Answer on Question#57210 – Chemistry – General chemistry

Question: Combustion of 2.78 g of ethyl butyrate leads to the formation of 6.32 g of CO2 and 2.58 g of H2O. The Molar mass is between 100 and 150. What is the empirical and molecular formula?

Solution:

1. Ethyl butyrate is compound that contains C, H and perhaps O. Check the presence of O:

$m(O_2) = m(CO_2) + m(H_2O)$ - m(ethyl butyrate) = 6.32 g + 2.58 g – 2.78 g = 6.12 g.

In CO_2 :

$w(O) = \frac{M(O)}{M(CO_2)} = \frac{2 \cdot 16 g/mol}{44 g/mol} = 0.7272$

$m_1(O) = w(O) \cdot m(CO_2) = 0.7272 \cdot 6.32$ g = 4.5959 g

In H_2O:

$w(O) = \frac{M(O)}{M(H_2O)} = \frac{16 g/mol}{18 g/mol}$ = 0.8889

$m_2(O) = w(O) \cdot m(H_2O) = 0.8889 \cdot 2.58 = 2.2934$ g

$m_1(O) + m_2(O) = 4.5959$ g + 2.2934g = 6.89 g

$m_1(O) + m_2(O) > m(O_2)$ – so our compound contains O

2. Find the empirical formula:

$n(CO_2) = \frac{6.32 \text{ g}}{44 \text{ g/mol}}$= 0.1436 mol

$n(H_2O) = \frac{2.58 \text{ g}}{18 \text{ g/mol}}$ = 0.1433 mol

$n(O_2) = \frac{6.12 \text{ g}}{32 \text{ g/mol}}$ = 0.19125 mol

In ethyl butyrate:

$n(C) = n(CO_2)$ = 0.1436 mol

$n(H) = n(H_2O)$ = 0.2866 mol

$n(O) = n(H_2O) + 2n(CO_2) – 2n(O_2)$ = 0.1433 mol + 0.2872 mol - 0.3825 mol = 0.048 mol

N(C) : N(H) : N(O) = 0.1436 : 0.2866 : 0.048 = 3 : 6 : 1

So C_3H_6O is empirical formula of ethyl butyrate.

3. Find the molecular formula. Molecular formula of ethyl butyrate is $(C_3H_6O)_n$

$M(C_3H_6O)$ = 58 g/mol

$n_{min} = 100/58 = 1.72$

$n_{max} = 150/58 = 2.59$

The only integer is 2. So molecular formula is $C_6H_{12}O_2$.

Answer:empirical formula is C_3H_6O

molecular formula is $C_6H_{12}O_2$.