

Empirical Formula: The simplest formula for a compound-- simplest whole number ratio. (fully reduced.)

For example: NaCl , CH_2 , H_2O , NH_3

Molecular Formula: Actual formula for the molecule.

- Sometimes the molecular formula and the empirical formula of a compound are the same.
Ex: A water molecule is H_2O . Water's empirical formula is also H_2O (fully reduced.)
- However, sometimes the molecular formula of a compound is a multiple of its empirical formula.
Ex: The molecular formula of ethane gas is C_2H_6 , but its empirical formula is CH_3
Ex: The molecular formula of benzene is C_6H_6 , but its empirical formula is CH .

Practice Problems:

- 1) A compound has an empirical formula of CH_2 . The molar mass of the compound is 56.1 g/mole. What is the compound's molecular formula?

HINT: **Step 1:** What is the molar mass of just the empirical formula? _____

Step 2: Find out what multiple the molecular formula is to the empirical formula. To do so, plug in:

$$\text{multiple} = \frac{\text{molar mass of molecular formula}}{\text{molar mass of empirical formula}} =$$

Step 3: multiply the empirical formula by this multiple. Write molecular formula.

- 2) Glucose, a natural sugar found in fruit, has the empirical formula CH_2O and its molar mass is 180.2 g/mol. What is the molecular formula of glucose?
- 3) The compound diethyl maleate, used as an additive and intermediate for plastics, pigments, pharmaceuticals, and agricultural products, has the empirical formula of $\text{C}_2\text{H}_3\text{O}$ and molar mass 172 g/mole. What is its molecular formula?
- 4) It is experimentally determined that a sample of the stimulant caffeine contains 49.5% C, 5.15% H, 28.9% N, and 16.5% O.
- a) What is the empirical formula of caffeine?

- b) The molar mass of caffeine is 195 g/mole. What is caffeine's molecular formula?