Percent Composition and Empirical Formula

1. What is the percent composition of all the elements in $Al_2(SO_4)_3$?

2. A compound contains 36.5% Na, 25.4% S, and 38.1% O. Find its empirical formula.

3. Find the empirical formula of a compound consisting of 53.7% iron and 46.3% sulfur.

4. Determine the empirical formula for the following compounds:

a. A compound containing 0.0130 mol carbon, 0.0390 mol hydrogen, and 0.0065 mol oxygen.

b. A compound containing 72.7% magnesium and 27.8% nitrogen by mass.

c. Glucose contains 40% carbon, 6.7% hydrogen, and 53.3% oxygen by mass.

Percent Composition and Empirical Formula

Answers

1. What is the percent composition of all the elements in $Al_2(SO_4)_3$?

Al: 2 x 26.98 amu = 53.96 amu   Al: 53.96 amu/ 341.1 amu = 15.77%

S: 3 x 32.06 amu = 96.18 amu   S: 96.18 amu/ 341.1 amu = 28.11%

O: 12 x 16 amu = 192 amu   O: 192 amu/ 341.1 amu = 56.12%

Mass of $Al_2(SO_4)_3$ = 53.96 amu + 96.18 amu + 192 amu = 342.1 amu

2. A compound contains 36.5% Na, 25.4% S, and 38.1% O. Find its empirical formula.

Na: 36.5 g /23 g mol^{-1} = 1.59 mol/0.79 mol → 2

S: 25.4 g /32 g mol^{-1} = 0.79 mol/0.79 mol → 1

O: 38.1 g /16 g mol^{-1} =2.38 mol/0.79 mol → 3

The empirical formula is Na_2SO_3

3. Find the empirical formula of a compound consisting of 53.7% iron and 46.3% sulfur.

Fe: 53.7 g /56 g mol^{-1} = 0.959 mol/0.959 mol → 1 x 2 = 2

S: 46.3 g /32 g mol^{-1} = 1.45 mol/0.959 mol → 1.5 x 2 = 3

The empirical formula is Fe_2S_3

4. Determine the empirical formula for the following compounds:

a. A compound containing 0.0130 mol carbon, 0.0390 mol hydrogen, and 0.0065 mol oxygen.

C: 0.0130 mol/0.0065 mol = 2

H: 0.0390 mol/0.0065 mol = 6

O: 0.0065 mol/0.0065 mol = 1

The empirical formula is C_2H_6O

b. A compound containing 72.7% magnesium and 27.8% nitrogen by mass.

Mg: 72.7 g /24.31 g mol^{-1} = 2.97 mol/1.984 mol → 1.5 x 2 = 3

N: 27.8 g /14.01 g mol^{-1} = 1.984 mol/1.984 mol → 1 x 2 = 2

The empirical formula is Mg_3N_2

c. Glucose contains 40% carbon, 6.7% hydrogen, and 53.3% oxygen by mass.

C: 40 g /12.01 g mol^{-1} = 3.331 mol/3.331 mol → 1

H: 6.7 g /1.01 g mol^{-1} = 6.334 mol/3.331 mol → 2

O: 53.3 g /16 g mol^{-1} = 3.331 mol/3.331 mol → 1

The empirical formula is CH_2O.