Percent Yield

The amount of a product formed when the limiting reactant is completely consumed is called the **theoretical yield** of that product. This is the *maximum amount* of product that could be produced from the quantities of reactants used.

In reality, the amount of product predicted by the theoretical yield is seldom obtained. The **actual yield** is the amount of product actually produced when the chemical reaction is carried out in an experiment.

The actual yield is often given as a percentage of the theoretical yield. This is called the **percent yield**:

$$percent\ yield = \frac{actual\ yield}{theoretical\ yield} \times 100\%$$

Example 1

When potassium chromate (K_2CrO_4) is added to a solution containing 0.5 g silver nitrate ($AgNO_3$), solid silver chromate (Ag_2CrO_4) is formed.

a) Determine the theoretical yield of the silver chromate precipitate.

b) If 0.455 g of silver chromate is obtained, calculate the percent yield.

Percent Yield Worksheet

1. Given the following equation:

$$\_\_\_\_\_ K_2PtCl_4 + \_\_\_\_\_ NH_3 \rightarrow \_\_\_\_\_ Pt(NH_3)_2Cl_2 + \_\_\_\_\_ KCl$$

   a) Balance the equation.
   b) Determine the theoretical yield of KCl if you start with $34.5\ g\ NH_3$.
   c) If $76.4\ g\ Pt(NH_3)_2Cl_2$ are produced when you actually carry out this experiment, what is the percent yield?

2. Given the following equation:

$$H_3PO_4 + 3KOH \rightarrow K_3PO_4 + 3H_2O$$

   a) If $49.0\ g\ H_3PO_4$ is reacted with excess KOH, determine the theoretical yield of K_3PO_4.
   b) If $49.0\ g\ K_3PO_4$ are produced when you actually carry out this experiment, what is the percent yield?

3. Given the following equation:

$$Al_2(SO_3)_3 + 6NaOH \rightarrow 3Na_2SO_3 + 2Al(OH)_3$$

   If you start with $389.4\ g\ Al_2(SO_3)_3$ and produce $212.4\ g\ Na_2SO_3$, what is the percent yield for this reaction?

4. Given the following equation:

$$Al(OH)_3(s) + 3HCl(aq) \rightarrow AlCl_3(aq) + 3H_2O(l)$$

   If you start with $50.3\ g\ Al(OH)_3$ and produce $39.5\ g\ AlCl_3$, what is the percent yield?

5. Given the following equation:

$$\_\_\_\_\_ K_2CO_3 + \_\_\_\_\_ HCl \rightarrow \_\_\_\_\_ H_2O + \_\_\_\_\_ CO_2 + \_\_\_\_\_ KCl$$

   a) Balance the equation.
   b) Determine the theoretical yield of KCl if you start with $34.5\ g\ K_2CO_3$.
   c) If $3.4\ g\ H_2O$ are produced when you actually carry out this experiment, what is the percent yield?

6. Given the following equation:

$$H_2SO_4 + Ba(OH)_2 \rightarrow BaSO_4 + 2H_2O$$

   a) If 98.0 g H_2SO_4 is reacted with excess $Ba(OH)_2$, determine the theoretical yield of $BaSO_4$.
   b) If 213.7 g $BaSO_4$ are produced when you actually carry out this experiment, what is the percent yield?

7. Given the following equation:

$$3CaCl_2 + 2Li_3PO_4 \rightarrow 6LiCl + Ca_3(PO_4)_2$$

   If you start with 82.4 g $CaCl_2$ and produce 52.3 g $Ca_3(PO_4)_2$, what is the percent yield?

8. Given the following equation:

$$Cr(OH)_3 + 3HI \rightarrow CrI_3 + 3H_2O$$

   If you start with 50.3 g $Cr(OH)_3$ and produce 39.5 g CrI_3, what is the percent yield?