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Lab 14: Formula of a Hydrate

INTRODUCTION:

A hydrate is a compound with water molecules loosely associated with it. In naming, name the compound as usual adding a prefix + hydrate. An example would be $CaSO_4 \bullet 3H_2O$. This compound would be called calcium sulfate trihydrate. $CaSO_4 \bullet 5H_2O$ would be calcium sulfate pentahydrate. The • symbol indicates there are that many water molecules attached to one molecule of the substance. In determining the molar mass, you need to include the mass of the water (s).

The water in a hydrated salt can be easily removed by heating the compound, thus making an anhydrous (without water) salt. You will determine the amount of water in the hydrated salt by weighing the compound before and after heating. You will convert the mass into moles and thus determine the molar ratio of water to anhydrous salt.

EQUIPMENT: Crucibles

MATERIALS: Hydrates of Iron (II) sulfate, copper (II) sulfate and sodium thiosulfate.

PROCEDURE:

1) Weigh three clean and dry crucibles. Record the masses.
2) Add 2 g of each of the hydrates to a crucible. Record the masses.
3) Heat the crucibles on the hot plate for 5 minutes.
4) Allow the crucible to cool and re-weigh.
5) Repeat the heating until there is no change in the mass of the crucible + hydrate.

DATA:

	($FeSO_4$)	($CuSO_4$)	($Na_2S_2O_3$)	Unknown
Mass empty:				
Mass with hydrate:				
Mass with anhydrous salt: 1st heating				
Mass with anhydrous salt: 2nd heating				
Mass of water				

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Moles of water				
Mass of anhydrous salt				
Moles of anhydrous salt				

QUESTIONS:

1) What is the formula of the hydrate in each known case?

_____

_____

_____

_____

_____

_____

_____

_____

2) Use the following sample data to determine the formula of $BeO \bullet X\ H_2O$.

Mass of hydrate = 8.61 g
Mass of water = 3.60 g

a) What is the mass of the anhydrous salt?

_____

b) What is the formula of the hydrate?

_____

c) What is the percentage composition of the hydrate? (% Be, % O and % H_2O)

_____

3) Barium chloride is 14.74% water by weight. What is the formula for the hydrated salt?

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4) What is the theoretical percentage of water in the following hydrates? Name the hydrates.

i. $NiCl_2 \bullet 6H_2O$

_____

ii. $Ca(NO_3)_2 \bullet 4H_2O$

_____

iii. $ZnSO_4 \bullet 7H_2O$

_____

5) A hydrated compound is found to have a mass of 1.632 g before heating and a mass of 1.008 g after heating. What is the experimental percentage of water in this hydrate?

_____

_____

_____

_____

6) An unknown salt: $MY \bullet X\,H_2O$ Is 10.6 % water. If "MY " has a molar mass of 150 g/ mole, what is the value of *X* (in moles)

_____

_____

_____