

Name: Key
Blk: _____ Date: _____

Chemistry 11
STOICHIOMETRY
AND PERCENT YIELD

Sometimes 100% of the expected amount of products can not be obtained from a chemical reaction.

The term Percent Yield is used to describe the amount of products that are actually obtained as a percentage of the expected amount.

Reasons for less than 100% yield:

1. all of the reactant may not react (impure)
2. some of the product is lost (in filter etc).

$$\text{PERCENT YIELD} = \frac{\text{mass of product obtained}}{\text{mass of product expected}} = \frac{\text{actual}}{\text{expected}} \times 100\%$$

Example 1: When 15.0 g of CH_4 is reacted with an excess of Cl_2 according to the reaction:



a total of 29.7 g of CH_3Cl is formed. What is the percent yield of the reaction?

Step 1: Write out the balanced equation



Step 2: Write out the PERCENT YIELD FORMULA and identify what you are looking for

$$\text{P.Y} = \frac{\text{ACTUAL}}{\text{Expected}} \times 100\% \quad ; \quad \frac{29.7 \text{ g}}{? \text{ g}} = ?$$

Step 3: Identify the ACTUAL amount produced:

$$29.7 \text{ g CH}_3\text{Cl}$$

Step 4: Calculate the EXPECTED amount using STOICHIOMETRY

$$15.0 \text{ g CH}_4 \times \frac{1 \text{ mol CH}_4}{16.0 \text{ g CH}_4} \times \frac{1 \text{ mol CH}_3\text{Cl}}{1 \text{ mol CH}_4} \times \frac{50.5 \text{ g CH}_3\text{Cl}}{1 \text{ mol CH}_3\text{Cl}} = 47.3 \text{ g CH}_3\text{Cl}$$

Step 5: Plug the ACTUAL and EXPECTED into the formula

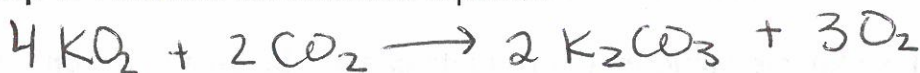
$$\text{P.Y} = \frac{29.7 \text{ g CH}_3\text{Cl}}{47.3 \text{ g CH}_3\text{Cl}} \times 100\% = \boxed{62.8\%}$$

Example 2: What mass of K_2CO_3 is produced when 1.50 g of KO_2 is reacted with an excess of CO_2 according to the reaction:



If the reaction has a 76.0 % yield?

Step 1: Write out the balanced equation



Step 2: Write out the PERCENT YIELD FORMULA and identify what you are looking for

$$P.Y = \frac{\text{actual}}{\text{expected}} \times 100\% = 76.0\% = \frac{?}{\text{expected}}$$

Step 3: Calculate the EXPECTED amount using STOICHIOMETRY

$$1.50 \text{ g } KO_2 \times \frac{1 \text{ mol } KO_2}{71.1 \text{ g } KO_2} \times \frac{2 \text{ mol } K_2CO_3}{4 \text{ mol } KO_2} \times \frac{138.2 \text{ g}}{1 \text{ mol } K_2CO_3} = 1.46 \text{ g } K_2CO_3$$

Step 4: Now use the Percent Yield Formula + expected to solve for ACTUAL

$$76.0\% = \frac{x}{1.46 \text{ g}} \rightarrow 0.760 \times 1.46 \text{ g} = x$$

1.11 g K_2CO_3 is actually produced

Example 3: What mass of CuO is required to make 10.0 g of Cu according to the reaction:



IF the reaction has a 58.0 % yield?

Step 1: Write out the balanced equation



Step 2: Write out the PERCENT YIELD FORMULA and identify what you are looking for

$$58.0\% = \frac{10.0 \text{ g } Cu}{x} \rightarrow \frac{10.0 \text{ g } Cu}{0.580} = x \Rightarrow 17.2 \text{ g } Cu$$

Step 3: Re-arrange the FORMULA to solve for EXPECTED Cu

$$0.580 \cdot x = \left(\frac{10.0 \text{ g } Cu}{x} \right) \cdot x \rightarrow \frac{0.580 \cdot x}{0.580} = \frac{10.0 \text{ g } Cu}{0.580} \Rightarrow 17.2 \text{ g } Cu$$

Step 4: Use the Expected Cu to solve for the required amount of CuO (STOICH)

$$17.2 \text{ g } Cu \times \frac{1 \text{ mol } Cu}{63.5 \text{ g } Cu} \times \frac{3 \text{ mol } CuO}{3 \text{ mol } Cu} \times \frac{79.5 \text{ g } CuO}{1 \text{ mol } CuO} = \boxed{21.6 \text{ g } CuO}$$