

Name _____

Honors Chemistry

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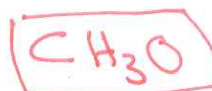
Group Review Quiz Members:

Empirical/Molecular Formula Review

Answer the following questions that relate to the analysis of chemical compounds.

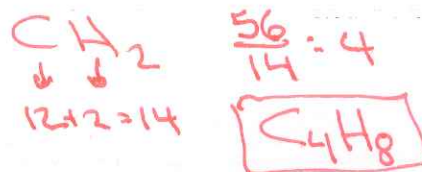
1. Elemental analysis of this unknown compound yields the following percentages by weight: H = 9.74%; C = 38.70%; O = 51.56%. Determine the empirical formula of the compound.

$$\begin{aligned} \text{H} &: 9.74 \div 1.01 = 9.64 \div 3.22 = 3 \\ \text{C} &: 38.70 \div 12.01 = 3.22 \div 3.22 = 1 \\ \text{O} &: 51.56 \div 16.00 = 3.22 \div 3.22 = 1 \end{aligned}$$



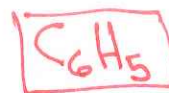
2. Assume that you have a gas with the following elementary analysis: C, 85.7%; H, 14.3%. Each gas has a molecular weight of 56. What is the molecular formula for the compound?

$$\begin{aligned} \text{C} &: 85.7 \div 12.01 = 7.14 \div 7.14 = 1 \\ \text{H} &: 14.3 \div 1.01 = 14.15 \div 7.14 = 2 \end{aligned}$$



3. A hydrocarbon is found to contain 93.46% carbon and 6.54% hydrogen. Calculate the empirical formula of the unknown hydrocarbon.

$$\begin{aligned} \text{C} &: 93.46 \div 12.01 = 7.78 \div 6.54 = 1.19 \times 5 = 6 \\ \text{H} &: 6.54 \div 1.01 = 6.54 \div 6.54 = 1.00 \times 5 = 5 \end{aligned}$$



4. Two volatile compounds Y and Z each contain element Q. The percent by weight of element Q in each compound was determined. Some of the data obtained are given below.

| Compound | Percent by Weight of Element Q | Molecular Weight |
|----------|--------------------------------|------------------|
| Y | 73.0% | 104. |
| Z | 59.3% | 64.0 |

(a) Determine the mass of element Q contained in 1.00 mole of each of the compounds.

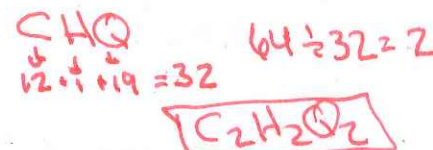
(b) Calculate the most probable value of the atomic weight of element Q.

(c) Compound Z contains carbon, hydrogen, and element Q. When 1.00 gram of compound Z is oxidized and all of the carbon and hydrogen are converted to oxides, 1.37 grams of CO_2 and 0.281 gram of water are produced. Determine the most probable molecular formula of compound Z.

$$\begin{aligned} \text{a. Y} &: 0.730 \times 104 = 75.92 \text{ g} \\ \text{Z} &: 0.593 \times 64 = 38.0 \text{ g} \end{aligned}$$

$$\begin{aligned} \text{C} &: \left(\frac{12}{44}\right)(1.37) = 0.374 \div 0.0312 = 12 \\ \text{H} &: \left(\frac{2}{18}\right)(0.281) = 0.0312 \div 0.0312 = 1 \\ \text{Q} &: \longrightarrow 0.595 \div 0.0312 = 19 \end{aligned}$$

b. 19.0 - Fluorine; both masses are a multiple of 19.0. There is no element w/ a weight of 38.0 or 76.0.

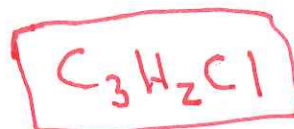


5. Elemental analysis of an unknown pure substance indicates that the percent composition by mass is as follows: Carbon - 49.02%, Hydrogen - 2.743%, Chlorine - 48.23%. Determine the empirical formula of the unknown substance.

$$C: 49.02 \div 12.01 = 4.082 \div 1.361 = 3$$

$$H: 2.743 \div 1.01 = 2.716 \div 1.361 = 2$$

$$Cl: 48.23 \div 35.45 = 1.361 \div 1.361 = 1$$



6. An unknown compound contains only the three elements C, H, and O. A pure sample of the compound is analyzed and found to be 65.60 percent C and 9.44 percent H by mass. Calculate the empirical formula of the unknown hydrocarbon.

$$C: 65.60 \div 12.01 = 5.46 \div 1.56 = 3.50 \times 2 = 7$$

$$H: 9.44 \div 1.01 = 9.35 \div 1.56 = 6 \times 2 = 12$$

$$O: 24.96 \div 16.00 = 1.56 \div 1.56 = 1 \times 2 = 2$$



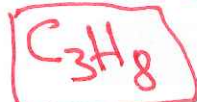
7. Answer the following questions about acetylsalicylic acid, the active ingredient in aspirin. The amount of acetylsalicylic acid in a single aspirin tablet is 325 mg, yet the tablet has a mass of 2.00 g. Calculate the mass percent of acetylsalicylic acid in the tablet.

$$\frac{0.325}{2.00} \times 100 = \boxed{16.3\%}$$

8. In an experiment, a sample of an unknown, pure gaseous hydrocarbon was analyzed. Results showed that the sample contained 6.000 g of carbon and 1.344 g of hydrogen. Determine the empirical formula of the hydrocarbon.

$$C: 6.000 \div 12.01 = 0.500 \div 0.500 = 1 \times 3 = 3$$

$$H: 1.344 \div 1.01 = 1.33 \div 0.500 = 2.66 \times 3 = 8$$



9. Answer the following questions about a pure compound that contains only carbon, hydrogen, and oxygen. A 0.7549 g sample of the compound burns in $O_2(g)$ to produce 1.9061 g of $CO_2(g)$ and 0.3370 g of $H_2O(g)$.

(i) Calculate the individual masses of C, H, and O in the 0.7549 g sample.

(ii) Determine the empirical formula for the compound.

$$C: \left(\frac{12.01}{44.01} \times 1.9061 \right) = \frac{\text{total: } 0.7549}{0.5202} \div 12.01 = 0.0433 \div 0.0123 = 3.50 \times 2 = 7$$

$$H: \left(\frac{2.02}{18.02} \times 0.3370 \right) = 0.03778 \div 1.01 = 0.0374 \div 0.0123 = 3 \times 2 = 6$$

$$O: \text{Subtraction} = 0.1969 \div 16.00 = 0.0123 \div 0.0123 = 1 \times 2 = 2$$

