

Name KEY Date \_\_\_\_\_ Period \_\_\_\_\_

## Theoretical and Percent Yield Worksheet

1. Write the equations for calculating % yield and % error in the boxes below:

% yield:

% error:

2. What does a % yield tell you?

3. What does a % error tell you?

### Worked example:

Given the following equation, determine the percent yield of KCl if you react 34.5 g of  $K_2CO_3$  with excess HCl and you are able to actually isolate 36.1 g of KCl. Also Calculate the % error.



Steps:

- Balance the equation.
- Determine the theoretical yield of KCl if you start with 34.5 g of  $K_2CO_3$ .
- Starting with 34.5 g of  $K_2CO_3$ , and you isolate 36.1 g of KCl, what is the percent yield?
- Calculate the percent error for this reaction.



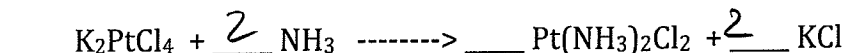
b)  $34.5 \text{ g } K_2CO_3 \times \frac{1 \text{ mole } K_2CO_3}{138.21 \text{ g } K_2CO_3} \times \frac{2 \text{ mol KCl}}{1 \text{ mol } K_2CO_3} \times \frac{74.55 \text{ g KCl}}{1 \text{ mol KCl}} = 37.2 \text{ g KCl}$

c) % yield =  $\frac{\text{actual yield}}{\text{theoretical yield}} \times 100$  so... % yield of KCl =  $\frac{36.1 \text{ g KCl}}{37.2 \text{ g KCl}} \times 100 = 97.0\%$

d) % error =  $\frac{|(\text{theoretical} - \text{actual})|}{\text{theoretical yield}} \times 100$  so... % error =  $\frac{|(37.2 - 36.1)|}{37.2} \times 100 = 2.96\%$

Now you try...

1. What is the % yield and % error if when 16.22 g of  $\text{NH}_3$  is reacted with excess  $\text{K}_2\text{PtCl}_4$ , 265.52 g of  $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$  is produced according to the following equation:



- a) Balance the equation.  $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$   
 b) Determine the theoretical yield of ~~KCl~~ if you start with 16.22 grams of  $\text{NH}_3$ .  
 c) Starting with ~~16.22~~ <sup>16.22</sup> g of  $\text{NH}_3$ , and you isolate ~~75.4~~ <sup>129.1</sup> g of  $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$ , what is the percent yield?  
 d) Calculate the percent error for this reaction.

$$b) 16.22 \text{ g NH}_3 \times \frac{1 \text{ mol NH}_3}{17 \text{ g NH}_3} \times \frac{1 \text{ mol Pt}(\text{NH}_3)_2\text{Cl}_2}{2 \text{ mol NH}_3} \times \frac{299 \text{ g Pt}(\text{NH}_3)_2\text{Cl}_2}{1 \text{ mol Pt}(\text{NH}_3)_2\text{Cl}_2} = \boxed{143 \text{ g}}$$

$$c) \% \text{ yield} = \frac{129.1 \text{ g}}{143 \text{ g}} \times 100 = \boxed{90\% \text{ yield}}$$

$$d) \% \text{ error} = \frac{|143 - 129.1|}{143} \times 100 = \boxed{10\% \text{ error}}$$

2. Given the following equation:



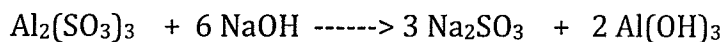
- a) If 49.0 g of  $\text{H}_3\text{PO}_4$  is reacted with excess  $\text{KOH}$ , determine the percent yield of  $\text{K}_3\text{PO}_4$  if you isolate 49.0 g of  $\text{K}_3\text{PO}_4$ .  
 b) Calculate the percent error for this reaction.

$$a) 49.0 \text{ g H}_3\text{PO}_4 \times \frac{1 \text{ mol H}_3\text{PO}_4}{98 \text{ g H}_3\text{PO}_4} \times \frac{1 \text{ mol K}_3\text{PO}_4}{1 \text{ mol H}_3\text{PO}_4} \times \frac{212 \text{ g K}_3\text{PO}_4}{1 \text{ mol K}_3\text{PO}_4} = \boxed{106 \text{ g}} \text{ theoretical yield}$$

$$\% \text{ yield} = \frac{49.0 \text{ g}}{106 \text{ g}} \times 100 = \boxed{46\% \text{ yield}}$$

$$b) \% \text{ error} = \frac{|106 - 49.0|}{106} \times 100 = \boxed{54\% \text{ error}}$$

3. Given the following equation:



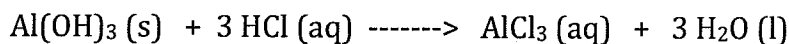
- a) If you start with 389.04 g of  $\text{Al}_2(\text{SO}_3)_3$  and you isolate 212.60 g of  $\text{Na}_2\text{SO}_3$ , what is your percent yield for this reaction?  
 b) Calculate the percent error for this reaction.

