NS E4 (pg 1 of 1) Empirical & Molecular Formulas

Name_____Per___

Beyond Empirical Formulas – Molecular Formulas for Molecular compounds

As you know, the chemical formulas for ionic compounds are always written in lowest whole number ratio, however, molecular compounds are not always written in the lowest whole number ratios. We often used formaldehyde CH_2O and sugar $C_6H_{12}O_6$ as an example. The formula for formaldehyde (that stinky chemical used to preserve dead animals) is CH_2O and this is both a molecular and empirical formula for this chemical. For sugar, the actual molecule is $C_6H_{12}O_6$ yet, the lowest whole number ratio of this particular combination of carbon, hydrogen and oxygen, i.e. the empirical formula is CH_2O.

Sample Problem:

Determine the empirical formula for some compound that was analyzed to be 1.33 g of carbon, 0.22 g of hydrogen, and 1.78 g of oxygen. Determine the molecular formula for this compound if the molar mass was measured and found to be 180 g/mole.

- First, change to moles

$$1.33g \times \frac{1mol}{12.0g} = 0.111molC$$

$$0.22g \times \frac{1mol}{1.01g} = 0.218molH \text{ = 0.111 mole}$$

$$1.78g \times \frac{1mol}{16.0g} = 0.111molO$$

- Proceed to step 2.
  - C $\frac{0.111molC}{0.111molC} = 1C$
  - H $\frac{0.218}{0.111} = 1.96 \sim 2H$ *(close enough to 2)*
  - O $\frac{0.111}{0.111} = 1\ O$ Voilà. The empirical formula is CH_2O

- To determine the molecular formula, first calculate the molar mass of the empirical formula
  - For CH_2O molar mass = 30 g/mole

- Then divide the molar mass given in the problem by the molar mass of the empirical formula
  - $\frac{180}{30} = 6$
  - Therefore when the factor of 6 is distributed through the empirical formula CH_2O
  - Voilà. The empirical formula converts to $C_6H_{12}O_6$