ChemQuest 41

Hydrates

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hour: \_\_\_\_\_

**Information: Hydrates**

A hydrate is a compound that has water infused within it. For example, CaCO3**∙**6H2O is a hydrate of calcium carbonate. There are 6 moles of water infused into each mole of CaCO3. The mole ratio of water to calcium carbonate is 6:1. If you heat a hydrate in a lab, the water will be released from the crystal. Therefore, heating a hydrate causes it to lose mass—the mass of the water. Using this information allows us to calculate the mass of a hydrate. Let’s take a look at an example problem.

Example: 8.24 g of a hydrate of CaCl2 were heated strongly. After heating, all of the water was driven out of the crystal and remaining mass was 5.00 g. What is the formula of the hydrate?

Answer: We need to calculate the moles of CaCl2 and the moles of H2O and then find the ratio.

**Step 1: Find the mass of water and of the compound.**

The mass of water was 8.24 – 5.00 = 3.24 g. (This is the mass that the crystal lost due to water being driven off.)

The mass of CaCl2 was 5.00 g. (This is the mass left after heating.)

**Step 2: Calculate the moles of water and of the compound by dividing each mass by the molar mass from the periodic table.**

Water CaCl2

Molar mass of CaCl2 from periodic table.



Molar mass of water from periodic table.

**Step 3: Find the ratio. Pick the smallest mole from your answers to step 2. Then divide each by that smallest number.**

Water CaCl2



Therefore, there are 4 waters for each CaCl2 and the formula is **CaCl2∙4H2O**.

**Critical Thinking Questions**

1. A certain hydrate of Na3PO4 was heated. Before heating, the mass was 17.2g. After intense heating the mass was 8.2g. What is the formula of the hydrate?
2. 15.01 g of a hydrate of sodium sulfate was heated. The mass decreased to 8.53 g. What was the formula of the hydrate?

**Review Questions**

1. A certain compound contains 26.35% of C, 3.29% of H and 70.35% of O. If the molecular mass of this compound is 819 amu, what is the molecular formula of the compound? (Hint: first find the empirical formula.)
2. Find the percent composition of oxygen in each of the following compounds:

a) K2O b) Ca(NO3)2 c) Al2O3 d) Li2CO3

1. What is the molecular formula of a compound that has an empirical formula of CO2 and a molar mass of 220 g/mol?
2. If 0.095 moles of NaCl are needed for a certain reaction, how many grams is this?
3. How many atoms of gold are there in one gram of gold?
4. The number of carbon monoxide (CO) molecules needed to cause a fatality in a certain room is 1.5x1021 molecules. How many grams is this?
5. How many grams of silver would you need if you had 3.05x1024 atoms of silver?
6. What will the balance read when 1.57 moles of Na2SO4 are placed on it?
7. How many molecules are there in 25 g of SiO2?
8. Which of the following has more molecules in it?

A) a container that hold 35 g of CO2 OR B) a container that holds 47 g of CF4