Chemistry 11

Stoichiometry II

Name: key
Date:
Block:

1. Mole Ratio
2. Gram to Gram Conversions

Mole Ratio

Balance the following reactions and fill in the boxes below with the mole ratio.

3 $MgBr_2$	+	___ Fe_3N_2	→	___ Mg_3N_2	+	3 $FeBr_2$
24.0 mol		8.00 mol		8.00 mol		24.0 mol

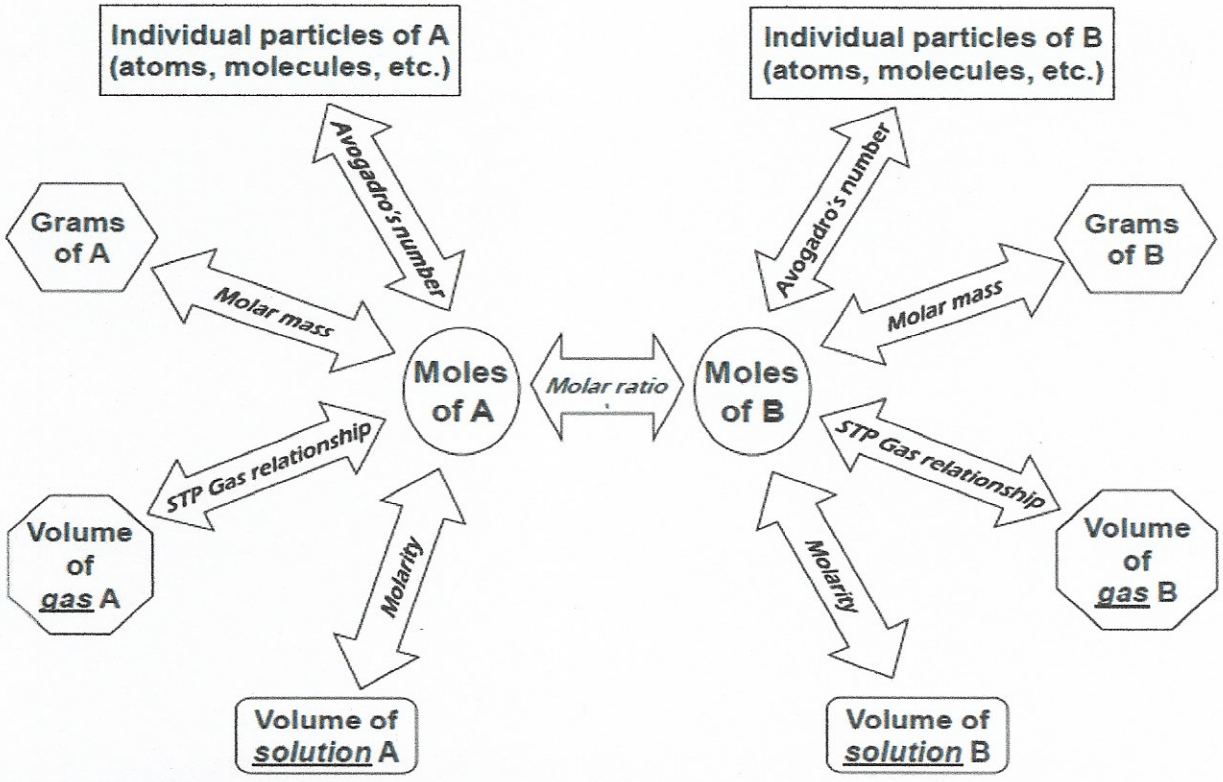
$24.0 mol\ FeBr_2 \times \frac{1\ mol\ Fe_3N_2}{3\ mol\ FeBr_2} = 8.00\ mol\ Fe_3N_2$

* For every 1 molecule of Fe_3N_2, 3 molecules of $FeBr_2$ are produced.

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?

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

⇒ What is your given? 3.25 mol K

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

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

⇒ Calculate: (proper SF and units!)

$3.25\ mol\ K \times \frac{3\ mol\ KCl}{3\ mol\ K} = \boxed{3.25\ mol\ KCl}$ $3.25\ mol\ K \times \frac{1\ mol\ Al}{3\ mol\ K} = \boxed{1.08\ mol\ Al}$

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?

$4Na + O_2 \longrightarrow 2N_2O$

⇒ What is your given? 0.600 mol O_2

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

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

⇒ Calculate: (proper SF and units!)

