$$\% \rightarrow g \rightarrow mol \rightarrow CH_4$$

Chemistry 11
MOLECULAR FORMULA

Once the EMPIRICAL FORMULA (_simplest_ _formula_)of a substance is known you can
determine the MOLECULAR FORMULA (_actual_ _formula_)
Provided that you have the following information:

① empirical mass (Empirical formula)
② molar mass (g/mol)

The EQUATION for determining the MOLECULAR FORMULA is:

$$M.F. = "N" \cdot E.F \quad ; \quad N = \frac{molar\ mass}{empirical\ mass}$$

Example 1. A molecule has an EMPIRICAL FORMULA of HO and a molar mass of 34.0 g/mol. What is the molecule's
Molecular Formula?

Step 1. Determine (or in this case, identify) the EMPIRICAL FORMULA

HO

Step 2. Calculate the <u>EMPRIRICAL MASS</u> (similar procedure as calculating the molar mass of a known compound, but
using the empirical formula instead!)

$$H = 1.0$$
$$O = \underline{16.0}$$
$$17.0 \quad g \quad \leftarrow empirical\ mass$$

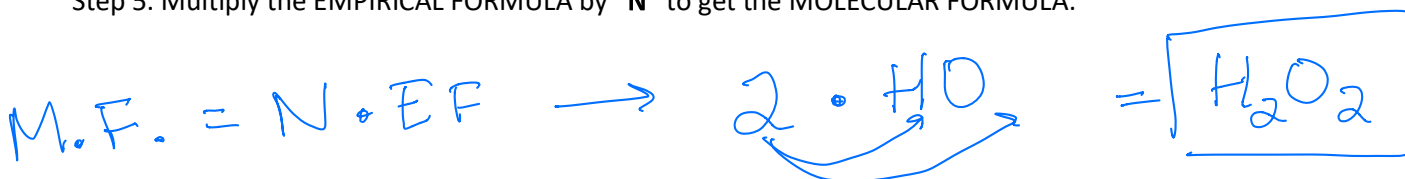**Step 3.** Calculate (or identify, as in this case) the molar mass (NOTE: must be in g/mol!)

34.0 g /mol

Step 4. Calculate "N" using the MOLECULAR FORMULA EQUATION

$$N = \frac{molar\ mass}{empircal\ mass} = \frac{34.0\ g/mol}{17.0\ g} = \underline{\underline{2}}\ mol$$

Step 5. Multiply the EMPIRICAL FORMULA by **"N"** to get the MOLECULAR FORMULA:

$$M.F. = N \cdot EF \rightarrow 2 \cdot HO \quad = \boxed{H_2O_2}$$

Example 2. A gas has the EMPIRICAL FORMULA of POF_3. IF 0.350 L of the gas at STP has a mass of 1.62g, what is the molecular formula of the compound?

Step 1. Determine (or in this case, identify) the EMPIRICAL FORMULA

$$POF_3$$

Step 2. Calculate the EMPRIRICAL MASS:

$$1 \ P = 31.0$$
$$1 \ O = 16.0$$
$$3 \ F = 57.0 \rightarrow 104.0 \ g$$

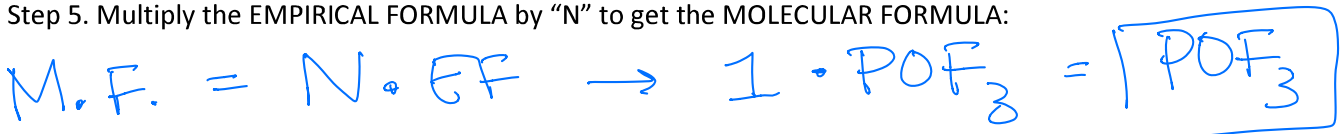Step 3. Calculate the molar mass:(NOTE: must be in g/mol!)

$$\frac{1.62 \ g}{0.350 \ L} \cdot \left(\frac{22.4 \ L}{1 \ mol} \right) = 104 \ g/mol$$

Step 4. Calculate "N" using the MOLECULAR FORMULA EQUATION

$$N = \frac{m.m}{e.m} = \frac{104 \ g/mol}{104.0 \ g} = 1 \ mol$$

Step 5. Multiply the EMPIRICAL FORMULA by "N" to get the MOLECULAR FORMULA:

$$M.F. = N \cdot EF \rightarrow 1 \cdot POF_3 = \boxed{POF_3}$$

Example 3. The EMPIRICAL FORMULA of a compound is SiH_3. If 0.0275 moles of the compound has a mass of 1.71 grams, what is the compound's molecular formula?

Step 1. Determine (or in this case, identify) the EMPIRICAL FORMULA

$$SiH_3$$

Step 2. Calculate the EMPRIRICAL MASS:

$$1 \ Si = 28.1$$
$$3 \ H = \frac{3.0}{31.1 \ g}$$
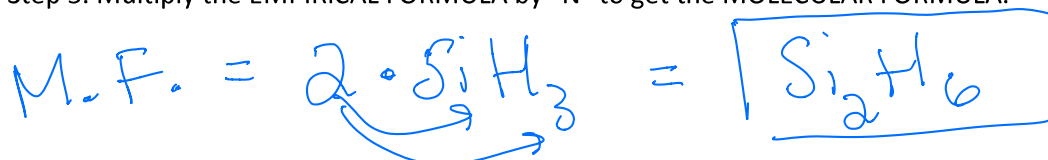
Step 3. Calculate the molar mass:(NOTE: must be in g/mol!)

$$\frac{1.71 \ g}{0.0275 \ mol} = 62.2 \ g/mol$$

Step 4. Calculate "N" using the MOLECULAR FORMULA EQUATION

$$N = \frac{m.m}{e.m} = \frac{62.2 \ g/mol}{31.1 \ g} = \text{"2" } mol$$

Step 5. Multiply the EMPIRICAL FORMULA by "N" to get the MOLECULAR FORMULA:

$$M.F. = 2 \cdot SiH_3 = \boxed{Si_2H_6}$$

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