Question #60427, Chemistry / Organic Chemistry |

The organic compound Y contains C, H and O only. When Y is subjected to complete combustion, CO2 and H2O obtained are in the mole ratio of 2:1, respectively. The accurate relative molecular mass of Y is equal to 152. The percentage of O in Y is less than 40%, by weight. Determine the molecular formula of Y.

The relative atomic masses are as follows, C=12.0; H=1.0; O=16.0

Answer:

Let's assume that the compound Y has formula $C_aH_bO_k$.

Thus, its combustion can be described by the equation:

$C_aH_bO_k + fO_2 \rightarrow aCO_2 + (b/2)H_2O$

As given ν(CO2)/ ν(H2O) = 2/1, then

a/(0.5b) = 2,

a =b

The general formula can be written as $C_aH_aO_k$ and the equation for molecular weight is:

12a + a + 16k = 152

13a +16k =152

The percentage of O gives the number of its atoms:

w(O) = m(O)/152 = [16k/152]< 0.4

16k<60.8

k< 3.8

Thus, the possible number of oxygen can be k =1, 2, 3.

The substitution of the parameter k into 1, 2, 3 in the equation 13a + 16k = 152 results in:

k = 1, 13a + 16 = 152, a = 10.46

k = 2, 13a + 32 = 152, a = 9.23

k = 3, 13a + 48 =152, a = 8.

The right combination is k = 3 and a = 8 **and the formula is $C_8H_8O_3$**.