

note: in Chemistry "yield" means to form or "produce"

Name: \_\_\_\_\_  
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### Chemistry 11 STOICHIOMETRY AND PERCENT YIELD

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

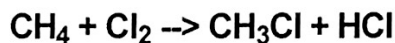
The term Percent yield is used to describe the amount of products that are actually obtained as a percentage of the expected amount.

Reasons for less than 100% yield:

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

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

Example 1: When 15.0 g of CH<sub>4</sub> is reacted with an excess of Cl<sub>2</sub> according to the reaction:



a total of 29.7 g of CH<sub>3</sub>Cl 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

$$\text{P.Y.} = \frac{\text{actual}}{\text{expected}} \cdot 100 \rightarrow \frac{29.7 \text{ g CH}_3\text{Cl}}{?} \cdot 100$$

Step 3: Identify the ACTUAL amount produced:

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

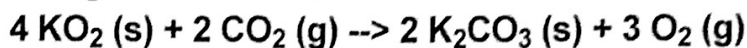
Step 4: Calculate the EXPECTED amount using STOICHIOMETRY → g CH<sub>3</sub>Cl

$$15.0 \text{ g CH}_4 \left( \frac{1 \text{ mol CH}_4}{16.0 \text{ g CH}_4} \right) \left( \frac{1 \text{ mol CH}_3\text{Cl}}{1 \text{ mol CH}_4} \right) \left( \frac{50.5 \text{ g CH}_3\text{Cl}}{1 \text{ mol CH}_3\text{Cl}} \right) = 47.3 \text{ g CH}_3\text{Cl}$$

Step 5: Plug the ACTUAL and EXPECTED into the formula

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

**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

$$\underline{76.0\%} = \frac{\text{actual}}{\text{expected}} \cdot 100 \rightarrow 0.760 = \frac{\text{actual}}{\text{expected}}$$

**Step 3:** Calculate the EXPECTED amount using STOICHIOMETRY

$$\underline{1.50 \text{ g } KO_2} \left( \frac{1 \text{ mol } KO_2}{71.1 \text{ g } KO_2} \right) \left( \frac{2 \text{ mol } K_2CO_3}{4 \text{ mol } KO_2} \right) \left( \frac{138.2 \text{ g}}{1 \text{ mol } K_2CO_3} \right) = \underline{1.46 \text{ g } K_2CO_3}$$

↑  
expected

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

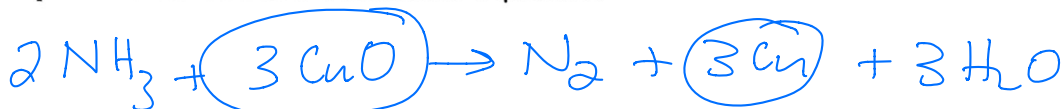
$$\underline{1.46} (0.760) = \left( \frac{x \text{ g } K_2CO_3}{\underline{1.46 \text{ g } K_2CO_3}} \right) \cdot 100 \rightarrow \boxed{1.11 \text{ g } K_2CO_3}$$

**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

$$\frac{\underline{58.0\%}}{100} = \frac{\text{actual}}{\text{expected}} \cdot \frac{100}{100} \rightarrow 0.580 = \frac{10.0 \text{ g } Cu}{x \text{ g } Cu}$$

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

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

$$x \text{ g } Cu = \boxed{17.2 \text{ g } Cu} \text{ exp}$$

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

$$17.2 \text{ g } Cu \left( \frac{1 \text{ mol } Cu}{63.5 \text{ g } Cu} \right) \left( \frac{3 \text{ mol } CuO}{3 \text{ mol } Cu} \right) \left( \frac{79.5 \text{ g } CuO}{1 \text{ mol } CuO} \right) = \boxed{21.6 \text{ g } CuO}$$

c

