

3 • Molecules and Compounds

HYDRATES & COMPOSITION PROBLEMS

1. Cupric chloride, CuCl_2 , when heated to 100°C is dehydrated. If 0.235 g of $\text{CuCl}_2 \cdot x \text{H}_2\text{O}$ gives 0.185 g of CuCl_2 on heating, what is the value of x ?
2. The “alum” used in cooking is potassium aluminum sulfate hydrate, $\text{KAl}(\text{SO}_4)_2 \cdot x \text{H}_2\text{O}$. To find the value of x , you can heat a sample of the compound to drive off all of the water and leave only $\text{KAl}(\text{SO}_4)_2$. Assume you heat 4.74 g of the hydrated compound and that the sample loses 2.16 g of water. What is the value of x ?
3. If “Epsom salt,” $\text{MgSO}_4 \cdot x \text{H}_2\text{O}$ is heated to 250°C , all the water of hydration is lost. On heating a 1.687-g sample of the hydrate, 0.824 g of MgSO_4 remains. What is the formula of Epsom salt?
4. When $\text{CaSO}_4 \cdot x \text{H}_2\text{O}$ is heated, all of the water is driven off. If 34.0 g of CaSO_4 (molar mass = 136) is formed from 43.0 g of $\text{CaSO}_4 \cdot x \text{H}_2\text{O}$, what is the value of x ?
5. Citric acid is composed of only carbon, hydrogen, and oxygen. When a 0.5000 g sample of citric acid was burned, it produced 0.6871 g of CO_2 and 0.1874 g of H_2O . The molar mass of the compound is 192 g/mol. What are the empirical and molecular formulas of citric acid?
6. A 0.537 g sample of a substance containing only carbon, hydrogen, and oxygen was burned in air to produce 1.030 g of CO_2 and 0.632 g H_2O . What is the percent composition of the original substance? What is the empirical formula of the original substance?