

# Percent Composition, Empirical Formula, & Molecular Formula

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1. A compound containing 5.9265% H and 94.0735% O has a molar mass of 34.01468 g/mol. Determine the empirical and molecular formula of this compound.
2. What is the molecular formula of a compound composed of 25.9% nitrogen and 74.1% oxygen with a molecular mass of 324 amu?
3. What is the molecular formula of a compound comprising 36.4% carbon, 15.2% hydrogen, and 48.4% oxygen with a molecular mass of 132 amu?
4. What is the molecular formula of a compound that is 13.33% carbon, 4.44% hydrogen, 46.67% nitrogen, and 35.56% oxygen with a molar mass of 360 amu?

# Percent Composition, Empirical Formula, & Molecular Formula

## Answers

1. A compound containing 5.9265% H and 94.0735% O has a molar mass of 34.01468 g/mol. Determine the empirical and molecular formula of this compound.

$$\text{Moles of H} = 5.9265 \text{ g} / 1.01 \text{ g/mol} = 5.87 \text{ mol} / 5.87 \text{ mol} = 1$$

$$\text{Moles of O} = 94.0735 \text{ g} / 16.00 \text{ g/mol} = 5.88 \text{ mol} / 5.88 \text{ mol} = 1$$

$$\text{Empirical formula mass} = 1 \times 1.01 \text{ g/mol} + 1 \times 16.00 \text{ g/mol} = 17.01 \text{ g/mol}$$

$$\text{Ratio} = 34.01468 \text{ g/mol} / 17.01 \text{ g/mol} = 2$$

$$\text{Empirical formula} = \text{HO}$$

$$\text{Molecular formula} = (\text{HO})_2 = \text{H}_2\text{O}_2$$

2. What is the molecular formula of a compound composed of 25.9% nitrogen and 74.1% oxygen with a molecular mass of 324 amu?

$$\text{Moles of N} = 25.9 \text{ g} / 14 \text{ g/mol} = 1.85 \text{ mol} / 1.85 \text{ mol} = 1 \times 2 = 2$$

$$\text{Moles of O} = 74.1 \text{ g} / 16 \text{ g/mol} = 4.63 \text{ mol} / 1.85 \text{ mol} = 2.5 \times 2 = 5$$

$$\text{Empirical formula mass} = 2 \times 14 \text{ g/mol} + 5 \times 16 \text{ g/mol} = 108 \text{ g/mol}$$

$$\text{Ratio} = 324 \text{ g/mol} / 108 \text{ g/mol} = 3$$

$$\text{Empirical formula} = \text{N}_2\text{O}_5$$

$$\text{Molecular formula} = (\text{N}_2\text{O}_5)_3 = \text{N}_6\text{O}_{15}$$

3. What is the molecular formula of a compound comprising 36.4% carbon, 15.2% hydrogen, and 48.4% oxygen with a molecular mass of 132 amu?

$$\text{Moles of C} = 36.4 \text{ g} / 12.01 \text{ g/mol} = 3.03 \text{ mol} / 3.03 \text{ mol} = 1$$

$$\text{Moles of H} = 15.2 \text{ g} / 1.01 \text{ g/mol} = 15.08 \text{ mol} / 3.03 \text{ mol} = 5$$

$$\text{Moles of O} = 48.4 \text{ g} / 16.00 \text{ g/mol} = 3.03 \text{ mol} / 3.03 \text{ mol} = 1$$

$$\text{Empirical formula mass} = 1 \times 12.01 \text{ g/mol} + 5 \times 1.01 \text{ g/mol} + 1 \times 16.00 \text{ g/mol} = 33 \text{ g/mol}$$

$$\text{Ratio} = 132 \text{ g/mol} / 33 \text{ g/mol} = 4$$

$$\text{Empirical formula} = \text{CH}_5\text{O}$$

$$\text{Molecular formula} = (\text{CH}_5\text{O})_4 = \text{C}_4\text{H}_{20}\text{O}_4$$

4. What is the molecular formula of a compound that is 13.33% carbon, 4.44% hydrogen, 46.67% nitrogen, and 35.56% oxygen with a molar mass of 360 amu?

$$\text{Moles of C} = 13.33 \text{ g} / 12.01 \text{ g/mol} = 1.11 \text{ mol} / 1.11 \text{ mol} = 1$$

$$\text{Moles of H} = 4.44 \text{ g} / 1.01 \text{ g/mol} = 4.40 \text{ mol} / 1.11 \text{ mol} = 4$$

$$\text{Moles of N} = 46.67 \text{ g} / 14.00 \text{ g/mol} = 3.33 \text{ mol} / 1.11 \text{ mol} = 3$$

$$\text{Moles of O} = 35.56 \text{ g} / 16.00 \text{ g/mol} = 2.22 \text{ mol} / 1.11 \text{ mol} = 2$$

$$\text{Empirical formula mass} = 1 \times 12.01 \text{ g/mol} + 4 \times 1.01 \text{ g/mol} + 3 \times 14.00 \text{ g/mol} + 2 \times 16.00 \text{ g/mol} = 90 \text{ g/mol}$$

$$\text{Ratio} = 360 \text{ g/mol} / 90 \text{ g/mol} = 4$$

$$\text{Empirical formula} = \text{CH}_4\text{N}_3\text{O}_2$$

$$\text{Molecular formula} = (\text{CH}_4\text{N}_3\text{O}_2)_4 = \text{C}_4\text{H}_{16}\text{N}_{12}\text{O}_8$$