**EMPIRICAL FORMULA**

Substance A

Substance A was analysed for carbon, hydrogen and oxygen. The sample was found to contain 62.0% carbon, 10.4% hydrogen and 27.5% oxygen by mass. The molecular weight of the compound was found to be approximately 58 g mol-1. Find the empirical formula and molecular formula.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **C** | **H** | **O** | **(Marks)** |
| **m in 100 g** | **62** | **10** | **28** | **🡨 1 mark** |
| **n** | **5.16** | **10.3** | **1.72** | **🡨 1 mark** |
| **Ratio (/1.72)** | **3** | **6** | **1** | **🡨 1 mark** |

**M(C3H6O) = 58.078 g mol-1 (1 mark for showing calculation)**

**Empirical formula: C3H6O (1 mark)**

**Molecular formula: C3H6O (1 mark)**

Substance B

Substance B has an empirical formula of C3H8O. A 1.027 g sample of the colourless liquid was vapourised and found to occupy 0.594 L at 150 °C and 101.3 kPa. Calculate the molecular weight of the compound, and hence find the molecular formula of the compound.

**M(C3H8O) = 60.094 g mol-1 (1 mark)**

**Molecular formula: C3H8O (1 mark)**

Substance C

Substance C was known to contain carbon, hydrogen and oxygen. A 0.775 g sample of the colourless liquid underwent combustion in an excess of oxygen, producing 1.83 g of carbon dioxide and 0.751 g of water.

A separate of 0.620 g sample was vapourised under standard temperature and pressure conditions. The resulting gas occupied 129 mL volume at 220 °C and 1.50 atm pressure.

Find the molecular and empirical formula of the compound.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **C** | **H** | **O** | **(Marks)** |
| **n** | **0.0416** | **0.0834** | **0.0120** |  |
| **Ratio (/0.0120)** | **~3.5** | **~7** | **1** | **🡨 1 mark** |
| **x2** | **7** | **14** | **2** | **🡨 1 mark** |

**M(C7H14O2) = 130.182 g mol-1 (1 mark)**

**Empirical formula: C7H14O2 (1 mark)**

**Molecular formula: C7H14O2 (1 mark)**

Substance D

Substance D is a pale-yellow coloured viscous liquid. The substance known to contain carbon, hydrogen and oxygen.

* A 1.250 g sample of the colourless liquid underwent combustion in an excess of oxygen, producing 3.506 g of carbon dioxide.
* A separate 0.885 g sample underwent combustion in an excess of oxygen, producing 0.9596 g of water.
* A separate analysis revealed a molecular weight of approximately 280-285 g mol-1.

Calculate the empirical formula and molecular formula of the compound.

**Adjusting for sample size… m(H2O) sample 2 = m(H2O) sample 1 x 1.25/0.885 = 1.356 g (1 mark)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **C** | **H** | **O** | **(Marks)** |
| **n** | **0.07976** | **0.1505** | **0.008776** |  |
| **Ratio (/0.008776)** | **~9** | **~17** | **1** | **🡨 1 mark** |

**Empirical formula C9H17O2 (1 mark)**

**M(C9H17O) = 181 g mol-1 (1 mark)**

**Molecular weight needs to be around 2x this much. ∴ molecular formula C18H34O2 (1 mark)**