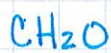


Molecular Formulas - true formulas

- are a multiple of the empirical formula

} → subscripts
→ molar mass

EF



$$\begin{array}{l} 1 \text{ C } (12.011 \text{ g}) = 12.011 \text{ g} \\ 2 \text{ H } (1.0078 \text{ g}) = 2.0156 \text{ g} \\ 1 \text{ O } (15.999 \text{ g}) = 15.999 \text{ g} \\ \hline 30.0256 \text{ g} \end{array}$$

MF



$$\begin{array}{l} 6 \text{ C } (12.011 \text{ g}) = 72.066 \text{ g} \\ 12 \text{ H } (1.0078 \text{ g}) = 12.0936 \text{ g} \\ 6 \text{ O } (15.999 \text{ g}) = 95.994 \text{ g} \\ \hline 180.1536 \text{ g} \end{array}$$

- calculating a molecular formula.

- (1) Find the empirical formula.
- (2) Find the molar mass of the empirical formula.
- (3) Divide the molar mass of molecular formula (molecular mass) given in the question by the molar mass of the empirical formula. This is your multiplier.
- (4) multiply the subscripts in the empirical formula by the multiplier to get the molecular formula.

$$\frac{180.1536}{30.0256} = 6$$

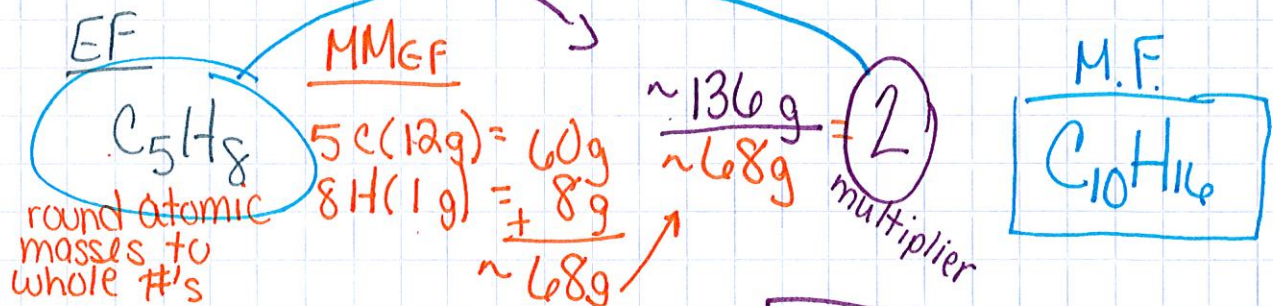
multiplier

Examples

(1) Limonene, the scent of lemons, is composed of 88.164% C and 11.836% H. Its molecular mass is 136.2348g. Calculate the M.F.

$$88.164\text{g C} / 12.011\text{g/mol} = 7.3403\text{mol C} = (1\text{ C})_5$$

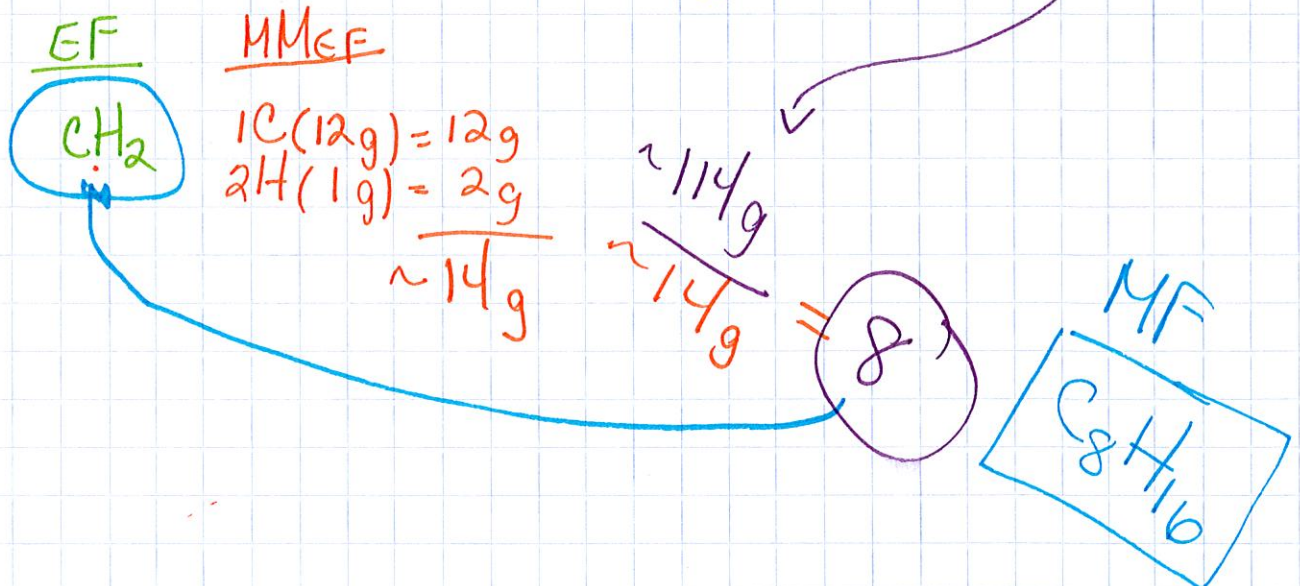
$$11.836\text{g H} / 1.0078\text{g/mol} = 11.7444\text{mol H} = (1.6\text{ H})_5$$



(2) Octane has a molecular mass of $\sim 114\text{g}$ and is composed of 84.1192% C and 15.8808% H. Determine the M.F.

$$84.1192\text{g C} / 12.011\text{g/mol} = 7.0035\text{mol C} = 1\text{ C}$$

$$15.8808\text{g H} / 1.0078\text{g/mol} = 15.7579\text{mol H} = 2\text{ H}$$



(3) Tryptophan, a compound found in turkey that can cause sleepiness in large amounts contains 64.6933% C, 5.9217% H, 13.7171% N, and 15.6679% O and has a molecular mass of 204g. Determine the molecular formula.

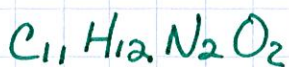
$$64.6933\text{g C} / 12.011\text{g/mol} = \frac{5.3862\text{mol C}}{.9793\text{mol}} = (5.5\text{ C})_2$$

$$5.9217\text{g H} / 1.0078\text{g/mol} = \frac{5.8759\text{mol H}}{.9793\text{mol}} = (6\text{ H})_2$$

$$13.7171\text{g N} / 14.007\text{g/mol} = \frac{.9793\text{mol N}}{.9793\text{mol}} = (1\text{ N})_2$$

$$15.6679\text{g O} / 15.999\text{g/mol} = \frac{.9793\text{mol O}}{.9793\text{mol}} = (1\text{ O})_2$$

EF



MMEF

$$\begin{array}{r} 11\text{C} (12\text{g}) = 132\text{g} \\ 12\text{H} (1\text{g}) = 12\text{g} \\ 2\text{N} (14\text{g}) = 28\text{g} \\ 2\text{O} (16\text{g}) = + 32\text{g} \\ \hline \sim 204\text{g} \end{array}$$

$$\frac{204\text{g}}{204\text{g}} = 1$$

M.F.

