Name: ________________________________ Section: ____________________

Option Fe: Pre-lab Calculations for the Iron Based Experiment:

1. Calculate the molar mass of the starting hydrated salt material, $FeSO_4 \cdot 7H_2O$.

2. Your oxalate synthesis product will be $FeC_2O_4 \cdot 2H_2O$. Calculate the molar mass of $FeC_2O_4 \cdot 2H_2O$.

3. Write a balanced molecular equation that shows your $FeSO_4 \cdot 7H_2O$, reacting with oxalic acid ($H_2C_2O_4$) to form $FeC_2O_4 \cdot 2H_2O$. What will be the other product(s) of the double displacement reaction? Water will need to be added somewhere to balance correctly.

4. Pyrolysis of $FeC_2O_4 \cdot 2H_2O$ will follow one of the following molecular equations. Balance each molecular equation. *(It's OK to keep a fraction when balancing the O_2 molecule in* A *or* B*)*

A. $FeC_2O_4 \cdot 2H_2O(s)$ + $O_2(g)$ → $FeO(s)$ + $H_2O(g)$ + $CO_2(g)$

B. $FeC_2O_4 \cdot 2H_2O(s)$ + $O_2(g)$ → $Fe_2O_3(s)$ + $H_2O(g)$ + $CO_2(g)$

C. $FeC_2O_4 \cdot 2H_2O(s)$ → $FeCO_3(s)$ + $H_2O(g)$ + $CO(g)$

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5. For each of the possible reactions, calculate the theoretical yield (in grams) of the solid product, assuming that you use 1.0 g $FeC_2O_4 \cdot 2H_2O$ and that oxygen is the excess reactant. You will need to write in coefficients from question 4 to balance the molecular equations.

A. $FeC_2O_4 \cdot 2H_2O(s)$ + $O_2(g)$ → $FeO(s)$ + $H_2O(g)$ + $CO_2(g)$

B. $FeC_2O_4 \cdot 2H_2O(s)$ + $O_2(g)$ → $Fe_2O_3(s)$ + $H_2O(g)$ + $CO_2(g)$

C. $FeC_2O_4 \cdot 2H_2O(s)$ → $FeCO_3(s)$ + $H_2O(g)$ + $CO(g)$

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Option Mn: Pre-lab calculations for the Manganese based experiment:

1. Calculate the molar mass of the starting hydrated salt material, $MnSO_4 \cdot H_2O$.

2. Your oxalate synthesis product will be $MnC_2O_4 \cdot 3H_2O$. Calculate the molar mass of $MnC_2O_4 \cdot 3H_2O$

3. Write a balanced molecular equation that shows $MnSO_4 \cdot H_2O$, reacting with oxalic acid ($H_2C_2O_4$) to form $MnC_2O_4 \cdot 3H_2O$. What will be the other product(s) of the double displacement reaction? Water will need to be added somewhere to balance correctly.

4. Pyrolysis of $MnC_2O_4 \cdot 3H_2O$ will follow one of the following molecular equations. Balance each molecular equation. *(It's OK to keep a fraction when balancing the O_2 molecule in* A *or* B.*)*

   A. $MnC_2O_4 \cdot 3H_2O(s)$ + $O_2(g)$ $\rightarrow$ $MnO(s)$ + $H_2O(g)$ + $CO_2(g)$

   B. $MnC_2O_4 \cdot 3H_2O(s)$ + $O_2(g)$ $\rightarrow$ $Mn_3O_4(s)$ + $H_2O(g)$ + $CO_2(g)$

   C. $MnC_2O_4 \cdot 3H_2O(s)$ $\rightarrow$ $MnCO_3(s)$ + $H_2O(g)$ + $CO(g)$

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5. For each of the possible reactions, calculate the theoretical yield (in grams) of the solid product, assuming that you use 1.0 g $MnC_2O_4 \cdot 3H_2O$ and that oxygen is the excess reactant. You will need to write in coefficients from question 4 to balance the molecular equations.

A. $MnC_2O_4 \cdot 3H_2O(s)$ + $O_2(g)$ → $MnO(s)$ + $H_2O(g)$ + $CO_2(g)$

B. $MnC_2O_4 \cdot 3H_2O(s)$ + $O_2(g)$ → $Mn_3O_4(s)$ + $H_2O(g)$ + $CO_2(g)$

C. $MnC_2O_4 \cdot 3H_2O(s)$ → $MnCO_3(s)$ + $H_2O(g)$ + $CO(g)$

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Data and Calculations

Part 1: Synthesis of Metal Oxalate

Determine the identity of the limiting reactant, theoretical yield of the hydrated metal oxalate, and the percent yield of the hydrated metal oxalate product. Complete Table 1.

Table 1. Synthesis of Metal Oxalate

a) complete chemical formula of your starting material: (formula found on question 1)	
b) mass of hydrated metal salt used (g) *tare your 100 ml beaker and add 1.9-2.1g sample*	
c) moles of hydrated metal salt used convert grams from (b) using molar mass in question 1	
d) volume of 0.888M oxalic acid solution used *should be close to 25.0mL*	
e) moles of oxalic acid used *calculate from volume and molarity*	
f) mass of filter paper	
g) experimental yield: total mass of hydrated metal oxalate precipitate (grams) after drying by vacuum filtration. filter paper + salt mass: _______ *subtract the filter paper*	
h) identify the limiting reactant: either your starting formula in part (a) or oxalic acid *Refer to the balanced chemical equation in pre-lab quest. #3 and your moles of each reactant calculated in c and e*	
i) theoretical yield of hydrated metal oxalate product (g)	
j) percent yield of hydrated metal oxalate product	

Calculations: Show your calculations. Watch your units and report all answers with the correct number of significant figures.

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Data and Calculations

Part 2: Decomposition (Pyrolysis) of Metal Oxalate
Complete Table 2. The pyrolysis reaction occurs with near 100% yield, so the actual yield of the pyrolysis reaction should be very close to the theoretical yield you calculated for the correct reaction equation (as calculated in Question #5 of the prelab).

Table 2. Pyrolysis of Metal Oxalate

a) Weigh the empty Aluminum dish before adding the filtered product.	
b) Before pyrolysis: mass of hydrated metal oxalate (grams) *Ideally between 0.99 to 1.01 gram* Al + oxalate salt mass: _________ *subtract the Al dish*	
c) After pyrolysis: final mass of pyrolysis product (grams) Al + pyrolyzed salt mass: _________ *subtract the Al dish*	
d) theoretical mass of product in reaction **A** From prelab (quest. #5A):	
e) theoretical mass of product in reaction **B** From prelab (quest. #5B):	
f) theoretical mass of product in reaction **C** From prelab (quest. #5C):	
g) Using the above information, which pyrolysis reactions actually occurred, **A**, **B** or **C**?	
h) What is the expected chemical formula of the pyrolyzed metal salt formed?	

Calculations: Refer to your work from prelab Question #5 from your option. Watch your units and report all answers with the correct number of significant figures.