Percent Yield

The product yield for a reaction can at most be 100%. This means that all of the limiting reagent is converted to products. In practice the yield is always less than 100%. Yield of 20% or less are not uncommon for more complicated reactions.

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \text{ x } 100\ \%$$

The yields can be expressed several different ways as long as the units agree. Both yields could be measured in one of g, mol, mL, L, etc.

The actual yield is what is actually observed experimentally (also called the experimental yield).

The theoretical yield is based on a stoichiometric calculation to determine what should be produced if all goes well (also called the stoichiometric yield).

eg (from sheet #7-1) 225 g of calcium carbonate is decomposed to yield calcium oxide and carbon dioxide. Only 28.2 L of carbon dioxide is recovered at S.T.P.

a) Write a balanced chemical equation for the reaction.

b) Calculate the theoretical yield of CO_2 as a volume of gas at S.T.P.

c) Using the actual yield stated in the problem, determine the percent yield of the reaction.

$$\underset{225\ g}{CaCO_3} \rightarrow CaO + \underset{(28.2\ L)}{CO_2}$$

Theoretical Yield Calculation (could be limiting excess):

$$225\ \text{g } CaCO_3 \times \frac{1\ \text{mol } CaCO_3}{100.09\ \text{g } CaCO_3} \times \frac{1\ \text{mol } CO_2}{1\ \text{mol } CaCO_3} \times \frac{22.414\ \text{L } CO_2}{1\ \text{mol } CO_2} = 50.4\ \text{L } CO_2$$

Percent Yield Calculation:

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

$$\%\ \text{yield} = \frac{28.2\ \text{L } CO_2}{50.4\ \text{L } CO_2} \times 100\ \%$$

$$\%\ \text{yield} = 56.0\ \%$$