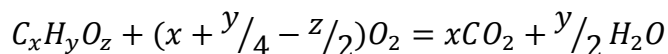


A 0.500-g sample burns in excess O₂ to yield 1.25 g of CO₂ and 0.613 g of H₂O. Determine the empirical formula.

Solution:

Suppose that our sample has a formula C_xH_yO_z, then:



Now calculate the number of mole equivalents:

$$n(CO_2) = \frac{1,25g}{x \cdot 44 \frac{g}{mol}} = \frac{0,028}{x} (mol);$$

$$n(H_2O) = \frac{0,613}{\frac{y}{2} \cdot 18} = \frac{0,068}{y} (mol);$$

$$n(C_xH_yO_z) = \frac{0,5}{12x + y + 16z} (mol).$$

$$\begin{cases} n(CO_2) = n(C_xH_yO_z) \\ n(H_2O) = n(C_xH_yO_z) \end{cases} \text{ or } \begin{cases} \frac{0,028}{x} = \frac{0,5}{12x + y + 16z} \\ \frac{0,068}{y} = \frac{0,5}{12x + y + 16z} \end{cases}$$

$$\begin{cases} 0,341x + 0,028y + 0,454z = 0,5x \\ 0,818x + 0,068y + 1,091z = 0,5y \end{cases}$$

$$\begin{cases} 0,028y + 0,454z = 0,159x & | /0,028 \\ 0,818x + 1,091z = 0,432y & | /0,432 \end{cases}$$

$$+ \begin{cases} y + 16,2z = 5,67x \\ 1,9x + 2,5z = y \end{cases}$$

$$1) y + 16,2z + 1,9x + 2,5z = 5,67x + y$$

$$18,7z = 3,77x \quad | /3,77$$

$$5z = x \text{ or } \frac{x}{z} = \frac{5}{1}$$

$$2) 1,9x + 2,5z = y, \text{ if } 5z = x, \text{ then } 2,5z = 0,5x$$

$$1,9x + 0,5x = y$$

$$2,4x = y \text{ or } \frac{y}{x} = 2,4 = \frac{12}{5}$$

$$\text{So, } \frac{x}{z} = \frac{5}{1} \text{ and } \frac{y}{x} = \frac{12}{5} \text{ we can see, that } x:y:z = 5:12:1 \text{ or } C_5H_{12}O_1.$$

Answer: empirical formula **C₅H₁₂O₁**.