

Question 1

A sample of an organic compound with a mass of 1.224 g was completely burned in oxygen and found to produce 2.340 g of carbon dioxide and 1.433 g of water only. Calculate the empirical formula of the organic compound.

Answer

$$\text{Mass of carbon} = \frac{12.0}{44.0} \times 2.340 = 0.638 \text{ g}$$

$$\text{Mass of hydrogen} = \frac{2.0}{18.0} \times 1.433 = 0.159 \text{ g}$$

$$\text{Mass of oxygen} = 1.224 - (0.638 + 0.159) = 0.427 \text{ g}$$

	Carbon	Hydrogen	Oxygen
Calculate number of moles	$0.638/12.0 = 0.053$	$0.159/1.0 = 0.159$	$0.427/16.0 = 0.0267$
Calculate the mole ratio	$0.053/0.0267 = 2$	$0.159/0.0267 = 6$	$0.0267/0.0267 = 1$

So the empirical formula is $\text{C}_2\text{H}_6\text{O}$.

Question 2

Oxalic acid is found in rhubarb and contains only the elements carbon, hydrogen and oxygen. When 1.540 g of oxalic acid was burned in oxygen, 1.504 g of CO₂ and 0.310 g of water were formed. Calculate the empirical formula for oxalic acid. If the molecular mass of oxalic acid is 90.0, what is its molecular formula?

Answer

Doing a similar calculation to question 1 gives an empirical formula of CHO₂. Since this adds up to give a formula mass of 45 and the molecular mass is 90, then the molecular formula must be double the empirical formula, i.e. C₂H₂O₄.

Question 3

An organometallic compound known as ferrocene contains only the elements Fe, C and H. When 1.672 g of ferrocene was combusted in oxygen, 3.962 g of CO₂ and 0.810 g of water were formed. Calculate the empirical formula of ferrocene.

Answer

