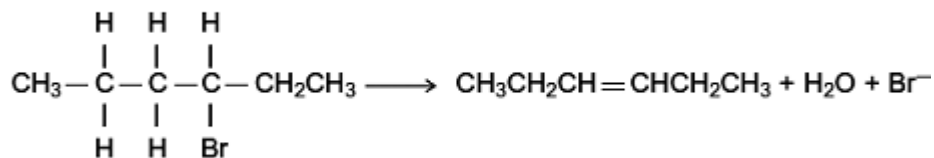


**Q1.** Alkenes are useful intermediates in the synthesis of organic compounds.

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

$\text{HO}^-$ :



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)

**Q2.** 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)

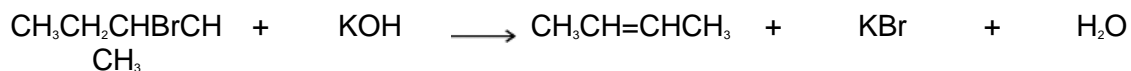
- (b) The first stage in this conversion involves the reaction of hydrogen bromide with but-1-ene.



Outline a mechanism for this reaction.

(4)

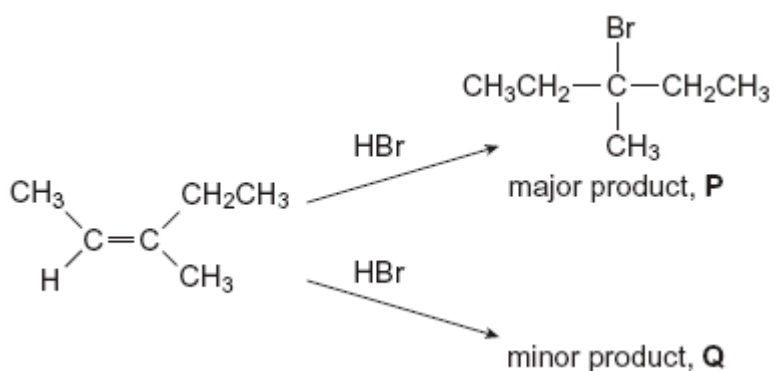
(c) The second stage is to convert 2-bromobutane into but-2-ene.



Outline a mechanism for this reaction.

(3)  
(Total 8 marks)

**Q3.** The alkene (Z)-3-methylpent-2-ene reacts with hydrogen bromide as shown below.



(a) (i) Name the major product **P**.

.....

(1)

(ii) Name the mechanism for these reactions.

.....

(1)

(iii) Draw the displayed formula for the minor product **Q** and state the type of structural isomerism shown by **P** and **Q**.

Displayed formula for **Q**

Type of structural isomerism .....

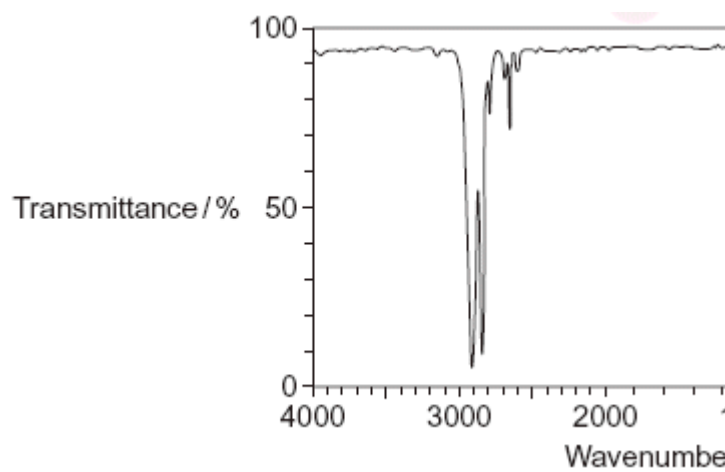
(2)

(iv) Draw the structure of the (E)-stereoisomer of 3-methylpent-2-ene.

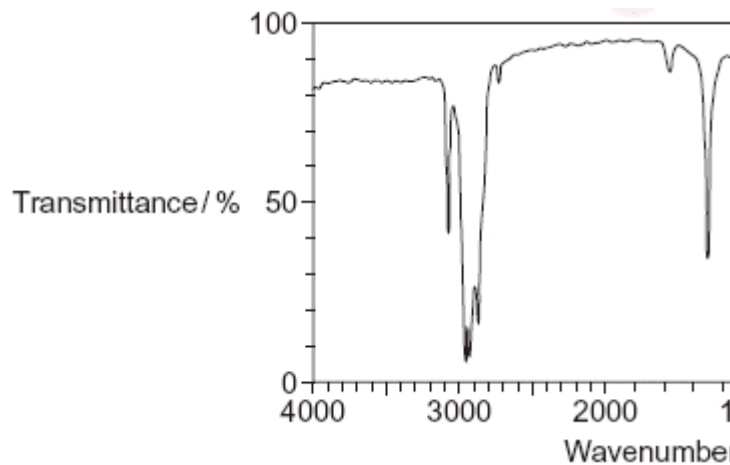
(1)

(b) The infrared spectra of two compounds **R** and **S** are shown below. **R** and **S** have the molecular formula  $C_6H_{12}$  and are structural isomers of 3-methylpent-2-ene. **R** is an unsaturated hydrocarbon and **S** is a saturated hydrocarbon.

