Calculations: Formulae of Organic Compounds

1. When a sample with a mass of 2.448 g of a compound present in liquefied petroleum gas was analyzed, it was found to contain 2.003 g of carbon and 0.448 g of hydrogen. What is its empirical formula? The molecular mass was determined to be 44 g mol^{-1}, suggest a structural formula and a name for the compound.
(Answer C_3H_8)

2. A sample of a liquid consisting of only C, H, and O and having a mass of 0.5438g was burned in pure oxygen and 1.039 g of CO_2 and 0.6369 g of H_2O were obtained. What is the empirical formula of the compound? Determine all possible structural isomers for the compound and name them.
(Answer CH_2 , C_4H_8)

3. Isobutylene is a raw material for making synthetic rubber. A sample with a mass of 0.6481g was found to contain 0.5555g of carbon; the rest was hydrogen. Its molecular mass was determined to be 57 g mol^{-1}. What are the empirical and molecular formulas of isobutylene?
(Answer C_3H_8)

4. Cyanuric acid is used for such different purposes as making synthetic sponges and for killing weeds. A sample with a mass of 0.5627 g was found to contain 0.1570 g of carbon, 0.01317 g of hydrogen, and 0.1832g of nitrogen, with the balance being oxygen. Its molecular mass was found to be 129 g mol^{-1}. Calculate the empirical and molecular formulas of cyanuric acid.
(Answer $C_3H_3N_3O_3$)

5. 0.50 g of an organic compound containing carbon, hydrogen and oxygen gave on combustion 0.6875 g of CO_2 and 0.5625 g of H_2O. Find the empirical formula of the substance. If its molecular formula is 32 g mol^{-1}, suggest a structural formula for it.
(Answer CH_4O, methanol, CH_3OH)

6. 1.363 g of an organic compound gave on combustion 1.100 g of CO_2 and 0.563 g of H_2O. Also 1.435 g of the compound gave 2.507 g of AgBr. The molecular mass of the compound is 110 g mol^{-1}. Determine its molecular formula.
(Answer C_2H_5 Br)

7. Several organic compounds have the following data when analyzed 0.64 g of the compound on combustion gave 1.45 g of CO_2 and 0.96 g H_2O. 0.147 g of the compound gave 29.8 cm^3 of nitrogen at 25 °C and 101.3 kPa. The molecular mass of the compound was determined to be 60 g mol^{-1}.   Determine the common molecular formula for these organic compounds and write the structural formula for all possible isomers.
(Answer $C_3H_{10}N$)

8. Two organic compounds A and B containing carbon, hydrogen and oxygen have identical molecular formulae. 0.80 g of A gave on combustion 1.76 g CO_2 and 0.96 g H_2O. The molecular mass of B was determined to be 60 g mol^{-1}. Find the molecular formula and suggest structural formula for A and B with names.

(Answer A; $C_6H_{16}O_2$,   B: C_3H_8O

9. An organic compound containing carbon, hydrogen, oxygen and sulphur was found to contain 31.4 % carbon, 2.52 % hydrogen. 0.70 g of the compound gave 1.37 g of $BaSO_4$. Find the empirical formula. If the molecular mass is 238 g mol^{-1}, suggest a structural formula and a name for the compound.

(Answer $C_6H_6O_6S_2$)

10. One of the most deadly poisons, strychnine, has a molecular mass of 334gmol^{-1} and the composition 75.42% C, 6.63% H, 8.38% N; the rest is oxygen. Calculate the empirical and molecular formulas of strychnine.

(Answer $C_{21}H_{22}O_2N_2$)

11. An unknown compound containing only carbon, hydrogen, and nitrogen is combusted in a chamber containing excess oxygen. 6.50 g of the unknown produces   15.9 g of carbo dioxide and 4.33 g of water. What is the empirical formula of the unknown?

12. Because of its detrimental effect on the environment, the lead compound that was added to gasoline in the past has been replaced in recent years by methyl tert-butyl ether (a compound of carbon, hydrogen and oxygen) to enhance the performance of gasoline. When 12.1 g of the compound were burned in an excess of oxygen, 30.2 g of carbon dioxide and 14.8 g of the water vapour were formed. What is the empirical formula of the compound?