CONCEPT: COMBUSTION ANALYSIS

- **Combustion Analysis** is an analytical process that determines the *empirical formula* of a compound.
  - □ Normally combustion reactions involves a compound of _____ (*hydrocarbon*) or _____ reacting with O_2.
  - □ The products formed are _____ and _____.

Combustion of Carbon Compounds

_____ + O_2 ⟶ _____ + _____

_____ + O_2 ⟶ _____ + _____

Combustion of Carbon Compounds

EXAMPLE: 2,3-dihydroxysuccinic acid is responsible for the acidulous flavor of some candies and is composed of carbon, hydrogen, and oxygen. If combustion of 12.01 g of this acid creates 14.08 g CO_2 and 4.32 g H_2O, what is its empirical formula?

STEP 1: Convert the grams of CO_2 to grams of _____.

STEP 2: Convert the grams of H_2O to grams of _____.

STEP 3: If necessary, subtract the grams of **STEPS 1** & **2** from the grams of the sample to determine the 3rd element.

STEP 4: Convert all the masses into _____.

STEP 5: Divide each mole answer by the smallest mole value in order to obtain whole numbers for each element.

STEP 6: If you get a value of _____ or _____ then you can round to the nearest whole number.

- □ If you can't round, we multiply by a factor to create whole numbers.

CONCEPT: COMBUSTION ANALYSIS

PRACTICE: An unknown compound is composed of carbon, hydrogen and oxygen. A 4.30 g sample is ignited and creates 8.59 g CO_2 and 3.52 g H_2O. If the molar mass is 176.22 g/mol, what is the molecular formula?

PRACTICE: In the presence of a small amount of oxygen a combustion reaction will not only produce carbon dioxide, but also carbon monoxide. The incomplete combustion of naphthalene, a hydrocarbon used in many dyes, produced 2.80 g CO, 4.40 g CO_2 and 1.44 g H_2O. Determine its empirical formula.

CONCEPT: COMBUSTION ANALYSIS

Combustion of Non-Hydrocarbons

- A *non-hydrocarbon* represents a compound containing not only C and H, but also _____, _____ and/or a _____.
  - □ Through combustion analysis, they can create gaseous products such as _____, _____ or a _____ molecule.

EXAMPLE: A solvating agent ($\mathcal{M}$ = 147.0 g/mol) that contains C, H, and Cl is used for spectroscopic processes. Determine its molecular formula when 0.250 g sample creates 0.451 g CO_2 and 0.0617 g of H_2O upon combustion.

STEP 1: If present, convert the grams of CO_2 to grams of _____.

STEP 2: Convert the grams of H_2O to grams of _____.

STEP 3: If necessary, subtract the grams of **STEPS 1** & **2** from the grams of the sample to determine the 3rd element.

STEP 4: Convert all the masses into _____.

STEP 5: Divide each mole answer by the smallest mole value in order to obtain whole numbers for each element.

STEP 6: If you get a value of _____ or _____ then you can round to the nearest whole number.

- □ If you can't round, we multiply by the a factor to create whole numbers.

CONCEPT: COMBUSTION ANALYSIS

PRACTICE: A compound composed of carbon, hydrogen and nitrogen undergoes a combustion reaction to produce 264.21 g CO_2, 63.06 g H_2O and 46.4 g NO_2. Determine its empirical formula.

PRACTICE: The combustion of 4.16 grams of a compound which contains only C,H,O and F yields 7.7 g CO_2 and 2.52 g H_2O. Another sample of the compound with a mass of 3.63 g is found to contain 0.58 g F. What is the empirical formula of the compound?