**Finding Empirical and Molecular Formulas**

**Problem:**

A compound is 75.46% carbon, 4.43% hydrogen, and 20.10% oxygen by mass. It has a molecular weight of 318.31 g/mol. What is the molecular formula for this compound?

**Strategy:**

1. **Find the empirical formula**
   * Get the mass of each element by assuming a certain overall mass for the sample   
     (100 g is a good mass to assume when working with percentages).

(.7546) (100 g) = 75.46 g C

(.0443) (100 g) = 4.43 g H

(.2010) (100 g) = 20.10 g O

* + Convert the mass of each element to moles using molar mass of the element.

(75.46 g C) (1 mol/ 12.00 g C) = 6.289 mol C

(4.43 g H) (1 mol/ 1.008 g H) = 4.39 mol H

(20.10 g O) (1 mol/ 16.00 g O) = 1.256 mol O

* + Find the ratio of the moles of each element.   
    Divide by the smallest mole value found in the previous step.
  1. l O)/ (1.256) = 1 mol O
  2. mol C)/ (1.256) = 5.007 mol C
  3. mol H)/ (1.256) = 3.50 mol H
  + Use the mole values found in the previous step as subscripts to write the empirical formula.

*C5H3.5O5*

* + Multiplying the mole ratios by two to get whole number, the empirical formula becomes:

*C10H7O2*

1. **Find the molar mass of the empirical formula.**

10(12.00) + 7(1.008) + 2(16.00) =159.06 g/mol

1. **Figure out how many empirical units are in a molecular unit.**

(318.31 g/mol) / (159.06 g/mol) =*2.001* empirical units per molecular unit

1. **Write the molecular formula.**  
   Since there are two empirical units in a molecular unit, the molecular formula is:

*2 x (C10H7O2) =* **C20H14O4**