

Empirical Formula: Assignment II

“Empirical” means “based only on observation and measurement”.

Empirical formula is determined from experimental analysis of the compound in terms of its component elements.

(NOTE: No knowledge of how the atoms are linked together in the compound is required)

1. A sample of boron and hydrogen contains 6.444 g of B and 1.803g of H. The molar mass is 30 g mol^{-1} . What is its molecular formula? [Answer: B_2H_6]

2. Allicin is responsible for the characteristic smell of garlic. An analysis of the compound gives the following percent composition by mass.

C	H	S	O
44.4%	6.21%	39.5%	9.86%

Calculate its empirical formula. What is its molecular formula given that its molar mass is 162 g mol^{-1} ?

3. The molar mass of caffeine is $194.19 \text{ g mol}^{-1}$. Is the molecular formula of caffeine $\text{C}_4\text{H}_5\text{N}_2\text{O}$ or $\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$?

4. Peroxyacetyl nitrate, PAN, is one of the components of smog. It is a compound of C, H, N and O. Determine the percent composition of oxygen and the empirical formula from the following percent composition by mass:

C	H	N
19.8%	2.50%	11.6%

5. When 0.273g of Mg is heated strongly in a nitrogen, N_2 atmosphere, a chemical reaction occurs. The product of the reaction weighs 0.378 g. Calculate the empirical formula of the compound containing Mg and N. Name the compound. [Ans: Mg_3N_2]

6. Carbohydrates are compounds containing C, H and O in which the hydrogen to oxygen ratio is 2:1. A certain carbohydrate contains 40.0 % carbon by mass. Calculate the empirical and molecular formulas of the compound if the approximate molar mass is 178 g mol^{-1} .
[Ans: Empirical formula = CH_2O . Molecular formula = $\text{C}_6\text{H}_{12}\text{O}_6$]

7. Analysis of a metal chloride MCl_3 shows that it contains 67.2 % chlorine by mass. Calculate the molar mass of M and identify it. [Ans: Molar mass = 0.633, element = chromium]

8. Myoglobin stores oxygen for metabolic processes in muscle. Chemical analysis shows that it contains 0.34 % of iron by mass. What is the molar mass of myoglobin? (There is one Fe atom per molecule) [Ans: Molar mass = $1.6 \times 10^4 \text{ g mol}^{-1}$]

9. Zircon, a diamond like mineral contains by mass the following:

34.91 % O 15.32 % Si 49.76 % Zr

What is the empirical formula of zircon?

10. Resocinal, a compound used to manufacture resins and drugs, is by mass:

65.44 % C 5.49 % H 29.06 % O

The molar mass of the compound is 110 g mol^{-1} , determine its empirical and molecular formula.