

Stoich Warm-Up: Answer the following to check your understanding of stoich problems.

- 1) What is meant by theoretical yield? Define it in your own words.

Amount of product you predict can be made with a certain amount of reactant. Found with stoichiometry conversions.

- 2) What is the difference between experimental yield and theoretical yield? Discuss percent yield & percent error in your answer.

Experimental yield is the amount of product you actually collect in lab.

% Yield: How much of the theoretical collected

$$\% \text{ Yield} = \frac{\text{Exp}}{\text{Theor}} (100)$$

% Error: How far off you were from theoretical

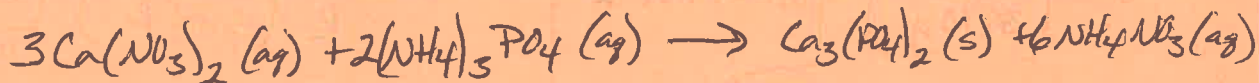
$$\% \text{ Error} = \frac{|\text{Exp} - \text{Theor}|}{\text{Theor}} (100)$$

- 3) 3.41 g of ammonia (NH₃) reacts with excess water to produce ammonium hydroxide. What would be the theoretical yield of ammonium hydroxide in grams?



$$3.41 \text{ g NH}_3 \left(\frac{1 \text{ mol NH}_3}{17.02 \text{ g}} \right) \left(\frac{1 \text{ mol NH}_4\text{OH}}{1 \text{ mol NH}_3} \right) \left(\frac{35.05 \text{ g}}{1 \text{ mol NH}_4\text{OH}} \right) = \boxed{7.02 \text{ g NH}_4\text{OH}}$$

- 4) Excess calcium nitrate reacts with 114.9 g of ammonium phosphate. What would be the theoretical yield of the precipitate?



$$114.9 \text{ g } (\text{NH}_4)_3\text{PO}_4 \left(\frac{1 \text{ mol } (\text{NH}_4)_3\text{PO}_4}{149.09 \text{ g}} \right) \left(\frac{1 \text{ mol Ca}_3(\text{PO}_4)_2}{2 \text{ mol } (\text{NH}_4)_3\text{PO}_4} \right) \left(\frac{310.18 \text{ g}}{1 \text{ mol Ca}_3(\text{PO}_4)_2} \right) = 119.5 \text{ g Ca}_3(\text{PO}_4)_2$$

Key

Theoretical Yield Exit Slip

1) How do you know if a problem is a regular stoich conversion or a limiting reagent problem?

- If one reactant is present in excess & only one value is given it is a regular stoich conversion. (Ex: 12.5 g of NaCl is added to excess CaBr_2)
- If two amounts of reactants are given, you have to figure out which one is limiting. (Ex: 12.5 g of NaCl is added to 7.9 g of CaBr_2)

2) Determine the theoretical yield of iron in the following example:

Excess potassium is placed into a solution containing 33.0 g of dissolved iron (III) chloride.



$$33.0 \text{ g FeCl}_3 \left(\frac{1 \text{ mol FeCl}_3}{162.20 \text{ g}} \right) \left(\frac{1 \text{ mol Fe}}{1 \text{ mol FeCl}_3} \right) \left(\frac{55.85 \text{ g}}{1 \text{ mol Fe}} \right) = \boxed{11.4 \text{ g Fe}}$$

3) Determine the theoretical yield of iron in the following example:

14.1 g of potassium are placed into a solution containing 33.0 g of dissolved iron (III) chloride.



① Who is limiting?

$$14.1 \text{ g K} \left(\frac{1 \text{ mol K}}{39.10 \text{ g}} \right) = \boxed{0.361 \text{ mol K}}$$

$$33.0 \text{ g FeCl}_3 \left(\frac{1 \text{ mol FeCl}_3}{162.20 \text{ g}} \right) = \boxed{0.203 \text{ mol FeCl}_3}$$

How much you have

$$0.361 \text{ mol K} \left(\frac{1 \text{ mol FeCl}_3}{3 \text{ mol K}} \right) = \boxed{0.120 \text{ mol FeCl}_3}$$

needed to use up all of the K we have

- We have more than enough FeCl_3 to react all of the K (have 0.203 mol, only need 0.120 mol)
- Therefore FeCl_3 is the excess reagent & K is the limiting reagent

② Calc the theor. yield using amount of limiting

$$0.361 \text{ mol K} \left(\frac{1 \text{ mol Fe}}{3 \text{ mol K}} \right) \left(\frac{55.85 \text{ g}}{1 \text{ mol Fe}} \right) = \boxed{6.72 \text{ g Fe}}$$