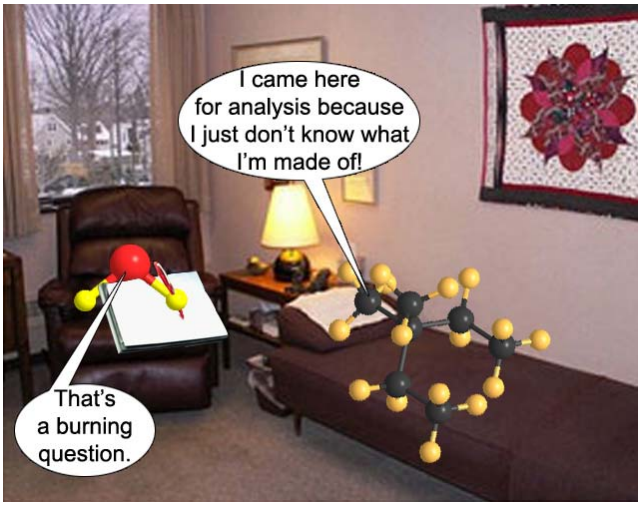
Analysis by Combustion

You have an unknown hydrocarbon. What is it? One way to analyze it is by burning it. Hydrocarbons burn to produce two oxides, water and carbon dioxide. It is possible to measure the masses of the oxides formed and determine the nature of the compound they came from. This works because you know the percent composition of both the water and the carbon dioxide. As a result, it is possible to find the mass of carbon and the mass of hydrogen in the original compound. From these masses, it is possible to determine the percent composition of the original compound and the empirical formula.



Sample Problem

A pure hydrocarbon is burned in an excess of oxygen and produces 616.6 g of carbon dioxide and 283.5 g of water. What is it's empirical formula?

Step 1: Determine the number of grams of carbon and the number of grams of hydrogen burned based on the percent composition of their oxides.

a) Find the formula masses of each

CO_2	H_2O
C = 12.01 × 1 = 12.01	H = 1.008 × 2 = 2.016
O = 16.00 × 2 = 32.00	O = 16.00 × 2 = 16.00
44.01	18.02

b) Find the percentages of each.

$\%C: \frac{12.01}{44.01} \times 100 = 27.29\%$ $\%H: \frac{2.016}{18.02} \times 100 = 11.19\%$

c) determine the number of grams of each

C: 616.6 g × 0.2729 = 168.3 g H: 283.5 g × 0.1119 = 31.72 g

Step 2: Determine the mole ratios

	C	H
moles	$\frac{168.3}{12.01} = 14.01$	$\frac{31.72}{1.008} = 31.47$
ratio	$\frac{14.01}{14.01} = 1$	$\frac{31.47}{14.01} = 2.25$
integer	$1 \times 4 = 4$	$2.25 \times 4 = 9$

formula C_4H_9

Answer the questions below as shown in the preceding example.

1. A pure hydrocarbon is burned in an excess of oxygen and produces 1,813 g of carbon dioxide and 990.2 g of water. What is it's empirical formula?

2. A pure hydrocarbon is burned in an excess of oxygen and produces 929.7 g of carbon dioxide and 380.6 g of water. What is it's empirical formula?

3. A pure hydrocarbon is burned in an excess of oxygen and produces 3.811 kg of carbon dioxide and 1.743 kg of water. What is it's empirical formula?

4. A pure hydrocarbon is burned in an excess of oxygen and produces 1.318 kg of carbon dioxide and 1.079 kg of water. What is it's empirical formula?