

4. Answer EITHER A OR B

EITHER

4A. An organic substance **A** having the molecular formula $C_8H_8O_2$ liberates carbon dioxide when added to an aqueous solution of sodium hydrogencarbonate but does not decolorize bromine water. Reduction of **A** with lithium aluminium hydride yields **B** ($C_8H_{10}O$) which gives **C** (C_8H_8) on warming with concentrated sulphuric acid. Treatment of **C** with hydrogen bromide at room temperature gives a mixture of two compounds, **D** and **E**. **D**, the major product, is chiral while the minor product, **E**, is not. **D** reacts on heating with aqueous sodium hydroxide to give **F**, the resulting reaction mixture showing optical activity. **F** can be oxidized to **G** (C_8H_8O), which gives a pale yellow precipitate on warming with an alkaline solution of iodine dissolved in aqueous potassium iodide.

(a) Assign a structural formula to compound **A**, explaining your reasoning.

(3 marks)

(b) (i) Give the structural formula for **B**, explaining your reasoning.

(ii) What type of reaction occurs when **B** is converted to **C**?

(iii) Write down the structural formula of **C**.

(4 marks)

(c) (i) Write structural formulae for **D** and **E**.

(ii) Why is **D** chiral while **E** is not?

(iii) Give the mechanism of the reaction between **C** and hydrogen bromide which leads to the formation of **D**.

(iv) Explain, in terms of the mechanism, why **D** is the major product.

(8 marks)

(d) (i) The reaction between **D** and aqueous sodium hydroxide proceeds via an S_N2 mechanism. Show this mechanism in full, giving the structure of **F**.

(ii) Suggest why the resulting reaction mixture shows optical activity.

(iii) Write the structural formula for **G**, explaining how you arrived at it.

(8 marks)

(e) (i) Write the structure of an isomer of $C_8H_8O_2$ which would be expected to have a sweet smell.

(ii) Using any starting materials of your choice, give the conditions for the preparation of a sample of this isomer in the school laboratory.

(iii) Write the structures of TWO isomers of $C_8H_8O_2$ which would be readily oxidized.

(iv) Describe, with the expected result, a chemical test which would enable either of these isomers to be distinguished from **A** and the isomer given in (e)(i).

(7 marks)

TOTAL 30 MARKS