The COMPLETE Chemistry Guide to MATTER ATOMIC STRUCTURE EMPIRICAL AND MOLECULAR FORMULAS

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FINDING THE MOLECULAR FORMULA

EXAMPLE 1

What is the molecular formula of a compound that is 34.95% C, 6.844% H, 13.59% N and 46.56% O? The molecular weight of this compound is 210 g/mol.

Recall that to find the molecular formula we first need to find the empirical formula.

STEP 1 Change percentages to grams.

34.95 % C = 34.95 g C 6.844 % H = 6.844 g H 13.59 % N = 13.59 g N 46.56 % O = 46.56 g O

STEP 2 Convert values in grams to moles using the molar mass of each element which is found on the periodic table.

$$\frac{34.95\text{ g C}}{}\left|\frac{1\text{ mol C}}{12.01\text{ g C}}\right. = 2.910074938\ 1\text{ mol C} \qquad \frac{6.844\text{ g H}}{}\left|\frac{1\text{ mol H}}{1.008\text{ mol H}}\right. = 6.78968254\text{ mol H}$$

$$\frac{13.59\text{ g N}}{}\left|\frac{1\text{ mol N}}{14.01\text{ g N}}\right. = 0.9700214133\text{ mol N} \qquad \frac{46.56\text{ g O}}{}\left|\frac{1\text{ mol O}}{16.00\text{ g O}}\right. = 2.91\text{ mol O}$$

STEP 3 Divide each by the smallest moles. In this case the smallest is N.

$$\frac{2.910074938\ 1\text{ mol C}}{0.9700214133} = 3 \qquad \frac{6.78968254\text{ mol H}}{0.9700214133} = 6.9995$$

↑ Round up to a whole number

$$= 7$$

$$\frac{0.9700214133\text{ mol N}}{0.9700214133} = 1 \qquad \frac{2.91\text{ mol O}}{0.9700214133} = 2.9999$$

↑ Round up to a whole number

$$= 3$$

These are the potential subscripts for the empirical formula: $C_3H_7N_1O_3$

STEP 4 Write empirical formula with only whole numbers. Since all subscripts are whole numbers, we found the empirical formula.

Empirical Formula: $C_3H_7N_1O_3$