

Copper (II) Sulfate Pentahydrate Lab

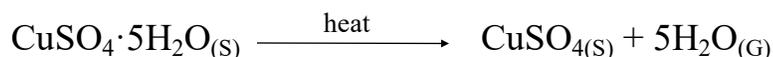
Percent Comp by Mass 80/1200 minutes name _____

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 particular one has 5 molecules of water bonded to each formula unit of it (penta). (pentahydrate = 5 water molecules per formula unit)

Different hydrated ionic compounds will have different numbers of water molecules that normally bond to them, but the number of water molecules is specific for each given hydrate.

When a hydrate is heated this water is released as steam. The left over, dehydrated ionic compound is now called an anhydrous salt. This hydrate is blue in color, the anhydrous salt is white.

When the hydrate escapes as steam, you’re left with just anhydrous copper (II) sulfate.



Objective of this 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 ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) into the dish, heat the evaporating dish for 14 minutes.
3. While heating for 16 minutes, calculate the molar mass of this compound on the next page. Then do the percent composition by mass for this compound as well. The water will be kept “whole”, do not do “H” and “O” separately in molar mass.
4. After heating, cool your evaporating dish on the table for 4 minutes, record the mass the dish with the salt.
5. Re-heat for four more minutes. Cool down for 4 minutes, and then mass it again. The mass of the dish/salt may have decreased (or not). We will discuss that.
6. When the dish is completely cooled down, sprinkle water from your fingers onto the white salt, observe.

Two very important safety items:

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

Please say out loud to your lab partner:

**“I promise to cool my evaporating dish before putting them on the scales,
AND before adding water at the end”.**

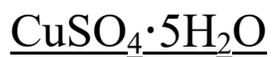
Save the left over wet compound in the beaker provided next to the sink.

DO NOT put the leftover compound into the sink drain!

	Data Table	Mass in grams	This is...
A	Mass of evaporating dish empty		Mass of empty dish
B	Mass of evaporating dish + blue hydrate		Dish + 3.00 g hydrate
C	First Mass of evaporating dish + the white salt		Dish + dehydrated salt
D	Second Mass of evaporating dish + the white salt		Dish + dehydrated salt
E	Mass of just the anhydrous salt		"D" minus "A"
F	Mass of the evaporated water		3.00 g minus "E"

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 H₂O. Molar mass has UNITS.

Molar mass



% Comp by mass

Cu

Cu

S

S

O

O

H₂O

H₂O

Lab Questions - do on loose leaf paper - SHOW ALL WORK + Formulas

1. State the % comp by mass of water in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (AV) (you already did this on page 2)
2. Calculate % comp by mass of water in your 3.00 grams of the $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (**** You MUST write the % comp formula from the reference table first) (MV)
3. Calculate the 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. Copy this table into your questions, fill it in, with units.

	Species	Mass of one mole (with unit)	Mass of one particle (with unit)
A	Cu		
B	S		
C	O		
D	H_2O		
E	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$		

Copy this table into your questions on white paper

5. What is the mass of 5 moles of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$?
6. What is the mass of 5 formula units of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$?
7. The $\text{CuSO}_4(\text{s})$ anhydrous salt, which is white, turn blue again when you dripped some water into the evaporating dish at the end of this lab experiment. What happened?
For 8-12 you must show work for molar mass and ALL percent comp by mass, not just for water)
8. Calculate the % comp by mass for water in magnesium nitrate hexahydrate. (round to whole number)
9. Calculate the % comp by mass for water in barium hydroxide octahydrate. (round to whole number)
10. Calculate the % comp by mass for water in mercury (I) nitrate monohydrate. (round to whole number)
11. Calculate the % Comp by mass of water in vanadium (V) bromide dihydrdrate. (round to whole number)
12. How many formula units of copper (II) sulfate pentahydrate are in 3.00 grams of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$?
13. Skip this one
14. Define Anhydrous Salt
15. Looking back to # 11, if you had 125.0 grams of vanadium (V) bromide dihydrate, how many grams would be just vanadium?
16. Using this same vanadium compound, how many of the 125.0 grams would be just bromine?

page	This lab requires	points
Cover	Title, short intro paragraph	1 + 1 = 2
2	The 15 lab questions	15
Last	<p>Conclusion</p> <ol style="list-style-type: none"> 1. Write a short summary of what you did, and what the point of the lab experiment was. (use objective on front page of lab) 2. State specifically: <ol style="list-style-type: none"> a. How many grams of hydrate you started with b. How many grams of salt you were left with c. How many grams of water evaporated away d. What was your percent comp by mass of water in the compound you used. e. What was your percent error, compared to your AV, and tell why you made this error. 3. Tell how you would/could use percent comp by mass formula, if you had a periodic table and any formula, say, for something big like chlorophyll, with formula of: $C_{55}H_{72}O_5N_4Mg$ <p>Make sure you use <u>your data</u>: do not hint at anything, say what you mean and mean what you say, and make sure it's clear. Read it out loud to be sure. This conclusion should be perfect!</p>	8
	This lab is due on _____	25 total points