$$a) 389.04 \text{ g } \text{Al}_2(\text{SO}_3)_3 \times \frac{1 \text{ mol } \text{Al}_2(\text{SO}_3)_3}{294 \text{ g}} \times \frac{3 \text{ mol } \text{Na}_2\text{SO}_3}{1 \text{ mol } \text{Al}_2(\text{SO}_3)_3} \times \frac{126 \text{ g } \text{Na}_2\text{SO}_3}{1 \text{ mol } \text{Na}_2\text{SO}_3} = \boxed{500 \text{ g}}_{\text{theo.}}$$

$$\% \text{ yield} = \frac{212.60 \text{ g}}{500 \text{ g}} \times 100 = 42.5\% \text{ yield}$$

$$b) \% \text{ error} = \frac{|500 - 212.60|}{500} \times 100 = \boxed{57.5\%} \text{ error}$$

4. Given the following equation:



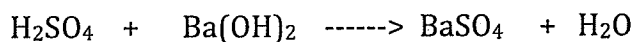
- a) If you start with 50.3 g of  $\text{Al}(\text{OH})_3$  and you isolate 39.5 g of  $\text{AlCl}_3$ , what is the percent yield and percent error?

$$50.3 \text{ g } \text{Al}(\text{OH})_3 \times \frac{1 \text{ mol } \text{Al}(\text{OH})_3}{78 \text{ g}} \times \frac{1 \text{ mol } \text{AlCl}_3}{1 \text{ mol } \text{Al}(\text{OH})_3} \times \frac{133 \text{ g } \text{AlCl}_3}{1 \text{ mol } \text{AlCl}_3} = \boxed{85.8 \text{ g}}_{\text{theo.}}$$

$$\% \text{ yield} = \frac{39.5 \text{ g } \text{AlCl}_3}{85.8 \text{ g } \text{AlCl}_3} \times 100 = 46\% \text{ yield}$$

$$\% \text{ error} = \frac{|85.8 \text{ g} - 39.5 \text{ g}|}{85.8 \text{ g}} \times 100 = 54\% \text{ error}$$

5. Given the following equation:



- a) If 98.00 g of  $\text{H}_2\text{SO}_4$  is reacted with excess  $\text{Ba}(\text{OH})_2$ , determine the percent yield of  $\text{BaSO}_4$  if you isolate 213.17 g of  $\text{BaSO}_4$ .  
 b) Calculate the percent error for this reaction.

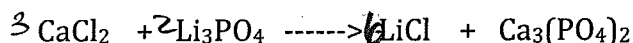
$$98.00 \text{ g } \text{H}_2\text{SO}_4 \times \frac{1 \text{ mol } \text{H}_2\text{SO}_4}{98 \text{ g } \text{H}_2\text{SO}_4} \times \frac{1 \text{ mol } \text{BaSO}_4}{1 \text{ mol } \text{H}_2\text{SO}_4} \times \frac{233 \text{ g } \text{BaSO}_4}{1 \text{ mol } \text{BaSO}_4} = \boxed{233 \text{ g } \text{BaSO}_4}$$

Theo. yield.

$$\% \text{ yield} = \frac{213.17 \text{ g}}{233 \text{ g}} \times 100 = \boxed{91.5\%}$$

$$\% \text{ error} = \frac{|233 - 213.17|}{233} \times 100 = \boxed{8.5\% \text{ error}}$$

6. Given the following equation:



- a) If you start with 82.4 g of  $\text{CaCl}_2$  and you isolate 82.4 g of  $\text{Ca}_3(\text{PO}_4)_2$ , what is your percent yield for this reaction and the percent error?

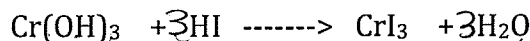
$$82.4 \text{ g } \text{CaCl}_2 \times \frac{1 \text{ mol } \text{CaCl}_2}{110 \text{ g } \text{CaCl}_2} \times \frac{1 \text{ mol } \text{Ca}_3(\text{PO}_4)_2}{3 \text{ mol } \text{CaCl}_2} \times \frac{310 \text{ g } \text{Ca}_3(\text{PO}_4)_2}{1 \text{ mol } \text{Ca}_3(\text{PO}_4)_2} = \boxed{77.4 \text{ g}}$$

Theo.

$$\% \text{ yield} = \frac{82.4 \text{ g}}{77.4 \text{ g}} \times 100 = \boxed{106\% \text{ yield}}$$

$$\% \text{ error} = \frac{|77.4 - 82.4|}{77.4} \times 100 = \boxed{6.5\% \text{ error}}$$

7. Given the following equation:



- a) If you start with 50.3 g of  $\text{Cr}(\text{OH})_3$  and you isolate 39.5 g of  $\text{CrI}_3$ , what is the percent yield?  
 b) Calculate the percent error for this reaction.

$$50.3 \text{ g } \text{Cr}(\text{OH})_3 \times \frac{1 \text{ mol } \text{Cr}(\text{OH})_3}{103 \text{ g } \text{Cr}(\text{OH})_3} \times \frac{1 \text{ mol } \text{CrI}_3}{1 \text{ mol } \text{Cr}(\text{OH})_3} \times \frac{433 \text{ g } \text{CrI}_3}{1 \text{ mol } \text{CrI}_3} = \boxed{211 \text{ g}}$$

Theo.

$$\% \text{ yield} = \frac{39.5 \text{ g } \text{CrI}_3}{211 \text{ g } \text{CrI}_3} \times 100 = \boxed{19\% \text{ yield}}$$

$$\% \text{ error} = \frac{|211 - 39.5|}{211} \times 100 = \boxed{81\% \text{ error}}$$