

Percent Yield Problems

Theoretical Yield = The *maximum* amount of product that can be formed from given reactants.

--Theoretical yield is the answer from the stoichiometry calculation = maximum possible amount

---Number based upon the "**theoretical**" mathematical equation – no experiments were conducted.

Actual Yield = The amount of product that *actually* forms when the reaction is carried out in the lab.

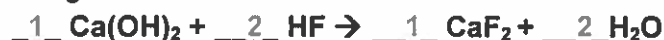
--Due to a variety of factors, the actual amount will ALWAYS be less than the theoretical yield.

---In real life, we never get as much as we anticipate, this "**actual**" amount from the lab experiment.

Percent Yield = The *ratio* of the actual yield to the theoretical yield expressed as a percentage.

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

EXAMPLE) How many grams of **hydrofluoric acid** (HF) are required to react completely with 23.68 grams of **calcium hydroxide** in the following reaction?



$$23.68 \text{ g Ca(OH)}_2 \times \frac{1 \text{ mol Ca(OH)}_2}{74.10 \text{ g Ca(OH)}_2} \times \frac{2 \text{ mol HF}}{1 \text{ mol Ca(OH)}_2} \times \frac{20.01 \text{ g HF}}{1 \text{ mol HF}} = \boxed{12.79 \text{ g HF}}$$

Based on the stoichiometry of this problem, the **Theoretical Yield** for this problem is **12.79 g HF**. But, when this experiment was conducted, an **Actual Yield** of only **10.41 g HF** was collected. Using the equation for percent yield, the **Percent Yield** of this experiment was **81.39%**.

$$\text{Percent Yield} = \frac{\text{Actual}}{\text{Theoretical}} \times 100 = \frac{10.41 \text{ g HF}}{12.79 \text{ g HF}} \times 100 = \boxed{81.39\%}$$

1) A student adds 200.0g of $\text{C}_7\text{H}_6\text{O}_3$ to an excess of $\text{C}_4\text{H}_6\text{O}_3$, this produces $\text{C}_9\text{H}_8\text{O}_4$ and $\text{C}_2\text{H}_4\text{O}_2$. Calculate the percent yield if 231 g of aspirin ($\text{C}_9\text{H}_8\text{O}_4$) is produced in an experiment.



2) According to the following equation, Calculate the percentage yield if 550.0 g of toluene (C_7H_8) added to an excess of nitric acid (HNO_3) provides 305 g of the p-nitrotoluene ($\text{C}_7\text{H}_7\text{NO}_2$) product in a lab experiment.



3) Aluminum reacts with an aqueous solution containing excess copper (II) sulfate. If 1.85 g Al reacts and the percentage yield of Cu is 56.6%, what mass of Cu is produced?



4) The combustion of methane(CH_4) produces carbon dioxide and water. Assume that 2.0 mol of CH_4 burned in the presence of excess air. What is the percentage yield if in an experiment the reaction produces 87.0 g of CO_2 ?

5) 15.3 grams of Lithium is dropped into a solution containing excess copper II phosphate. When the reaction is completed, 1.25 grams of copper is formed. What is the percent yield?

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