

## QUIZ

## Percent Composition and Empirical Formulas

### 1. The law of definite proportions

- \_\_\_\_\_ states that every sample of the same substance contains identical elements in the same fixed ratio by mass.
- When a 16.50 g sample containing nickel and oxygen is analyzed, 5.87 g of nickel are found. What is the percent composition of this mineral? 35.6 % Ni  
64.4 % O
- What is the percent composition of calcium fluoride ( $\text{CaF}_2$ ), which is a major component of human teeth?
  - 48.7% Ca, 51.3% F
  - 40.1% Ca, 59.9% F
  - 33.3% Ca, 66.7% F
  - 51.3% Ca, 48.7% F
- The forensic science shows on television provide a realistic outcome from the lab tests run on materials. However, the time frames with those tests are usually much longer than a television show may allow. One method of determining the identity of an unknown organic compound is through combustion analysis. A sample of an unknown substance is burned, and the amounts of water and carbon dioxide produced can be used to find the relative amounts of carbon, hydrogen, and oxygen. These devices can be modified to determine the composition of inorganic compounds as well.

A combustion analysis shows that an unknown sample of gas is made of 85.5% carbon and 14.3% hydrogen. What is the empirical formula of the compound?

- CH
  - CH<sub>2</sub>
  - C<sub>2</sub>H
  - CH<sub>3</sub>
- Assuming we have 100g of the substance:  
Carbon  $85.5\text{g} / 12.01 = 7.12$  moles  
Hydrogen  $14.3\text{g} / 1.01\text{g/mol} = 14.16$  moles  
 $\text{C} : \text{H} = (7.12/7.12) : (14.16/7.12) = 1 : 1.99 = \sim 1:2$   
Answer = CH<sub>2</sub>
- A lab technician knows the empirical formula of a molecule is CH<sub>2</sub>. He uses a mass spectrometer to determine the molar mass of the compound. The test results show that the molar mass is 56.1 g/mol.

What is its molecular formula?

- CH<sub>2</sub>
- C<sub>2</sub>H<sub>4</sub>
- C<sub>3</sub>H<sub>6</sub>
- C<sub>4</sub>H<sub>8</sub>

Carbon =  $\sim 12\text{g/mol}$   
Hydrogen =  $\sim 2\text{g/mol}$   
Total =  $\sim 14\text{g/mol}$

$$(56.1\text{g/mol}) / 14\text{g/mol} = \sim 4$$

Molecular Formula = 4 x Empirical Formula

Answer: C<sub>4</sub>H<sub>8</sub>