**EMPIRICAL FORMULA**

Substance A

Substance A was analysed for carbon, hydrogen and oxygen. The sample was found to contain 62.0% carbon, 10% hydrogen and 28% 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. **(6 marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **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. **(6 marks)**

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

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

Substance C

A compound of hydrogen, carbon and oxygen, is commonly known as oil of wintergreen. If a 20.00g sample of the compound was burned in air and it produced 9.46g of water and 46.30g of carbon dioxide. The molecular weight of the compound is found to be 152.15 g/ mol. Calculate the empirical formula and molecular formula of this compound. **(14 marks)**

**n (**

**46.30/ 44.01 = 1.052 mol**

**12.63 g**

**Molecular weight = 152.15 g/mol**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **C** | **H** | **O** | **(Marks)** |
| **N** | **1.052** | **1.050** | **0.391** |  |
| **Ratio (/0.391)** | **2.691** | **2.685** | **1** | **🡨 1 mark** |
| **X3** | **8** | **8** | **3** | **🡨 1 mark** |

**Empirical formula : C8H8O3**

**Empirical formula mass: 158.49 , working out**

**MFmass/ EFmass = approx.1 (1 mark)**

**Molecular formula: C8H8O3 (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.

**(11 marks)**

**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)**