Basic Chemistry Concepts

Problems Based on Conversion Between Empirical Formula and Molecular Formula

Problem 1

The empirical formula of a compound is CH_2. Its molar mass is 56 g/mol. Determine the molecular formula of the compound.

Problem 2

A compound has an empirical formula of NO_2 and a molar mass of 92 g/mol. Calculate the molecular formula.

Problem 3

The empirical formula of a compound is CH and its molar mass is 78 g/mol. Find the molecular formula of the compound.

Problem 4

A compound has an empirical formula of C_2H_5O and a molar mass of 90 g/mol. Determine the molecular formula.

Problem 5

A compound has an empirical formula of $C_3H_4O_3$. The molar mass of the compound is 176 g/mol. Calculate the molecular formula.

Problem 6

The empirical formula of a compound is P_2O_5 and its molar mass is 283.89 g/mol. Determine the molecular formula.

Answer Key

Problem 1

Empirical Formula: CH_2

- Empirical formula mass: 12.01 (C) + 2 × 1.008 (H) = 14.026 g/mol
- Molecular formula mass: 56 g/mol
- Factor = Molecular formula mass / Empirical formula mass

$$\text{Factor} = \frac{56}{14.026} \approx 4$$

- Molecular formula: $(CH_2)_4 = C_4H_8$

Problem 2

Empirical Formula: NO_2

- Empirical formula mass: 14.01 (N) + 2 × 16.00 (O) = 46.01 g/mol
- Molecular formula mass: 92 g/mol
- Factor = Molecular formula mass / Empirical formula mass

$$\text{Factor} = \frac{92}{46.01} \approx 2$$

- Molecular formula: $(NO_2)_2 = N_2O_4$

Problem 3

Empirical Formula: CH

- Empirical formula mass: 12.01 (C) + 1.008 (H) = 13.018 g/mol
- Molecular formula mass: 78 g/mol
- Factor = Molecular formula mass / Empirical formula mass

$$\text{Factor} = \frac{78}{13.018} \approx 6$$

- Molecular formula: $(CH)_6 = C_6H_6$

Problem 4

Empirical Formula: C_2H_5O

- Empirical formula mass: 2 × 12.01 (C) + 5 × 1.008 (H) + 16.00 (O) = 45.068 g/mol
- Molecular formula mass: 90 g/mol
- Factor = Molecular formula mass / Empirical formula mass

$$\text{Factor} = \frac{90}{45.068} \approx 2$$

- Molecular formula: $(C_2H_5O)_2 = C_4H_{10}O_2$

Problem 5

Empirical Formula: $C_3H_4O_3$

- Empirical formula mass: 3 × 12.01 (C) + 4 × 1.008 (H) + 3 × 16.00 (O) = 88.056 g/mol
- Molecular formula mass: 176 g/mol
- Factor = Molecular formula mass / Empirical formula mass

$$\text{Factor} = \frac{176}{88.056} \approx 2$$

- Molecular formula: $(C_3H_4O_3)_2 = C_6H_8O_6$

Problem 6

Empirical Formula: P_2O_5

- Empirical formula mass: 2 × 30.97 (P) + 5 × 16.00 (O) = 141.94 g/mol
- Molecular formula mass: 283.89 g/mol
- Factor = Molecular formula mass / Empirical formula mass

$$\text{Factor} = \frac{283.89}{141.94} \approx 2$$

- Molecular formula: $(P_2O_5)_2 = P_4O_{10}$