Honors Chemistry Lab #10- Hydrate Analysis

The polarity of the water molecule, which makes it a great solvent for ionic compounds, causes water molecules to cling to the structure of solid substances. When this occurs, the trapped water molecules are called water of hydration and they become an integral part of the crystal lattice structure. The crystal will be able to incorporate a definite number of moles of water per mole of the anhydrous ionic substance. This number is stated in the formula of the hydrate, as in the formulas There are many compounds that tend to absorb water vapor from the air. These compounds are said to be *hygroscopic*, and can be used as moisture-reducing agents. Other compounds absorb such large quantities of water vapor that they will dissolve in their own water of hydration, a property known as *deliquescence*. In this experiment, you will test a hygroscopic ionic compound to determine its water of hydration. Although the water molecules are securely attached to the ionic solid that you will test, they are susceptible to removal by heat. You will gently heat a sample of the compound to drive off the water of hydration. By measuring the mass of the sample before and after heating, you can determine the amount of water in the sample and calculate its water of hydration.

Materials: crucible with cover, crucible tongs, ring stand, ring, and clay triangle, Bunsen burner, magnesium sulfate, $MgSO_4 \cdot nH_2O$, copper(II) sulfate, $CuSO_4 \cdot nH_2O$, manganese(II) sulfate, $MnSO_4 \cdot nH_2O$, sodium carbonate, $Na_2CO_3 \cdot nH_2O$, balance

Procedure:

1. Obtain and wear goggles during the entire lab.

2. Measure and record the mass of a clean, dry crucible with cover. Obtain about ~3 g of the selected compound and place it in the crucible. Use a spatula to break up any large pieces of the substance by pressing the pieces against the wall of the crucible. Measure and record the mass of the crucible, cover, and compound.

3. Set up a ring stand, ring, and clay triangle for heating the sample. Rest the crucible on the clay triangle. Tip the cover slightly so that it does not fit snugly on top of the crucible. Set up a lab burner and ignite the burner away from the crucible. Adjust the burner to get a small flame.

4. Gently heat the crucible for about ten minutes. Depending on the compound that you selected, the color of the sample may change significantly as the water of hydration is driven out of the crystals.

5. Turn off the burner. Cover the crucible and allow the sample to cool for about ten minutes.

6. When the crucible is cool enough to handle safely, measure and record the mass of the crucible, cover, and contents.

7. Heat the crucible of your sample for five more minutes, allow it to cool, and measure and record its mass.

8. Continue heating the sample for five minutes at a time, until you have two mass measurements that are within about 0.050 g of each other. If time constraints force you to complete the experiment on a second day, place the crucible in an oven until you can continue your work.

9. Dispose of your sample as directed and clean your bench for inspection.

DATA TABLE:

Compound selected for analysis	
Mass of crucible and cover (g)	
Mass of crucible, cover, and hydrated sample (g)	
Mass of hydrated sample (g)	
Mass of crucible, cover, and dehydrated sample – 1st weighing (g)	
Mass of crucible, cover, and dehydrated sample – 2nd weighing (g)	
Mass of crucible, cover, and dehydrated sample – 3rd weighing (g)	
Mass of crucible, cover, and dehydrated sample – 4th weighing (g)	
Mass of dehydrated (anhydrous) sample (g)	
Mass of water evolved (g)	

DATA ANALYSIS:

1. Convert the mass of the dehydrated (anhydrous) salt into moles and show all your work.

2. Convert the mass of the water evolved into moles and show all your work.

3. The ratio of moles of the anhydrous salt to the moles of water can now be calculated by dividing the moles of the water by the moles of the anhydrous salt. You will get a number with decimals, in reality, this should be an integer. Show all work.

4. Round the number to an integer. What is the proper chemical formula and name for the compound that you tested, including the moles of hydration? See the board for an example.

5. Come see me for the know (accepted) value. Complete a percentage error computation using the decimal form of you answer in question 3 for the experimental value.

5. Explain how you determined the water of hydration for your chemical formula.

6. If you had not heated the sample long enough to remove all the water of hydration, how would your subsequent calculations have been affected? Be specific in your answer.

Please self-assess your lab report using the rubric/checklist.