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

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? *(14.1 mol H_2, 4.72 mol N_2)*

$N_2 + 3H_2 \longrightarrow 2NH_3$

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

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

Practice 2.

Copper(II)oxide reacts with phosphorus. What products are formed? If 5.692 mol of copper (II) oxide reacts, how many moles of the product are formed? *(1.897 mol Cu_3P_2, 2.846 mol O_2)*

$6\,CuO + P_4 \longrightarrow 2\,Cu_3P_2 + 3\,O_2$

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

$5.692\ mol\ CuO \times \frac{3\ mol\ O_2}{6\ mol\ CuO} = \boxed{2.846\ mol\ O_2}$

Practice 3.

7.11 g of H_2SO_4 reacts with sodium hydroxide. How many mol of the base is necessary for this reaction? *(0.145 mol NaOH)*

$H_2SO_4 + 2NaOH \longrightarrow 2H_2O + Na_2SO_4$

$7.11g\ H_2SO_4 \times \frac{1\ mol\ H_2SO_4}{98.09g\ H_2SO_4} \times \frac{2\ mol\ NaOH}{1\ mol\ H_2SO_4} = \boxed{0.145\ mol\ NaOH}$

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? 3.26g Mg

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

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

⇒ Calculate: (proper SF and units!)

$3.26g\ Mg \times \frac{1\ mol\ Mg}{24.31g\ Mg} \times \frac{1\ mol\ O_2}{2\ mol\ Mg} \times \frac{32.00g\ O_2}{1\ mol\ O_2} = \boxed{2.14g\ O_2}$

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? 5.78g 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 + 2 mol Cu_3P_2 : 1 mol P_4

⇒ Calculate: (proper SF and units!)

Example 3.

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

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

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?

$Pb + FeSO_4 \longrightarrow PbSO_4 + Fe$

⇒ What is your given? 1.12g $PbSO_4$

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

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

⇒ Calculate: (proper SF and units!)

$$1.12\text{g } PbSO_4 \times \frac{1\text{mol } PbSO_4}{\text{g } PbSO_4} \times \frac{1\text{mol Pb}}{1\text{mol } PbSO_4} \times \frac{207.20\text{g Pb}}{1\text{mol Pb}} =$$

$$1.12\text{g } PbSO_4 \times \frac{1\text{mol } PbSO_4}{\text{g } PbSO_4} \times \frac{1\text{mol } FeSO_4}{1\text{mol } PbSO_4} \times \frac{151.92\text{g}}{1\text{mol } FeSO_4} =$$

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? *(12.7g NaCl, 6.07g Fe)*

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

$$5.00\text{g Na} \times \frac{1\text{mol Na}}{22.99\text{g Na}} \times \frac{2\text{mol NaCl}}{2\text{mol Na}} \times \frac{58.44\text{g NaCl}}{1\text{mol NaCl}} = \boxed{12.7\text{g NaCl}}$$

$$5.00\text{g Na} \times \frac{1\text{mol Na}}{22.99\text{g Na}} \times \frac{1\text{mol Fe}}{2\text{mol Na}} \times \frac{55.85\text{g Fe}}{1\text{mol Fe}} = \boxed{6.07\text{g Fe}}$$

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. *(36.7g Al_2O_3, 57.5g Fe_2O_3, 19.4g Al)*

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

$$40.2\text{g Fe} \times \frac{1\text{mol Fe}}{55.85\text{g Fe}} \times \frac{2\text{mol Al}}{2\text{mol Fe}} \times \frac{26.98\text{g Al}}{1\text{mol Al}} = \boxed{19.4\text{g Al}}$$

$$40.2\text{g Fe} \times \frac{1\text{mol Fe}}{55.85\text{g Fe}} \times \frac{1\text{mol } Fe_2O_3}{2\text{mol Fe}} \times \frac{159.70\text{g } Fe_2O_3}{1\text{mol } Fe_2O_3} = \boxed{57.5\text{g } Fe_2O_3}$$

$$40.2\text{g Fe} \times \frac{1\text{mol Fe}}{55.85\text{g Fe}} \times \frac{1\text{mol } Al_2O_3}{2\text{mol Fe}} \times \frac{101.96\text{g } Al_2O_3}{1\text{mol } Al_2O_3} = \boxed{36.7\text{g } Al_2O_3}$$

Complete "Gram A → Gram B" worksheet