Review: Reactions
Classify the Reaction, Predict the Products, and Balance the Chemical Equation

(1) zinc chloride reacts with silver

(2) aluminum hydroxide reacts with oxalic acid

(3) sodium reacts with sulphur

(4) iron (II) chloride reacts with magnesium carbonate

(5) aluminum chloride decomposes

Stoichiometry

The word Stoichiometry comees from the greek word “stoichio” meaning element and “meter” meaning measure. Stoichiometry is the branch of chemistry dealing with quantities of substances that react in or are produced in chemical reactions.

Mole Ratios
The moles of a substance involved in a chemical reaction are always in proportion.

ex. Given the balanced reaction:

$4HBr + O_2 \rightarrow 2H_2O + 2Br_2$

For every one mole of O_2 there must be four moles of HBr reaction and there will be two moles of H_2O and two moles of Br_2 produced.

Given the moles of one substance in a reaction, the moles of any substance can be determined by multiplying by the mole ratio. The mole ratio is **“where you’re going divided by where you’re coming from”**.

if 2.00 moles of HBr react, determine the moles of O_2 reacting.

if 0.080 moles of H_2O are produced, determine the moles of HBr reacting

ex. Given the balanced reaction:

$Al_2(CO_3)_3 + 3MgBr_2 \rightarrow 2AlBr_3 + 3MgCO_3$

if 0.50 mol of $Al_2(CO_3)_3$ react, determine the moles of $MgCO_3$ produced

if 2.6 mol of $AlBr_3$ are produced, determine the moles of MgBr2 reacting

Review: Mole Ratios

ex. Given the balanced reaction:

$2NiPO_4 + Na_2SO_4 \rightarrow Ni_2(SO_4)_3 + 2Na_3PO_4$

if 0.050 mol of $NiPO_4$ react, determine the moles of $Ni_2(SO_4)_3$ produced

if 10.5 mol of $NiPO_4$ react, determine the moles of Na_2SO_4 reacting

Stoichiometry Calculations involving Mass

ex. Cobalt (III) bromide reacts with barium sulphate. If 190.4 g of cobalt (III) bromide are present, what mass of barium sulphate would be required in the reaction? What would be the mass of each of the products?

(1) Determine a balanced chemical equation
(2) Use the mass to calculate the number of moles present
(3) Use mole ratios to calculate moles required
(4) Use the number of moles to calculate the mass

Percent Yield

In reality, in a chemical reaction, the amount of product predicted by stoichiometry is not usually obtained. Side reactions and/or contamination can cause the amount of material obtained to be lower than the predicted/theoretical amount. Percent Yield is the amount of products actually obtained divided by the theoretical amount of product (as predicted by stoichiometry).

$$\%\, yield = \frac{actual\ mass}{theoretical\ mass} x100\%$$

Percent yield will always be equal to or less than 100%. Percent yield can vary for a reaction depending on the reaction conditions.

ex. Lithium oxide can be decomposed to form lithium and oxygen gas. If 89.0 g of lithium oxide yields 30.5 g of lithium, determine the percent yield for the reaction. What mass of oxygen would actually be obtained?

(1) Determine a balanced chemical equation
(2) Use the given information to calculate the theoretical mass of product obtained.
(3) Use the formula to calculate percent yield.
(4) Use the percent yield to calculate the mass of the other product.

Limiting and Excess Reactions

It is common when preparing a chemical reaction to add more of one of the reactants than is actually necessary (more than would be required by stoichiometry). Adding extra of one reactant can help to ensure that the other reactant is entirely used up.

ex. in a reaction between gold an nitrogen gas, more nitrogen gas than is actually needed would be added to ensure that the gold reacts entirely. The nitrogen gas would be in **excess**, so nitrogen gas would be the **excess reactant**. The gold would be **limiting**, so gold would be the **limiting reactant**.

ex. 35.1 g of beryllium oxide are reacted with 52.3 g of calcium. What is the mass of each of the products?
(a) Which reactant is limiting and which is excess?
(b) What is the mass of each of the products?
(c) What mass of the excess reactant is used in the reaction and what mass of the excess reactant remains after the reaction?

ex. 20.5 g of aluminum chloride reacts with 40.5 g of silver nitrate.

(a) Which reactant is limiting and which is excess?
(b) What is the mass of each of the products?
(c) What mass of the excess reactant is used in the reaction and what mass of the excess reactant remains after the reaction?