Percent Composition by Mass
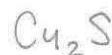
Percent Composition: the percent by ___mass___ of each element in a compound.

- According to the law of ___Definite___ ___Proportions___, a given chemical compound always contains the exact same elements in the exact same ratio by ___mass___.

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$$\% \text{ compostion of an element} = \frac{\textbf{total mass of element in compound}}{\textbf{total mass of compound}} \times 100$$

Guided Practice

Cu_2S

1. Find the percentage composition of each element in the compound copper (I) sulfide.

$$\% \, Cu = \frac{2 \times 63.55}{159.16} \times 100 = \boxed{79.86\% \, Cu}$$

$$\% \, S = \frac{32.06}{159.16} \times 100 = \boxed{20.14\% \, S}$$

2. Find the mass percentage of water in sodium carbonate decahydrate, $Na_2CO_3 \cdot 10H_2O$, which has a molar mass of 286.15 g/mol.

$$\% \, H_2O = \frac{10 \times 18.016}{286.15} \times 100 = \boxed{62.962\% \, H_2O}$$

3. When ammonia, NH_3, is formed, 1.0 gram of hydrogen reacts with about 5.0 grams of nitrogen. How much nitrogen would be needed to react with 2.5 grams of hydrogen in the production of ammonia?

$$\frac{1 \, g \, H_2}{5 \, g \, N_2} = \frac{2.5 \, g \, H_2}{x} \Rightarrow x = 5 \times 2.5 = \boxed{12.5 \, g \, N_2}$$

4. Lake Superior is the largest lake in North America and contains about 1.2×10^{16} kg of water. What mass of hydrogen is contained in Lake Superior?

   a. 6.0×10^{15} kg
   b. 1.1×10^{16} kg
   c. 1.3×10^{15} kg
   d. 1.2×10^{16} kg

$$\frac{2 \times 1.008}{18.016} \times 100 \approx \frac{2}{18} \times 100 \approx 10\%$$

$$\left(1.2 \, E \, 16 \, kg\right) \times 0.1 = 1.2 \, E \, 15 \, kg$$

5. For a 150 g sample of glucose, $C_6H_{12}O_6$, there is 60 g of carbon. How many grams of carbon are there for a 300 g sample of glucose?

   a. 30 g
   b. 60 g
   c. 90 g
   d. 120 g

$$\frac{60 \, g \, C}{150 \, g \, C_6H_{12}O_6} = \frac{x}{300 \, g \, C_6H_{12}O_6}$$

$$x = \frac{60 \cdot \overset{2}{\cancel{300}}}{\cancel{150}} = 120$$