MOLECULAR FORMULAS

EF = CH_2O $C_6H_{12}O_6$ ⇒ a whole # multiple of the EF

must know : EF, Mm of molecular formula

Steps
1) calculate the Mm of EF

2) if it matches the given molar mass, EF is the molecular formula

if it doesn't match $\frac{\text{molar mass given}}{\text{EF Mm}} =$ whole # → multiply subscripts of EF by ↗ to get molecular formula

example

EF = C_3H_7NO , Mm estimates = 146 g/mol

Mm EF = 73.11 g/mol $\frac{146\ g/mol}{73.11\ g/mol} \approx 2$

molecular formula : $C_6H_{14}N_2O_2$

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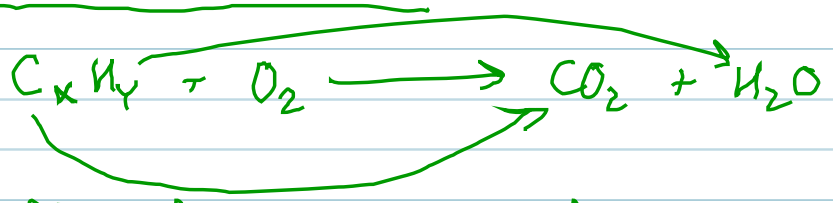
COMBUSTION ANALYSIS



1) find the mass of C in the CO_2 produced

2) find the mass of H in the H_2O produced

3) if sample mass $\neq$ 1 + 2, the difference is the mass of a third element (N, F, O, S...)

0.763 g sample burned $\Longrightarrow$ 2.23 g CO_2, 1.37 g H_2O } products

C: $2.23\,g\,CO_2 \times \frac{1\,mol}{44.01\,g} \times \frac{1\,mol\,C}{1\,mol\,CO_2} \times \frac{12.01\,g}{1\,mol} = 0.609\,g\,C$

H: $1.37\,g\,H_2O \times \frac{1\,mol}{18.02\,g} \times \frac{2\,mol\,H}{1\,mol\,H_2O} \times \frac{1.01\,g}{1\,mol} = 0.154\,g\,H$

$0.763\,g$

C: $0.609\,g \times \frac{1\,mol}{12.01\,g} = 0.0507 \Rightarrow 1$

H: $0.154\,g \times \frac{1\,mol}{1.01\,g} = 0.152 \Rightarrow 3$

CH_3

VITAMIN C

a 2.00 mg sample of vitamin C was burned, and 3.00 mg CO_2 and 0.816 mg H_2O were the only products. The molar mass of vitamin C was estimated to be 180 g/mol. What is the molecular formula of vitamin C?

$$C: 0.00300\,g \times \frac{1\,mol}{44.01\,g} \times \frac{1\,mol\,C}{1\,mol\,CO_2} \times \frac{12.01\,g}{1\,mol} = 8.19 \times 10^{-4}\,g\,C$$

$$H: 0.000816\,g \times \frac{1\,mol}{18.02\,g} \times \frac{2\,mol\,H}{1\,mol\,H_2O} \times \frac{1.01\,g}{mol} = 9.15 \times 10^{-5}\,g\,H$$

$0.00200\,g$ vitamin C
$- 8.19 \times 10^{-4}\,g\,C$
$- 9.15 \times 10^{-5}\,g\,H$
$0.00109\,g\,O$

$$C: 8.19 \times 10^{-4}\,g \times \frac{1\,mol}{12.01\,g} = 6.82 \times 10^{-5} \Rightarrow 1$$

$$H: 9.15 \times 10^{-5}\,g \times \frac{1\,mol}{1.01\,g} = 9.06 \times 10^{-5} \Rightarrow 1.33$$

$$O: 0.00109\,g \times \frac{1\,mol}{16\,g} = 6.81 \times 10^{-5} \Rightarrow 1$$

$\downarrow \times 3$

EF $M_m = 88.07$ g/mol

$$\frac{180\,g/mol}{88.07\,g/mol} \approx 2$$

EF $\Rightarrow C_3H_4O_3$

$C_6H_8O_6$
vitamin C