ANSWER KEY

**EXTRA PRACTICE: Percent Yield Practice #2** Name: ______________________

1. In a decomposition reaction of $CaCO_{3\,(s)}$, in which $CaO_{(s)}$ and $CO_{2\,(g)}$ are produced, what is the percent yield if 14.2 g $CaO_{(s)}$ is actually produced when 25.5 g $CaCO_{3\,(s)}$ is heated?

$\underline{1}\ CaCO_{3\,(s)} \rightarrow \underline{1}\ CaO_{(s)} + \underline{1}\ CO_{2\,(g)}$  * L.R. = $CaCO_3$

$$\frac{25.5\ g\ CaCO_3}{1} \times \frac{1\ mol\ CaCO_3}{100.09\ g\ CaCO_3} \times \frac{1\ mol\ CaO}{1\ mol\ CaCO_3} \times \frac{56.08\ g\ CaO}{1\ mol\ CaO} = 14.3\ g\ CaO$$

$$\%\ Yield = \frac{Actual}{Theor} \times 100 \rightarrow \%\ Yield = \frac{14.2\ g\ CaO}{14.3\ g\ CaO} \times 100 \rightarrow \boxed{99.3\%\ Yield}$$

2. Quicklime, $CaO_{(s)}$, can be prepared by roasting limestone, $CaCO_{3\,(s)}$, according to the chemical equation below. When $2.00 \times 10^3$ g of $CaCO_{3\,(s)}$ is heated, the actual yield of $CaO_{(s)}$ is $1.50 \times 10^3$ g. What is the percent yield of this decomposition reaction?

$\underline{1}\ CaCO_{3\,(s)} \rightarrow \underline{1}\ CaO_{(s)} + \underline{1}\ CO_{2\,(g)}$  * L.R. = $CaCO_3$

$$\frac{2.00E3\ g\ CaCO_3}{1} \times \frac{1\ mol\ CaCO_3}{100.09\ g\ CaCO_3} \times \frac{1\ mol\ CaO}{1\ mol\ CaCO_3} \times \frac{56.08\ g\ CaO}{1\ mol\ CaO} = 1121\ g\ CaO$$

$$\%\ Yield = \frac{Actual}{Theor} \times 100 \rightarrow \%\ Yield = \frac{1.50E3\ g\ CaO}{1121\ g\ CaO} \times 100 \rightarrow \boxed{134\%\ Yield}$$

3. Aluminum reacts with an aqueous solution of copper (II) sulfate to produce copper and aluminum sulfate. If 1.85 grams of the limiting reactant, aluminum, reacts and the percent yield of copper is 56.6%, what mass of copper is actually produced?

$\underline{2}\ Al_{(s)} + \underline{3}\ CuSO_{4\,(aq)} \rightarrow \underline{3}\ Cu_{(s)} + \underline{1}\ Al_2(SO_4)_{3\,(aq)}$  * L.R. = Al

$$\frac{1.85\ g\ Al}{1} \times \frac{1\ mol\ Al}{26.98\ g\ Al} \times \frac{3\ mol\ Cu}{2\ mol\ Al} \times \frac{63.55\ g\ Cu}{1\ mol\ Cu} = 6.54\ g\ Cu$$

$$\%\ Yield = \frac{Actual}{Theor} \times 100 \rightarrow 0.566 = \frac{x}{6.54\ g\ Cu} \rightarrow \boxed{x = 3.70\ g\ Cu\ actually\ produced}$$

4. The combustion reaction of methane ($CH_4$) produces carbon dioxide and water. Assume that 2.00 mol of $CH_4$ burned in the presence of 6.00 mol of oxygen. What is the percent yield if the reaction actually produces 68.5 g of water?

