

Q1. Which statement about *E*-1,2-dichloroethene is correct?

- A It has the same boiling point as *Z*-1,2-dichloroethene.
- B It forms a polymer with the same repeating unit as *Z*-1,2-dichloroethene.
- C It has the same IR spectrum as *Z*-1,2-dichloroethene in the range 400–1500 cm⁻¹.
- D It has a molecular ion peak different from that of *Z*-1,2-dichloroethene in its mass spectrum.

(Total 1 mark)

Q2. The table below shows the structures of three isomers with the molecular formula C₅H₁₀O

<p>Isomer 1</p>	(<i>E</i>)-pent-3-en-2-ol
<p>Isomer 2</p>	pentanal
<p>Isomer 3</p>	

(a) Complete the table by naming Isomer 3.

(1)

(b) State the type of structural isomerism shown by these three isomers.

.....

(1)

(c) The compound (*Z*)-pent-3-en-2-ol is a stereoisomer of (*E*)-pent-3-en-2-ol.

(i) Draw the structure of (*Z*)-pent-3-en-2-ol.

(1)

(ii) Identify the feature of the double bond in (*E*)-pent-3-en-2-ol and that in (*Z*)-pent-3-en-2-ol that causes these two compounds to be stereoisomers.

.....

(1)

(d) A chemical test can be used to distinguish between separate samples of Isomer **2** and Isomer **3**.

Identify a suitable reagent for the test.

State what you would observe with Isomer **2** and with Isomer **3**.

Test reagent

Observation with Isomer **2**.....

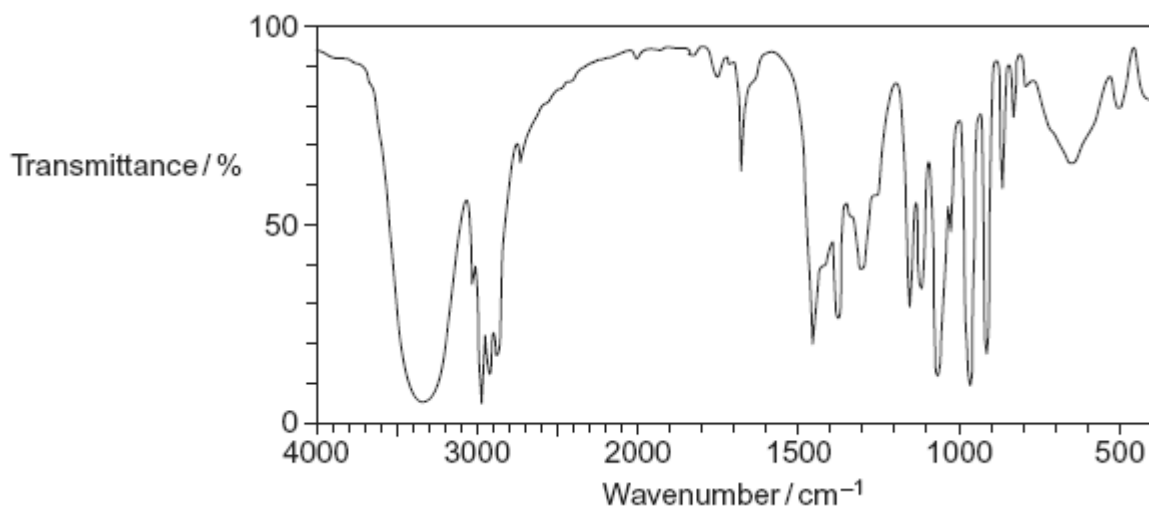
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Observation with Isomer **3**.....

.....

(3)

(e) The following is the infrared spectrum of one of the isomers **1**, **2** or **3**.



- (i) Deduce which of the isomers (**1**, **2** or **3**) would give this infrared spectrum. You may find it helpful to refer to **Table 1** on the Data Sheet.

.....

(1)

- (ii) Identify two features of the infrared spectrum that support your deduction. In each case, identify the functional group responsible.

Feature 1 and functional group

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.....

.....

Feature 2 and functional group

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.....

(2)
(Total 10 marks)

- Q3.** (a) Give the **formula** of a Group 2 metal hydroxide used in agriculture.

.....

(1)

- (b) Identify a sodium halide that does **not** undergo a redox reaction when added as a solid to concentrated sulfuric acid.

.....

(1)

- (c) Chlorine gas reacts with cold dilute sodium hydroxide solution to form sodium chloride and another chlorine-containing compound, **X**.

Give the **formula** of **X**.

.....

(1)

- (d) Give the **formula** of the substance responsible for the orange colour when chlorine gas is bubbled through an aqueous solution of sodium bromide.

.....

(1)

- (e) Solid sodium iodide undergoes a redox reaction with concentrated sulfuric acid.

Give the **formula** for each of the following in this reaction.

Formula of the solid reduction product

Formula of the oxidation product

(2)

- (f) Draw the structure of each of the following organic compounds.

- (i) The hydrocarbon that is a chain isomer of methylpropene, but does **not** exhibit E–Z stereoisomerism.

(1)

(ii) The alcohol that is a position isomer of butan-2-ol.

(1)

(iii) The hydrocarbon that has a peak, due to its molecular ion, at $m/z = 44$ in its mass spectrum.

(1)

(iv) The bromoalkane that reacts with sodium cyanide to produce propanenitrile.

(1)
(Total 10 marks)

Q4. Which statement about ethene is correct?

