Unit 8 - Topic 6
Molecular Math

Percent Composition

Determine the percentage composition of each of the compounds below:

1. $KMnO_4$

K   = _____

Mn   = _____

O   = _____

2. $Mg(NO_3)_2$

Mg   = _____

N   = _____

O   = _____

Percent Composition of Hydrates – A hydrate is a compound with water molecules loosely bonded to its crystal structure. The water is in a specific ratio to each formula unit of the salt. For example, the formula $CuSO_4 \bullet 5H_2O$ indicates there are five water molecules for every one formula unit of $CuSO_4$. Answer the questions below:

3. What percentage of water is found in $CuSO_4 \bullet 5H_2O$?

4. A 5.0 g sample of a hydrate of $BaCl_2$ was heated and only 4.3 g of the anhydrous (without water) salt remained. What percentage of water was in the hydrate?

Determining Empirical & Molecular Formulas

What is the empirical formula (lowest whole number ratio) of the compounds below?

5. 52.7% potassium, 47.3% chlorine

6. A major textile dye manufacturer developed a new yellow dye. The dye has a percent composition of 75.95% C, 17.72% N, and 6.33% H by mass with a molar mass of about 240 g/mol. Determine the molecular formula of the dye.

Molecular Math Drill

Mole Calculations

1. What is the gram formula mass of $Ca_3(PO_4)_2$?
   (1) 135 g/mol
   (2) 215 g/mol
   (3) 278 g/mol
   (4) 310 g/mol

2. What is the total mass in grams of 0.75 mole of SO_2?
   (1) 16 g
   (2) 24 g
   (3) 32 g
   (4) 48 g

3. A compound has a gram formula mass of 56 grams per mole. What is the molecular formula of this compound?
   (1) CH_2
   (2) C_2H_4
   (3) C_3H_6
   (4) C_4H_8

Empirical Formula

4. What is the molecular formula of a compound that has a molecular mass of 54 and the empirical formula C_2H_3?
   (1) C_2H_3
   (2) C_4H_6
   (3) C_6H_9
   (4) C_8H_{12}

5. What is the molecular formula of a compound with the empirical formula P_2O_5 and a gram-molecular mass of 284 grams?
   (1) P_2O_5
   (2) P_5O_2
   (3) $P_{10}O_4$
   (4) P_4O_{10}

Percent by Mass Drill

6. The percent by mass of calcium in the compound calcium sulfate ($CaSO_4$) is approximately
   (1) 15%
   (2) 29%
   (3) 34%
   (4) 47%

7. What is the percent by mass of nitrogen in the compound NH_4NO_3 (formula mass = 80.)?
   (1) 5.7%
   (2) 18%
   (3) 29%
   (4) 35%

8. What is the percent by mass of sulfur in sulfur dioxide?
   (1) 32
   (2) 33
   (3) 50
   (4) 67

9. A hydrate is a compound that includes water molecules within its crystal structure. During an experiment to determine the percent by mass of water in a hydrated crystal, a student found the mass of the hydrated crystal to be 4.10 grams. After heating to constant mass, the mass was 3.70 grams. What is the percent by mass of water in this crystal?
   (1) 90.%
   (2) 11%
   (3) 9.8%
   (4) 0.40%