

Determining Formulas of Hydrated Compounds

- Similar solution approach to other problems
- In the lab, heat hydrated copper sulfate and collect these data:



- What is x for the number of moles of water?

Need mass of water first, g

Determine Mass of Water

Mass of hydrated compound	1.023 g
Mass of anhydrous compound	<u>- 0.654 g</u>
Mass of water	0.369 g

Solution is just like for determining empirical formulas (g to mol to mol ratio to simplest whole number ratio to formula)

Calculate Moles

- $0.369 \text{ g H}_2\text{O} \cdot \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} = 0.0205 \text{ mol H}_2\text{O}$

- $0.654 \text{ g CuSO}_4 \cdot \frac{1 \text{ mol CuSO}_4}{159.6 \text{ g CuSO}_4} = 0.00410 \text{ mol CuSO}_4$

$$\frac{0.0205 \text{ mol H}_2\text{O}}{0.00410 \text{ CuSO}_4} = \frac{5 \text{ mol H}_2\text{O}}{1 \text{ mol CuSO}_4}$$

- Formula is $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ copper sulfate pentahydrate

Determine Mole Ratios and Empirical Formula

- Find simplest whole number mole ratio

$$\frac{0.0205 \text{ mol } \underline{H_2O}}{0.00410 \text{ CuSO}_4} = \frac{5 \text{ mol } \underline{H_2O}}{1 \text{ mol CuSO}_4}$$

- Write the empirical formula

$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ copper sulfate pentahydrate

Summary

- Determine the mass percent or percent composition of each element of a molecule using the molecular formula
- Determine an empirical formula using percent composition ($\% \rightarrow g \rightarrow \text{mol} \rightarrow \text{mol ratios}$).
- Determine a molecular formula using molar mass or molecular weight.

End