What do you want to convert it to? grams of O_2

⇒ What is the mole ratio? $2\,mol\,Mg : 1\,mol\,O_2$

⇒ Calculate: (proper SF and units!)

$$3.26\,g_{Mg} \times \frac{1\,mol_{Mg}}{24.31\,g_{Mg}} \times \frac{1\,mol_{O_2}}{2\,mol_{Mg}} \times \frac{32.00\,g_{O_2}}{1\,mol_{O_2}} = \boxed{2.14\,g_{O_2}}$$

Example 2:
If 5.78g of copper (II) phosphide decomposes, how much of each product is produced?

⇒ What is the balanced equation?

$$2\,Cu_3P_2 \longrightarrow 6\,Cu + P_4$$

⇒ What is your given? $5.78\,g\ Cu_3P_2$

⇒ What do you want to convert it to? g of Cu & g of P_4

⇒ What is the mole ratio? $2\ mol\ Cu_3P_2 : 6\ mol\ Cu : 1\ mol\ P_4$

⇒ Calculate: (proper SF and units!)

$$5.78\,g\,Cu_3P_2 \times \frac{1\,mol\,Cu_3P_2}{252.59\,g\,Cu_3P_2} \times \frac{6\,mol\,Cu}{2\,mol\,Cu_3P_2} \times \frac{63.55\,g\,Cu}{1\,mol\,Cu} = \boxed{4.36\,g\,Cu}$$

$$5.78\,g\,Cu_3P_2 \times \frac{1\,mol\,Cu_3P_2}{252.59\,g\,Cu_3P_2} \times \frac{1\,mol\,P_4}{2\,mol\,Cu_3P_2} \times \frac{123.88\,g\,P_4}{1\,mol\,P_4} = \boxed{1.42\,g\,P_4}$$

Example 3.
Lead reacts with iron (II) sulphate. If 1.12 g of lead (II) sulphate is produced, how many grams of each reactant was used?

⇒ What is the balanced equation?

$$Pb + FeSO_4 \longrightarrow PbSO_4 + Fe$$

(?g) (?g) (1.12g)

⇒ What is your given? $1.12\,g\ PbSO_4$

⇒ What do you want to convert it to? g of Pb & g of $FeSO_4$

⇒ What is the mole ratio? $1\ mol\ PbSO_4 : 1\ mol\ Pb : 1\ mol\ FeSO_4$

⇒ Calculate: (proper SF and units!)

$$1.12\,g\,PbSO_4 \times \frac{1\,mol\,PbSO_4}{303.27\,g\,PbSO_4} \times \frac{1\,mol\,Pb}{1\,mol\,PbSO_4} \times \frac{207.20\,g\,Pb}{1\,mol\,Pb} = \boxed{0.765\,g\,Pb}$$

$$1.12\,g\,PbSO_4 \times \frac{1\,mol\,PbSO_4}{303.27\,g\,PbSO_4} \times \frac{1\,mol\,FeSO_4}{1\,mol\,PbSO_4} \times \frac{151.92\,g\,FeSO_4}{1\,mol\,FeSO_4} = \boxed{0.561\,g\ FeSO_4}$$

Practice 1.

Sodium metal reacts with iron (II) chloride. How many grams of both products are produced when 5.00g of sodium metal is reacted?

$$2Na + FeCl_2 \longrightarrow 2NaCl + Fe$$

$$5.00\,g_{Na} \times \frac{1\,mol_{Na}}{22.99\,g_{Na}} \times \frac{2\,mol_{NaCl}}{2\,mol_{Na}} \times \frac{58.44\,g_{NaCl}}{1\,mol_{NaCl}} = \boxed{12.7\,g_{NaCl}}$$

$$5.00\,g_{Na} \times \frac{1\,mol_{Na}}{22.99\,g_{Na}} \times \frac{1\,mol_{Fe}}{2\,mol_{Na}} \times \frac{55.85\,g_{Fe}}{1\,mol_{Fe}} = \boxed{6.07\,g_{Fe}}$$

Practice 2.

Aluminum reacts with Fe_2O_3 to give aluminum oxide and iron. If 40.2 g of iron are produced, find the masses of the other chemicals involved.

$$2Al + Fe_2O_3 \longrightarrow Al_2O_3 + 2Fe$$

$$40.2\,g_{Fe} \times \frac{1\,mol_{Fe}}{55.85\,g_{Fe}} \times \frac{2\,mol_{Al}}{2\,mol_{Fe}} \times \frac{26.98\,g_{Al}}{1\,mol_{Al}} = \boxed{19.4\,g_{Al}}$$

$$40.2\,g_{Fe} \times \frac{1\,mol_{Fe}}{55.85\,g_{Fe}} \times \frac{1\,mol_{Fe_2O_3}}{2\,mol_{Fe}} \times \frac{159.70\,g_{Fe_2O_3}}{1\,mol_{Fe_2O_3}} = \boxed{57.5\,g_{Fe_2O_3}}$$

$$40.2\,g_{Fe} \times \frac{1\,mol_{Fe}}{55.85\,g_{Fe}} \times \frac{1\,mol_{Al_2O_3}}{2\,mol_{Fe}} \times \frac{101.96\,g_{Al_2O_3}}{1\,mol_{Al_2O_3}} = \boxed{36.7\,g_{Al_2O_3}}$$

Complete "Gram A → Gram B" worksheet