Name: SOLUTIONS

Date: _____ Hour: _____

Chem B Unit 7, Day 6: Yields

**G → M → M → G**

## Bellwork:

When 1.2 grams of magnesium metal is dropped into 0.1 mol of hydrochloric acid, how much magnesium chloride is produced?

(1) Balanced chemical equation: $Mg + 2HCl \rightarrow MgCl_2 + H_2$

(2) LR problem b/c 2 amounts of reactants given ∴ Need to do 2 calculations

$$1.2\text{ g Mg} \left| \frac{1\text{ mol Mg}}{24.3\text{ g Mg}} \right| \frac{1\text{ mol } MgCl_2}{1\text{ mol Mg}} \left| \frac{95.2\text{ g } MgCl_2}{1\text{ mol } MgCl_2} \right| = 4.7\text{ g } MgCl_2$$

$$0.1\text{ mol HCl} \left| \frac{1\text{ mol } MgCl_2}{2\text{ mol HCl}} \right| \frac{95.2\text{ g } MgCl_2}{1\text{ mol } MgCl_2} = 4.7\text{ g } MgCl_2$$

both reacta will run at the sam tim

## Vocab and tools:

| | *Your description based on the video* | *Your chemistry description* |
|---|---|---|
| Theoretical yield ~450 | How many people should be able to be served cake based on the cater's calculations | The amount of product we expect to get from a reaction GIVEN THE MATH! |
| Actual yield ~3 | How many people actually got cake after the catastrophe! | The amount of product we actually get from the experiment |

Always smaller (or equal to) theoretical yield.

ex. You can get 100 on a test (TY), but if you score a 90, then your AY is 90 (less than TY,

*Example problem:*

An experimental procedure asks you to react 15.5 g of $NH_4Cl$ with an excess of $AgNO_3$. In the reaction 35.5 g AgCl is produced. What is the percent yield?

$$NH_4Cl + AgNO_3 \rightarrow AgCl + NH_4NO_3$$

"Actual yield"

Use this to determine the theoretical yield of AgCl given this starting amount of $NH_4Cl$ – how much can we make?

Percent yield: $\frac{\textit{Mass of actual yield}}{\textit{Mass of theoretical yield}} \times 100\%$

Percent error: $\frac{|\textit{theoretical yield} - \textit{actual yield}|}{\textit{theoretical yield}} \times 100\%$

(1) TY: $15.5\text{ g } NH_4Cl \left| \frac{1\text{ mol } NH_4Cl}{53.49\text{ g } NH_4Cl} \right| \frac{1\text{ mol AgCl}}{1\text{ mol } NH_4Cl} \left| \frac{143.32\text{ g AgCl}}{1\text{ mol AgCl}} \right| = 41.5$ AgC

(2) Percent yield (how close were we?) $= \frac{AY}{TY} \times 100\% = \frac{35.5\text{ g AgCl}}{41.5\text{ g AgCl}} \times 100\% = \boxed{85.5\%}$

1. Given a hydrogen fuel cell reaction where 11.3 grams of water are expected to be released (TY), what is the percent yield if the fuel cell actually releases 8.44 g of water (AY)? What is the percent error?

TY: 11.3 g $H_2O$

AY: 8.44 g $H_2O$

Percent yield: $\frac{AY}{TY} \times 100\% = \frac{8.44\text{ g } H_2O}{11.3\text{ g } H_2O} \times 100\% = 75$

Percent error: $\frac{|TY - AY|}{TY} \times 100\% = \frac{|11.3\text{ g} - 8.44\text{ g}|}{11.3\text{ g}} \times 100\% = 25\%$

2. In the decomposition reaction of calcium carbonate, $CaCO_3$, if 20.7 grams of $CaCO_3$ produces 6.81 grams of CaO (AY), what is the percent yield?

a. Balanced chemical equation: $1\ CaCO_3 \rightarrow 1\ CaO + 1\ CO_2$

b. Theoretical yield of CaO given that 20.7 g $CaCO_3$ was used: 11.6 g CaO

TY: $20.7\text{ g } CaCO_3 \left| \frac{1\text{ mol } CaCO_3}{100.09\text{ g } CaCO_3} \right| \frac{1\text{ mol } CaO}{1\text{ mol } CaCO_3} \left| \frac{56.08\text{ g } CaO}{1\text{ mol } CaO} \right. = 11.6\text{ g } CaO$

c. Percent yield of CaO: 58.7%

Percent yield: $\frac{AY}{TY} \times 100\% = \frac{6.81\text{ g } CaO}{11.6\text{ g } CaO} \times 100\% = 58.7\%$

3. For the balanced equation shown below, if the reaction uses 0.112 grams of $Fe_3O_4$ and actually produces 0.059 grams of Fe (AY), what is the percent yield of Fe? (Use to find TY)

$$Fe_3O_4 + 4\ H_2 \rightarrow 3\ Fe + 4\ H_2O$$

(1) TY of Fe: $0.112\text{ g } Fe_3O_4 \left| \frac{1\text{ mol } Fe_3O_4}{231.54\text{ g } Fe_3O_4} \right| \frac{3\text{ mol Fe}}{1\text{ mol } Fe_3O_4} \left| \frac{55.85\text{ g Fe}}{1\text{ mol Fe}} \right. = 0.081\text{ g Fe}$

(2) Percent yield: $\frac{AY}{TY} \times 100\%$ $\frac{0.059\text{ g Fe}}{0.081\text{ g Fe}} \times 100\% =$ 72.8% yield

4. How many grams of $H_2O$ are produced from burning 40.8 grams of $C_6H_6O_3$ in the presence of oxygen, given that 39.0% yield is obtained? (PY; use to find TY)

$$1\ C_6H_6O_3 + 6\ O_2 \rightarrow 6\ CO_2 + 3\ H_2O$$ ← error on worksheet alert!

(1) Question is different - wants us to determine AY of $H_2O$ from PY & TY

(2) TY: $40.8\text{ g } C_6H_6O_3 \left| \frac{1\text{ mol } C_6H_6O_3}{126.11\text{ g } C_6H_6O_3} \right| \frac{3\text{ mol } H_2O}{1\text{ mol } C_6H_6O_3} \left| \frac{18.0152\text{ g } H_2O}{1\text{ mol } H_2O} \right. = 17.48\text{ g } H_2O$

(3) $PY = \frac{AY}{TY}$ rearrange $AY = PY \cdot TY$ $(0.390)(17.48\text{ g } H_2O) =$ 6.82 g $H_2O$ were actually produced