

Definitions:

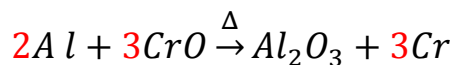
- Amounts of products calculated from the complete reaction of the limiting reagent is called **theoretical yields**.
- The amount actually produced of a product is the **actual yield**.

$$\text{Percent yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$$

- The reactant runs out first in a chemical reaction is called the *limiting reactant* or *limiting reagent*. The reaction stops after the limiting reagent runs out.

Example: Aluminum oxide was prepared by heating 225.0 g of chromium (II) oxide with 125.0 g of Al. If 100.0 g of aluminum oxide were obtained, calculate percent of yield.

- Balance the chemical reaction:



- Determine the limiting reactants:

First for the Al reactant:

$$\text{mol}(Al) = \frac{125 \text{ g}}{27 \text{ g/mol}} = 4.63 \text{ mole}$$

$$4.63 \text{ mol Al} \times \frac{1 \text{ mol of } Al_2O_3}{2 \text{ mol of Al}} = 2.32 \text{ mol of } Al_2O_3$$

Second for the CrO reactant:

$$\text{mol}(CrO) = \frac{225 \text{ g}}{68 \text{ g/mol}} = 3.31 \text{ mole}$$

$$3.31 \text{ mol CrO} \times \frac{1 \text{ mol of } Al_2O_3}{3 \text{ mol of CrO}} = 1.10 \text{ mol of } Al_2O_3$$

- Limiting reactants: Because CrO gives the less moles of product (1.10 mole of aluminum oxide), it is limiting reactant.

- 4) Convert the moles of the product by the limiting reactant to gram.

$$\text{mole} = \frac{\text{mass}}{\text{molar mass}}$$

$$\text{mass} = 1.10 \text{ mol } Al_2O_3 \times 102 \text{ g/mol} = 112.2 \text{ g}$$

- 5) Calculate percent of yield:

$$\text{Percent yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$$

$$\text{Percent yield of } Al_2O_3 = \frac{100.0 \text{ g}}{112.2 \text{ g}} \times 100 = 89.1\%$$