Combustion

Using percent composition to find empirical formulas

1) Fructose is a type of sugar that occurs in fruit and is the principal compound responsible for the sweetness of honey. Analysis of a 2.00 g sample showed it to contain 0.80 g C, 1.06 g O, and the remainder hydrogen. (a) What is the empirical formula of fructose? (b) given that the molar mass of fructose is 180 g/mol, determine the molecular formula of the compound.

2) Oxalic acid occurs in rhubarb. Analysis of a sample of oxalic acid of mass 10.0 g showed that is contained 0.22g H, 2.7 g C, and the remainder oxygen. What is the empirical formula of oxalic acid.

3) A 0.473 sample of a gas that occupies 200.0 mL at 1.81 atm and 25°C was analyzed and found to contain 0.414 g of nitrogen and 0.0591 g of H. What is the molecular formula of the compound? –comeback to this one when we study gas laws. It's a great test question!

4) A compound is analyzed and found to contain 88.82 % C and 11.18 % H. In another sample of the same compound, 9.4 grams of compound was determined to contain 0.0500 moles of compound. Find the empirical and molecular formulas.

5) Tooth enamel is composed largely of hydroxyapatite, which has the following mass percent composition: 41.41 % O, 18.50 % P, 0.20 % H, and 39.89 % Ca.. Calculate the empirical formula of hydroxyapatite. The molar mass of hydroxyapatite is 1004 g/mol. What is the molecular formula for hydroxyapatite.

6) The compound DDT has the following composition by mass: 47.5% C, 2.54% H and 50.0% Cl. Determine the empirical formula of DDT [$C_{14}H_9Cl_5$]

7) Determine the simplest formula for a compound that has the following composition: Cr 26.52%, S 24.52%, and O 48.96% [$Cr_2S_3O_{12}$]

8) Determine the empirical and molecular formula of caffeine, 49.5% C, 5.15 % H, 28.9 % N and 16.5 % O by mass with a molar mass of about 195 g.

9) Find the empirical formula of a compound that is 62.1 %C, 5.21 % H, 12.1 % N and 20.7 % O.

10) Nicotine is an addictive compound found in tobacco leaves. Elemental analysis of nicotine gives the following data: 74.0 % C, 8.65 % H, 17.35 % N. What is the empirical formula of nicotine? The molar mass of nicotine is less than 170 g/mol. What is the molecular formula?

11) A certain compound was known to have a formula, which could be represented as [PdC_xHyN_z]$(ClO_4)_2$. Analysis showed that the compound contained 30.15 % carbon and 5.06 % hydrogen. The total formula weight is 557 amu. What is x, y, and z? [molar masses: Pd = 106.42; C = 12.01; N 14.01; H= 1.008; Cl= 35.45; O = 16.00; hint: find the mass of carbon and hydrogen in 1 mole of sample; the mass of nitrogen is 557 — (Pd + C + H + Cl + O)]

Using combustion analysis to find empirical formulas

12) Hemlock is a poisonous herb of the carrot family. The ancient Greeks used hemlock extras for state executions. Socrates was killed in this way. In a combustion experiment, 50.50 mg of hemlock is burned in excess oxygen. The products are 139.9 mg carbon dioxide and 60.91 mg water. In a second experiment, 75.62 mg of compound was found to contain 8.35 mg of nitrogen. The molar mass is less than 200 g/ mol. Determine the molecular formula of hemlock.

13) In a combustion analysis of 0.152 g sample of the artificial sweetener aspartame, it was found that 0.318 g of carbon dioxide, 0.084 g of water, and 0.0145 g of nitrogen were produced. What is the empirical formula of aspartame? The molar mass of aspartame is 294 g/mol. What is the molecular formula.

14) A chemical compound was found to contain only Fe, C, and H. when 5.00 g of this compound were completely burned on oxygen, 11.8 g of carbon dioxide and 2.42 g of water were produced. Find the percent by mass of each element in the original compound and its empirical formula.

15) Elementary analysis showed that an organic compound contained, C H, N, and O as the only elementary constituents. A 1.279 sample was burned completely, as a result of which 1.60 g of CO_2 and 0.77 g of H_2O were obtained. A separately weighed 1.625 g sample contained 0.216 g of nitrogen. What is the empirical formula of the compound? [hint. Find the % composition of nitrogen in the original sample] $C_3H_7NO_{3A}$

16) 23.2 sample of an organic compound containing carbon, hydrogen, and oxygen was burned in excess oxygen and yielded 52.8 g of CO_2 and 21.6 g of water. Determine the empirical formula of the compound. [C_3H_6O]

17) The medicinal properties of garlic have been known for many centuries. These properties, as well as garlic's obvious odor, can be attributed to a variety of sulfur containing molecules. One such molecule is allicin, a potent antibacterial agent that is effective in the treatment of typhus. Allicin's clinical use has been abandoned, however, because of its potent odor. From 4.0 kg of garlic, a chemist isolates 6.0 g of allicin. Burning 5.00 mg of allicin produces 8.13 mg CO_2, 3.95 mg SO_2, and 2.76 mg H_2O. The molar mass of allicin is about 160 g/mol. Determine the molecular formula of allicin.