Period: _____ Name: _____ Station: _____ Computer #:_____

Lab Report: Percent Composition and Empirical Formula of Hydrate

Pre-lab Questions: Answer each of the following to be assigned a computer. Some of your answers will be used throughout the lab.

1. Differentiate between a hydrated salt and an anhydrous salt.

2. Calculate the formula weight (equal to molar mass) of H_2O. (Record in Data Table 1)

3. Calculate the formula weight of each of the following anhydrous salts. (Show Work for 1)

$CuSO_4$ _____ g/mole $NiCl_2$ _____ $CoCl_2$ _____ $CuCl_2$ _____ $MgSO_4$ _____

Experiment Objectives:

1. Find the percent composition of a hydrate salt.
2. Understand the meaning of empirical formula of a chemical compound and calculate the empirical formula of a hydrate salt.

I. PURPOSE:

II. MATERIALS:

III. SAFETY: Wear virtual goggles if working with glass, chemicals, and/or hot materials.

IV. PROCEDURE:

A) Go to the following website:

http://tinyurl.com/7l5fduh

(l is not a 1)

B) Review the Laboratory Equipment Manual.

C) Click on the "Go to Lab" button

D) Follow directions on the green virtual chalk board.

V. DATA: Record the data you collected in the lab for ONE hydrate only.

Data Table 1:

Name of selected anhydrous salt	
Formula of anhydrous salt	
Formula weight of anhydrous salt	
Formula weight of water	
Mass of crucible + cover (in grams)	'a' =
Mass of crucible + cover + sample BEFORE heating (in g)	'b' =
Mass of crucible + cover + sample AFTER heating (in g)	'c' =

VI. CALCULATIONS: Empirical Formula Calculation

1) Calculate the number of grams [w1] of the anhydrous salt you prepared. This is a simple subtraction from your data. (w1 = c – a)
2) From the number of grams of the anhydrous salt in step 1, calculate the number of moles[nsalt] of the anhydrous salt you prepared [=w1/formula weight]
3) Calculate number of grams of water [w2] in your hydrate sample. This is the difference in mass, between the hydrate and the anhydrous salt. (w2 = b – c)
4) Calculate moles of water[nwater] in your hydrate sample = w2/ formula wt. of water.
5) Calculate number of moles of water associated with 1 mole of the anhydrous salt = Number of moles of water / Number of moles of anhydrous salt. (nwater / nsalt)

REMEMBER, we cannot use part of a water molecule, so round your answer to the nearest whole number.

Show your work here. Enter your answers into the RESULTS Data Table 2.

VII. RESULTS: Write your answers from the calculation section in the table below.

Data Table 2:

Desired Value	Calculation Equation	Calculated Value
Weight of Anhydrous Salt in grams	(w1 = c-a)	
Number of moles [n_{salt}] of the anhydrous salt	[=w1/formula weight]	
Number of grams of water in grams	(w2 = b-c)	
Moles (n_{water}) of water in hydrate sample	W2/formula wt. of water	
Moles of water associated with 1 mole of the anhydrous salt		
Empirical formula for the hydrate		

***Analysis** (This is an extension to the experiment worth 5 bonus points)

Using your data above, you can determine how much water evaporated from each of the hydrated salts. This allows you to determine the percent of water that was present before evaporation in each of the hydrates. This is the **experimental percent composition of water**. Using the true empirical formulas of each hydrated salt (listed below in order from left to right on lab bench), the expected percent of water in each of the hydrated salts can be determined. This is the **actual percent composition of water**. The experimental value and the actual value of each salt can be used to determine the percent error that resulted in the lab. Use the steps and the table below to determine the percent error for each of the hydrates.

1. Calculate the mass of the hydrated salt (x). This is a simple subtraction from your data (b-a).
2. Calculate the mass of water lost as a result of heating the substance. This is also a simple subtraction from your data (b-c).
3. Calculate the experimental percent composition of water using the formula below.

   Experimental % Comp. of water = (Mass of water / Mass of Hydrate) x 100.
4. Use the true chemical formula of each hydrated salt to determine the actual percent composition of water.

   Actual % Comp. of water = (Mass of water in true formula / Mass of Hydrate) x 100.
5. Use the values from steps 3 and 4 to determine the percent error for each salt.

$$\text{Percent Error} = \frac{\text{Experimental Value} - \text{Accepted Value}}{\text{Accepted Value}} \times 100$$

Data Table 3: (Only the row of the salt tested needs to be completed.)

True Formula of Hydrate	Experimental % of water	Accepted % of water	% Error
$CuSO_4 \bullet 5H_2O$			
$NiCl_2 \bullet 6H_2O$			
$CoCl_2 \bullet 6H_2O$			
$CuCl_2 \bullet 2H_2O$			
$MgSO_4 \bullet 7H_2O$			

Show work here:

VIII. INTERPRETATIONS

A) Claim (An assertion of conclusion that answers the original question.)

- Complete the following sentences:

The empirical formula represents _____

_____

The tested hydrous salt, _____ (*chemical name*), has an empirical formula of _____

B) Evidence (Scientific data that supports the claim. The data needs to be appropriate and sufficient.)

- Complete the statements for the evidence section of the interpretation.

The experiment resulted in determining the mass lost after heating to be _____, which calculates to be _____ moles of water. Since the anhydrous salt was given it can be said that the mole ratio of water to salt is _____.

C) Reasoning (A justification that links the evidence to the claim. It shows why the data counts as evidence to support the claim by using the appropriate and sufficient scientific principles.)

- Arrange the following sentences in the best logical order to make a reasoning paragraph.

_____a) One mole of water weighs _____ grams.

_____b) Ratios of _____ can be used to compare the percentage of weight because the molar mass, _____ (*units*), is unique to each element.

_____c) Since the hydrous salt was merely heated not chemically burned, the mass that was lost is most likely due to the evaporation of _____.

_____d) Ratios of _____ can be used to compare the number of molecules because a mole is an identical counting number of _____.

End the paragraph with a concluding sentence.

_____

_____

IX. Error

1. Some experimental error exists in the performance of all labs. Describe two possible sources of error in the lab. (Calculation errors are not an acceptable answer.)

2. In an actual laboratory setting, the best method for performing this lab would be to perform the evaporation and weighing of the salt **three** times. In doing so, the goal is to end up with a constant mass. Explain why this is important. (worth 2 bonus points)