

Warm Up

How many grams does 4.941×10^{22} molecules of cinnamaldehyde weigh?

cinnamaldehyde = $C_{10}H_{10}O$
(scent of cinnamon)

$$\frac{4.941 \times 10^{22} \text{ molecules } C_{10}H_{10}O}{6.02 \times 10^{23} \text{ molecules}} \times \frac{1 \text{ mol}}{1 \text{ mol}} \times \frac{146.20 \text{ g}}{1 \text{ mol}} = 12.00 \text{ g } C_{10}H_{10}O$$

% Composition by Mass

$$\% \text{ element} = \frac{\text{mass element}}{\text{molar mass}} \times 100$$

Ex) Find the % of each element in cinnamaldehyde:
 $C_{10}H_{10}O$

$$\begin{array}{r} C \quad 10 \times 12.01 \text{ g} = 120.10 \text{ g} \\ H \quad 10 \times 1.01 \text{ g} = 10.10 \text{ g} \\ O \quad 1 \times 16.00 \text{ g} = +16.00 \text{ g} \\ \hline 146.20 \text{ g} \end{array}$$

$$\% C = \frac{120.10 \text{ g}}{146.20 \text{ g}} \times 100 = \underline{82.148\%}$$

$$\% H = \frac{10.10 \text{ g}}{146.20 \text{ g}} \times 100 = \underline{6.908\%}$$

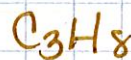
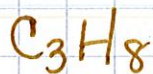
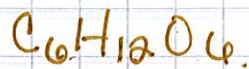
$$\% O = \frac{16.00 \text{ g}}{146.20 \text{ g}} \times 100 = \underline{10.94\%}$$

Empirical Formulas

= a simplified chemical formula for a compound

Ex) real formula

empirical formula



Calculating an E.F. - from % composition

1) Assume you have 100g of the substance. Convert % to grams.

Ex) Freshly cut grass
73.411% C, 10.289% H, 16.300% O
Find the EF

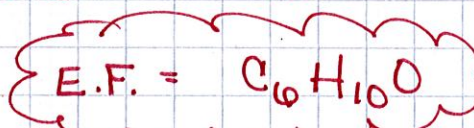
2) Convert grams to moles (\div by molar mass)

$$\frac{73.411\text{g C}}{12.01\text{ g/mol}} \quad \frac{10.289\text{g H}}{1.01\text{g/mol}} \quad \frac{16.300\text{g O}}{16.00\text{ g/mol}}$$

3) Look for the smallest answer. Divide all answers by the smallest. If you get whole #'s (or very close to whole #'s), those #'s are subscripts.

$$= \frac{6.1125\text{ mol C}}{1.0188\text{ mol}} \quad = \frac{10.1871\text{ mol H}}{1.0188\text{ mol}} \quad = \frac{1.0188\text{ mol O}}{1.0188\text{ mol}}$$

$$= 6\text{ C} \quad = 10\text{ H} \quad = 1\text{ O}$$



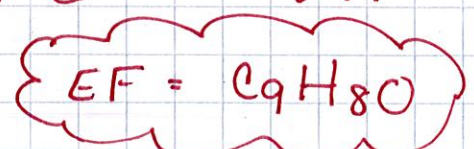
4) When you get a decimal b/w .3 \rightarrow .7, you need to multiply all answers so that you get a whole # (or very close to it)

Ex) scent of cinnamon
72.950% C, 5.4532% H, 10.798% O

$$\frac{72.950\text{g C}}{12.01\text{ g/mol}} \quad \frac{5.4532\text{g H}}{1.01\text{ g/mol}} \quad \frac{10.798\text{g O}}{16.00\text{ g/mol}}$$

$$= \frac{6.0741\text{ mol C}}{.6749\text{ mol}} \quad = \frac{5.3992\text{ mol H}}{.6749\text{ mol}} \quad = \frac{.6749\text{ mol O}}{.6749\text{ mol}}$$

$$= 9\text{ C} \quad = 8\text{ H} \quad = 1\text{ O}$$



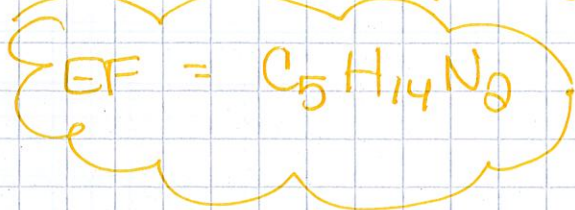
Ex) Cadavarine, scent of decaying bodies, is

58.752% C 13.834% H 27.414% N

$\frac{58.752 \text{ g C}}{12.01 \text{ g/mol}}$ $\frac{13.834 \text{ g H}}{1.01 \text{ g/mol}}$ $\frac{27.414 \text{ g N}}{14.01 \text{ g/mol}}$

$= \frac{4.8919 \text{ mol C}}{1.9567 \text{ mol}}$ $= \frac{13.6970 \text{ mol H}}{1.9567 \text{ mol}}$ $= \frac{1.9567 \text{ mol N}}{1.9567 \text{ mol}}$

$= (2.5 \text{ C})_2 = (7 \text{ H})_2 = (1 \text{ N})_2$
 $= 5 \text{ C} \quad = 14 \text{ H} \quad 2 \text{ N}$

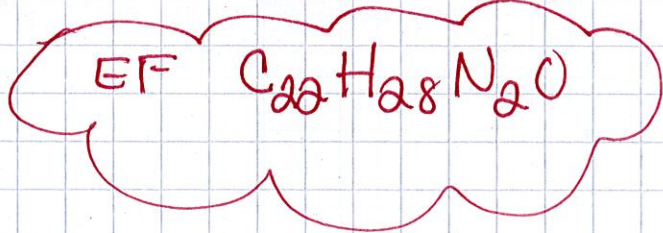


Ex) fentanyl

78.464% C 8.3982% H 8.3210% N 4.7514% O

$= 6.5332 \text{ mol C}$ 8.3150 mol H 5939 mol N $.2970 \text{ mol O}$

22 C 28 H 2 N 10



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