A It has no geometric isomers because there is free rotation around the C=C bond.

B It reacts with HBr in a nucleophilic addition reaction.

C It burns in excess oxygen to produce carbon dioxide and water.

D The C=C bond is twice as strong as the C–C bond in ethane.

(Total 1 mark)

Q5. It is possible to convert but-1-ene into its structural isomer but-2-ene.

(a) State the type of structural isomerism shown by but-1-ene and but-2-ene.

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(1)

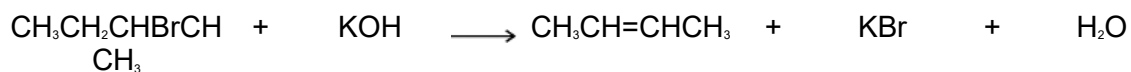
(b) The first stage in this conversion involves the reaction of hydrogen bromide with but-1-ene.



Outline a mechanism for this reaction.

(4)

(c) The second stage is to convert 2-bromobutane into but-2-ene.



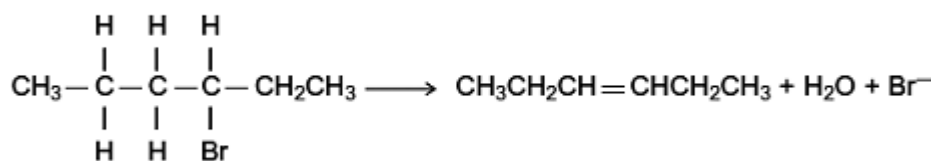
Outline a mechanism for this reaction.

(3)
(Total 8 marks)

Q6. Alkenes are useful intermediates in the synthesis of organic compounds.

(a) (i) Complete the elimination mechanism by drawing appropriate curly arrows.

HO^- :



3-bromohexane

hex-3-ene

(3)

(ii) Draw structures for the E and Z stereoisomers of hex-3-ene.

E isomer of hex-3-ene

Z isomer of hex-3-ene

(2)

(iii) State the meaning of the term *stereoisomers*.

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(Extra space)

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(2)

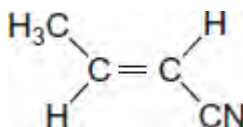
- (b) The equation for the first reaction in the conversion of hex-3-ene into hexan-3-ol is shown below.



Outline a mechanism for this reaction.

(4)
(Total 11 marks)

Q7. The alkene (*E*)-but-2-enenitrile is used to make acrylic plastics.
The structure of (*E*)-but-2-enenitrile is



- (a) (i) Draw the structure of (*Z*)-but-2-enenitrile.

(1)

- (ii) Identify the feature of the double bond in the *E* and *Z* isomers that causes them to be stereoisomers.
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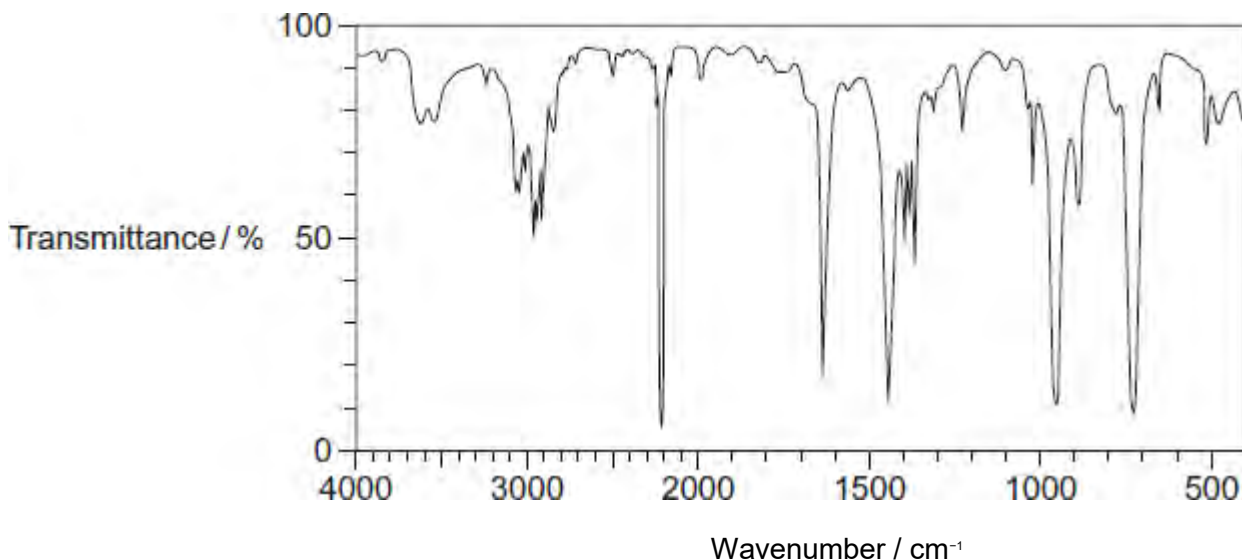
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(1)

- (b) Draw the repeating unit of the polyalkene formed by addition polymerisation of (*E*)-but-2-enitrile.

(1)

- (c) Consider the infrared spectrum of (*E*)-but-2-enitrile.



Identify **two** features of the infrared spectrum that support the fact that this is the infrared spectrum for but-2-enitrile.
You may find it helpful to refer to **Table 1** on the Data Sheet.

Feature 1

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.....

Feature 2

.....
.....

(2)
(Total 5 marks)