$\underline{1}\ CH_{4\,(g)} + \underline{2}\ O_{2\,(g)} \rightarrow \underline{1}\ CO_{2\,(g)} + \underline{2}\ H_2O_{(l)}$

(LR)
$$\frac{2.00\ mol\ CH_4}{1} \times \frac{2\ mol\ H_2O}{1\ mol\ CH_4} \times \frac{18.016\ g\ H_2O}{1\ mol\ H_2O} = 72.1\ g\ H_2O$$

(ER)
$$\frac{6.00\ mol\ O_2}{1} \times \frac{2\ mol\ H_2O}{2\ mol\ O_2} \times \frac{18.016\ g\ H_2O}{1\ mol\ H_2O} = 108\ g\ H_2O$$

$$\%\ Yield = \frac{Actual}{Theor} \times 100 \rightarrow \%\ Yield = \frac{68.5\ g\ H_2O}{72.1\ g\ H_2O} \times 100 \rightarrow \boxed{95.1\%\ Yield}$$

5. If 15.0 grams of copper (II) chloride react with 20.0 grams of sodium nitrate, what is the percent yield of this reaction if 11.3 grams of sodium chloride are experimentally produced in this reaction?

$\underline{1}\ CuCl_2 + \underline{2}\ NaNO_3 \rightarrow \underline{1}\ Cu(NO_3)_2 + \underline{2}\ NaCl$

$$\frac{15.0\text{ g } CuCl_2}{1} \times \frac{1\text{ mol } CuCl_2}{134.45\text{ g } CuCl_2} \times \frac{2\text{ mol NaCl}}{1\text{ mol } CuCl_2} \times \frac{58.44\text{ g NaCl}}{1\text{ mol NaCl}} = 13.0\text{ g NaCl (LR)}$$

$$\frac{20.0\text{ g } NaNO_3}{1} \times \frac{1\text{ mol } NaNO_3}{85\text{ g } NaNO_3} \times \frac{2\text{ mol NaCl}}{2\text{ mol } NaNO_3} \times \frac{58.44\text{ g NaCl}}{1\text{ mol NaCl}} = 13.8\text{ g NaCl (ER)}$$

$$\%\text{Yield} = \frac{\text{Actual}}{\text{Theor}} \times 100 \rightarrow \%\text{ Yield} = \frac{11.3\text{ g NaCl}}{13.0\text{ g NaCl}} \times 100 \rightarrow \boxed{86.9\%\text{ Yield}}$$

6. If 25.0 grams of iron (III) phosphate and an excess of sodium sulfate react, how many grams of iron (III) sulfate are produced?

$\underline{2}\ FePO_4 + \underline{3}\ Na_2SO_4 \rightarrow \underline{1}\ Fe_2(SO_4)_3 + \underline{2}\ Na_3PO_4$

* L.R. = $FePO_4$ / E.R. = $Na_2SO_4$

$$\frac{25.0\text{ g } FePO_4}{1} \times \frac{1\text{ mol } FePO_4}{150.82\text{ g } FePO_4} \times \frac{1\text{ mol } Fe_2(SO_4)_3}{2\text{ mol } FePO_4} \times \frac{399.88\text{ g } Fe_2(SO_4)_3}{1\text{ mol } Fe_2(SO_4)_3} = \boxed{33.1\text{ g } Fe_2(SO_4)_3}$$

↳ Theoretical

a. If 18.5 grams of iron (III) sulfate are actually produced when the reaction is carried out, what is your percent error?

$$\%\text{ Error} = \frac{|\text{Experimental} - \text{Theoretical}|}{\text{Theoretical}} \times 100$$

$$\%\text{ Error} = \frac{|18.5\text{ g} - 33.1\text{ g}|}{33.1\text{ g}} \times 100 \rightarrow \boxed{44.1\%\text{ Error}}$$

b. Is the answer to the percent yield reasonable? Explain why/why not.

$$\%\text{ Yield} = \frac{\text{Actual}}{\text{Theor}} \times 100 \rightarrow$$

$$\%\text{ Yield} = \frac{18.5\text{ g } Fe_2(SO_4)_3}{33.1\text{ g } Fe_2(SO_4)_3} \times 100 \rightarrow \boxed{55.9\%\text{ Yield}}$$ → YES, satisfies Law of Conservation of Mass

c. If you do this reaction with 15.0 grams of sodium sulfate and get a 65.0% yield, how many grams of sodium phosphate will you make?

$$\frac{15.0\text{ g } Na_2SO_4}{1} \times \frac{1\text{ mol } Na_2SO_4}{142.04\text{ g } Na_2SO_4} \times \frac{2\text{ mol } Na_3PO_4}{3\text{ mol } Na_2SO_4} \times \frac{163.94\text{ g } Na_3PO_4}{1\text{ mol } Na_3PO_4} = \boxed{11.5\text{ g } Na_3PO_4}$$