Spectrum 1



Spectrum 2



- (i) Identify the infrared Spectrum **1** or **2** that represents compound **R**. Use information from the infrared spectra to give **one** reason for your answer. You may find it helpful to refer to **Table 1** on the Data Sheet.

**R** is represented by Spectrum .....

Reason .....

.....

(2)

- (ii) State the type of structural isomerism shown by **R** and **S**.

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(1)

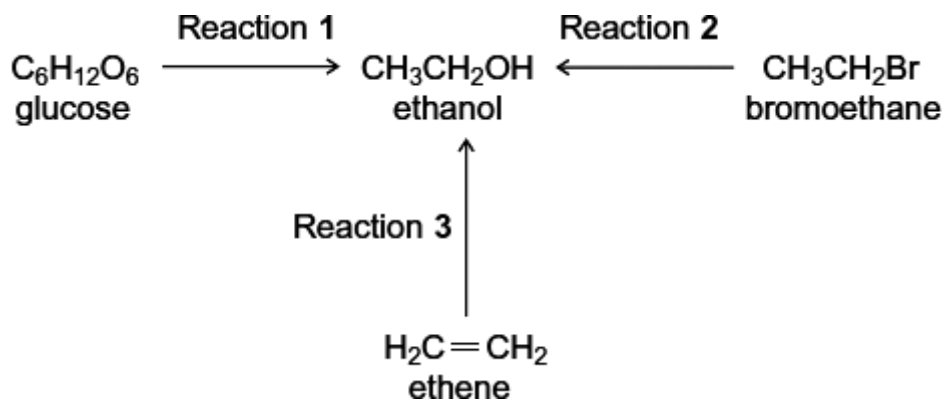
- (iii) Name **one** possible compound which could be **S**.

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(1)

(Total 9 marks)

**Q4.** Three different ways of producing ethanol are shown below.



- (a) Reaction 1 produces a 15% aqueous solution of ethanol. It is claimed that the ethanol produced in this way is a carbon-neutral biofuel.

Write an equation for Reaction 1 and name the process.

Write an equation for the complete combustion of ethanol.

Explain why the ethanol produced by this process may **not** be a *carbon-neutral* biofuel.

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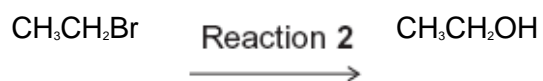
(Extra space) .....

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(5)

- (b) Give a reagent and conditions for Reaction 2.



Name and outline a mechanism for Reaction 2.

Suggest **one** reason, other than safety, why this method is **not** used in industry to make ethanol.

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(6)

(c) Reaction 3 is used in industry.



Identify a suitable catalyst for Reaction 3.

Identify the type of reaction.

Give **two** conditions, in addition to the presence of a catalyst, necessary for Reaction 3 to produce a high yield of ethanol.

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(Extra space) .....

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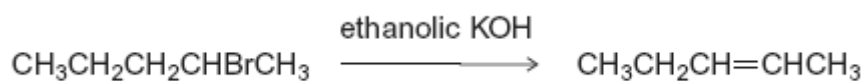
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(4)  
(Total 15 marks)

**Q5.** Organic reaction mechanisms help chemists to understand how the reactions of organic compounds occur. The following conversions illustrate a number of different types of reaction mechanism.

- (a) When 2-bromopentane reacts with ethanolic KOH, two structurally isomeric alkenes are formed.
- (i) Name and outline a mechanism for the conversion of 2-bromopentane into pent-2-ene as shown below.



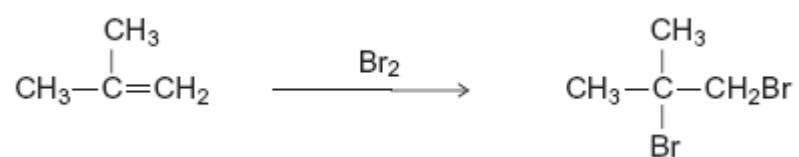


(4)

- (ii) Draw the structure of the other structurally isomeric alkene produced when 2-bromopentane reacts with ethanolic KOH.

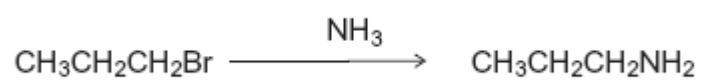
(1)

- (b) Name and outline a mechanism for the following conversion.



(5)

(c) Name and outline a mechanism for the following conversion.



(5)  
(Total 15 marks)