

Chemistry 2202
Stoich and Beyond!

A. Percent Yield

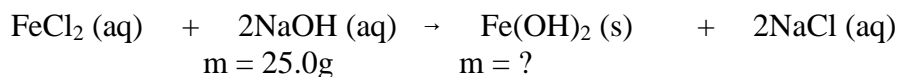
Stoichiometry tells us how much of a species reacts or is produced if everything was perfect- in other words the theoretical amounts. In reality, however, things are not perfect. When we compare how much in reality out of how much theoretically, we are looking at percent yield or percent reaction.

We can use a formula to express this:

$$\text{percent yield} = \frac{\text{actual yield (from real life)}}{\text{theoretical yield (from stoich calculation)}} \times 100\%$$

Example: A double replacement reaction occurs between iron(II) chloride and 25.0 g of sodium hydroxide solutions. In the laboratory, 27.3 g of iron(II) hydroxide was recovered. What was the percent yield?

In order to calculate the percent yield, we need to know the theoretical yield, so we use stoichiometry to find out the maximum amount of iron (II) hydroxide that could be made when 25.0 g of sodium hydroxide reacts. We do this the way we do all stoichiometry problems, with your 5 steps:



$$n \text{ of NaOH} = m/M = \frac{25.0\text{g}}{40.00 \text{ g/mol}} = 0.6250 \text{ mol}$$

$$\begin{aligned} n \text{ of Fe}(\text{OH})_2 (\text{s}) &= n \text{ of NaOH} \times \text{W/G} \\ &= 0.6250 \text{ mol} \times 1/2 \\ &= 0.3125 \text{ mol} \end{aligned}$$

$$m \text{ of Fe}(\text{OH})_2 (\text{s}) = nM = 0.3125 \text{ mol} \times 89.87 \text{ g/mol} = 28.1 \text{ g}$$

$$\text{percent yield} = \frac{\text{actual yield (from real life)}}{\text{theoretical yield (from stoich calculation)}} \times 100\%$$

$$= \frac{27.3 \text{ g}}{28.1 \text{ g}} \times 100 = 97.2 \%$$

There are many reasons why we don't get the exact amount we are supposed to, but they fall into one of two categories:

1. Random error - these come from mistakes that a person made, like reading a measurement incorrectly or miscalculating
2. Systematic error - these result from things you have no control over - such as the quality of the materials and equipment used. An example of this would be impure chemicals.

Try this one for practice:

A 1.28 g crystal of magnesium chloride completely reacted with a solution of silver nitrate to produce silver chloride and aqueous magnesium nitrate. The mass of the precipitate and filter paper was 5.29 g. The filter paper mass was 1.48 g. What was the percent yield?