**Empirical Formula by Combustion**

1. 3.45 g of an organic compound containing carbon, hydrogen and oxygen is combusted in air producing 6.60 g of carbon dioxide and 4.05 g of water.
   1. Calculate the empirical formula
   2. Determine the molecular formula if the molecular formula mass is 138.1 g mol-1.
2. Butyric acid, containing C, H, and O, is a component of rancid butter and has a vile stench. Burning 0.440 g of butyric acid in excess oxygen yields 0.882 g of CO2 and 0.360 g of H2O as the only products. What is the empirical formula and the molecular formula of butyric acid (molar mass equals 88 g mol-1)?
3. Formaldehyde, CH2O, is unstable as a pure gas, readily forming a mixture of a substance called trioxane and a polymer called paraformaldehyde. That is why formaldehyde is dissolved in a solvent, like water, before it is sold and used. The molecular formula of trioxane, which contains carbon, hydrogen, and oxygen, can be determined using the data from two different experiments. In the first experiment, 17.471 g of trioxane is burned in the apparatus shown above, and 10.477 g H2O and 25.612 g CO2 are formed. In the second experiment, the molecular mass of trioxane is found to be 90.079 g mol-1. Determine the molecular formula of trioxane.
4. Dianabol is one of the anabolic steroids that has been used by some athletes to increase the size and strength of their muscles. It is similar to the male hormone testosterone. Some studies indicate that the desired effects of the drug are minimal, and the side effects, which include sterility and increased risk of liver cancer and heart disease, keep most people from using it. The molecular formula of Dianabol, which consists of carbon, hydrogen, and oxygen, can be determined using the data from two different experiments. In the first experiment, 14.765 g of Dianabol is burned, and 43.257 g CO2 and 12.395 g H2O are formed. In the second experiment, the molecular mass of Dianabol is found to be 300.44 g mol-1. What is the molecular formula for Dianabol?
5. Challenge Question: Dimethyl hydrazine, the fuel used in Apollo lunar module has a molar mass of 60.10 g mol-1. It is made up of carbon, hydrogen and nitrogen atoms. The combustion of 2.859 g of the fuel in excess oxygen yields 4.190 g of CO2 and 3.428 g of H2O. What are the empirical and molecular formulae for dimethyl hydrazine?

****Answers: 1. a) C2H6O, b) C6H18O3 2. C2H4O, C4H8O2 3. CH2O, C3H6O3 4. C10H14O, C20H28O2****

****5. CH4N, C2H8N2****