Copper (II) Sulfate Pentahydrate Lab

Percent Comp by Mass 80/1200 minutes name

A hydrate is an ionic compound that has a specific amount of water as part of its structure. The water is "loosely" bonded to the compound. This one has 5 molecules of water bonded to each formula unit of it. (pentahydrate = 5 water molecules per formula unit)

There are many different hydrated ionic compounds, each will hold a specific number of H_2O molecules per formula unit. (monohydrate, dihydrate, trihydrate, etc.)

When a hydrate is heated this water is released as steam. The left over, dehydrated ionic compound is an anhydrous salt. This hydrate is blue in color; the anhydrous salt is white.
When the hydrate (water) escapes as steam, you're left with just anhydrous copper (II) sulfate.

$$CuSO_4 \cdot 5H_2O_{(S)} \xrightarrow{\text{heat}} CuSO_{4(S)} + 5H_2O_{(G)}$$

Objective of the lab: Using the percent composition by mass formula, you can calculate how much water is in this hydrate, then you can measure how much water comes out of your actual compound.

PROCEDURE

1. Get equipment set up as shown by teacher. Mass the evaporating dish empty and dry. Data on page 2.

2. Put 3.00 grams of the blue hydrate ($CuSO_4 \cdot 5H_2O$) into the dish, heat the evaporating dish for 24 minutes.

3. While heating, calculate the molar mass of this compound and the percent composition by mass as well. Keep the water "whole", do not break up the water into "H" and "O" in this math.

4. After heating, cool your evaporating dish on the table for <u>4 minutes</u>, record the mass the dish with the salt.

5. When the dish is completely cooled down, sprinkle water from your fingers onto the white salt, observe.

Two important safety items:

A. Hot evaporating dishes do not look hot, but they can be skin burning hot!
B. Hot dishes can melt the top of the scales. The tops to the scales cost $25.

Cool the evaporating dish before massing the second time, don't melt the top of your scale!

	Data Table	Mass in grams	This is…
A	Mass of evaporating dish empty	grams	Mass of empty dish
B	Mass of evaporating dish + blue hydrate	grams	Dish + 3.00 g hydrate
C	After heating Mass of evaporating dish + the white salt	grams	Dish + anhydrous salt
D	Mass of just the anhydrous salt	grams	"C" minus "A"
E	Mass of the evaporated water	grams	3.00 g minus "D"

Calculate the molar mass of copper (II) sulfate pentahydrate. Then do the percent comp. by mass for the whole compound. TREAT THE WATER as a unit: Calculate for: Cu, S, O, and H_2O. Molar mass has UNITS.

Molar mass

$\underline{CuSO_4 \cdot 5H_2O}$

Cu

S

O

H_2O

% Comp by mass

Cu

S

O

H_2O

18 Lab Questions - do on white paper - SHOW ALL WORK + Formulas

1. State the % comp by mass of water in $CuSO_4 \cdot 5H_2O$ (you already did this on page 2)

2. Calculate % comp by mass of water in your 3.00 grams of the $CuSO_4 \cdot 5H_2O$
   **** You MUST write the % comp formula from the reference table first

3. Calculate your percent error between your measured percent comp water and the actual percent comp by mass of water in the compound. (SF and sign required)

4. Calculate the % comp by mass of anhydrous salt left over in your evaporating dish from the original 3.00 grams of compound that you started with.
   **** You MUST write the % comp formula from the reference table first

5. What is the mass of 5.00 moles of $CuSO_4 \cdot 5H_2O$?

6. What is the mass of 5 formula units of $CuSO_4 \cdot 5H_2O$?

7. The $CuSO_{4(S)}$ anhydrous salt, which is white, turns blue again when you dripped some water into the evaporating dish at the end of this lab experiment. Explain what happened.

For 8-12 Show work for % comp by mass for all species, not just water (sum to 100%)
Round your answer to the nearest WHOLE NUMBER.

8. Calculate the % comp by mass for H_2O in magnesium nitrate hexahydrate.

9. Calculate the % comp by mass for H_2O in barium hydroxide octahydrate.

10. Calculate the % comp by mass for H_2O in mercury (I) nitrate monohydrate.

11. Calculate the % Comp by mass of H_2O in vanadium (V) bromide dihydrate.

12. Of 189 grams of vanadium (V) bromide dihydrate, how many grams are bromine?

13. Skip

14. Of 125.0 grams of vanadium (V) bromide dihydrate, how many grams are vanadium?

Keep going up to #19 on the next page.

15. How many formula units are in your original 3.00 grams of $CuSO_4 \cdot 5H_2O$?

16. How many water molecules were in your original 3.00 grams of $CuSO_4 \cdot 5H_2O$?

17. Define Anhydrous Salt

18. The formula for chlorophyll is: $C_{55}H_{72}O_5N_4Mg$ - what is the molar mass of chlorophyll?

19. What is the percent comp by mass of hydrogen in chlorophyll?

page	This lab requires	points
Cover	Title, short intro paragraph	1 + 2 = 3
2	The 18 lab questions	18
Last	Conclusion What did you measure? What did you calculate? What was your percent error and why did you get that? What can you conclude about this lab experiment?	4
This lab is due on		25