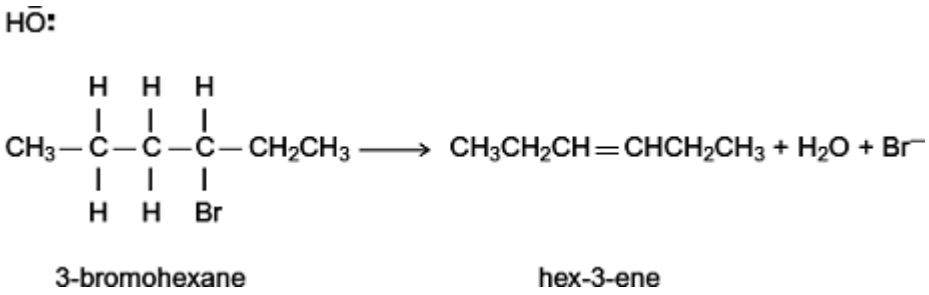
Q1. Alkenes are useful intermediates in the synthesis of organic compounds.

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



(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*.

.....

.....

.....

.....

.....

(Extra space) .....

.....

(2)

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

$CH_3CH_2CH=CHCH_2CH_3 + H_2SO_4 \longrightarrow CH_3CH_2CH_2CH(OSO_2OH)CH_2CH_3$

Outline a mechanism for this reaction.

(4)
(Total 11 marks)

Q2. How many different alkenes are formed when 2-bromo-3-methylbutane reacts with ethanolic potassium hydroxide?

A 2

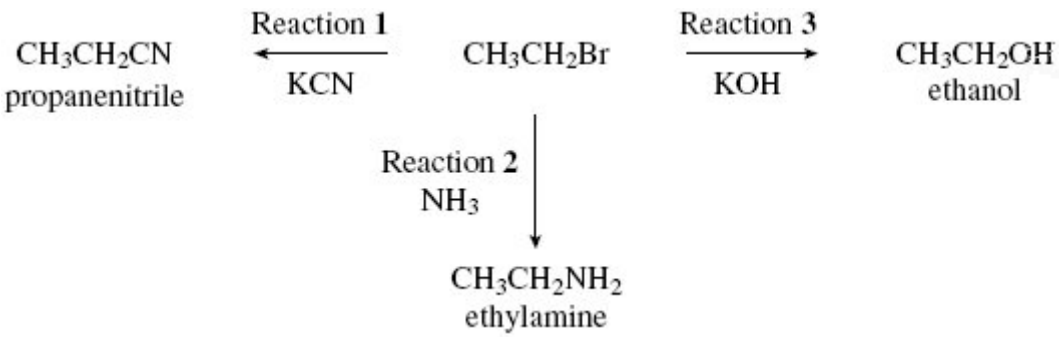
B 3

C 4

D 5

(Total 1 mark)

Q3. Nucleophiles react with bromoethane in substitution reactions. This type of reaction is illustrated in the following scheme.



(a) State what is meant by the term *nucleophile*.

.....

(1)

(b) Outline a mechanism for the reaction of potassium cyanide with bromoethane (Reaction **1**).

(2)

(c) Explain why an excess of ammonia is needed in Reaction **2** to produce a high yield of ethylamine.

.....

.....

(1)

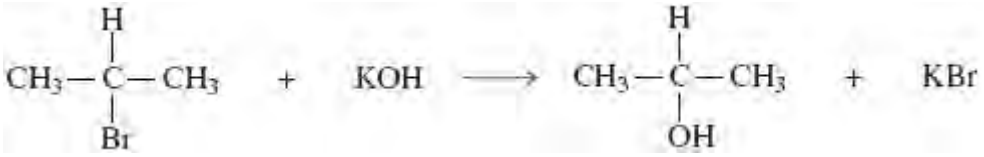
(d) When potassium hydroxide reacts with bromoethane, ethene can also be formed. Name and outline a mechanism for this reaction.

Name of mechanism .....

Mechanism

(4)
(Total 8 marks)

Q4. (a) Consider the following reaction.



(i) Name and outline a mechanism for this reaction.

Name of mechanism .....

Mechanism

(3)

(ii) Name the haloalkane in this reaction.

.....

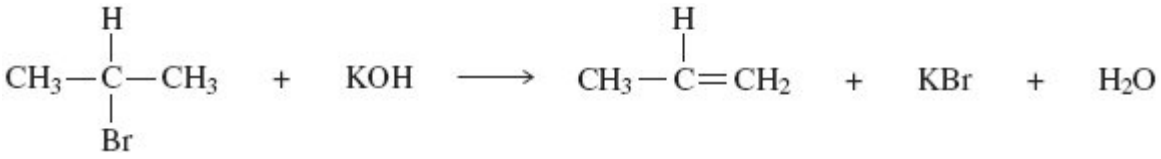
(1)

(iii) Identify the characteristic of the haloalkane molecule that enables it to undergo this type of reaction.

.....

(1)

(b) An alternative reaction can occur between this haloalkane and potassium hydroxide as shown by the following equation.



Name and outline a mechanism for this reaction.

Name of mechanism .....

Mechanism

(4)

(c) Give **one** condition needed to favour the reaction shown in part (b) rather than that shown in part (a).

.....

(1)

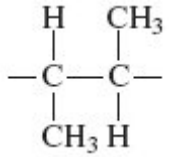
(d) Alkenes can be polymerised to produce poly(alkenes).

(i) State the type of polymerisation that alkenes undergo.

.....

(1)

(ii) Name the alkene that gives a polymer with the repeating unit shown below.



Name of alkene .....

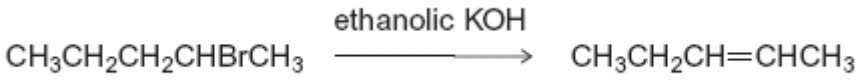
(1)

(Total 12 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.

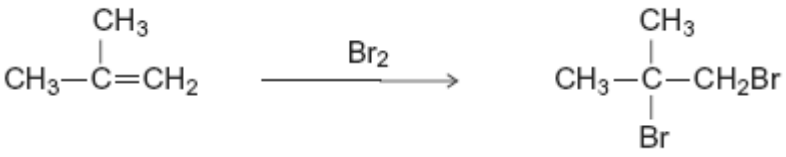


(4)

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

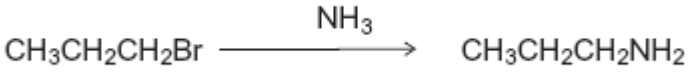
(1)

(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)

Q6. A student read the following passage on the Internet.

Haloalkanes contain a polar covalent bond. The carbon atom of the polar covalent bond can be attacked by nucleophiles. Nucleophilic attack enables haloalkanes to undergo substitution reactions.
A nucleophilic substitution reaction occurs when a haloalkane undergoes hydrolysis; the rate of hydrolysis of the haloalkane is influenced by the carbon–halogen bond enthalpy.

(a) Explain the meaning of each of the following terms in the information given above.

(i) *nucleophile*

.....

.....

.....

(1)

(ii) *substitution,* as applied to nucleophilic substitution in a haloalkane

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.....

.....

(1)

(iii) *hydrolysis*

.....

.....

.....

(1)

(iv) *bond enthalpy,* as applied to a carbon–halogen bond.

.....

.....

.....

(1)

(b) Outline a mechanism for the nucleophilic substitution reaction in which 2-bromopropane ($CH_3CHBrCH_3$) reacts with potassium hydroxide to form propan-2-ol.

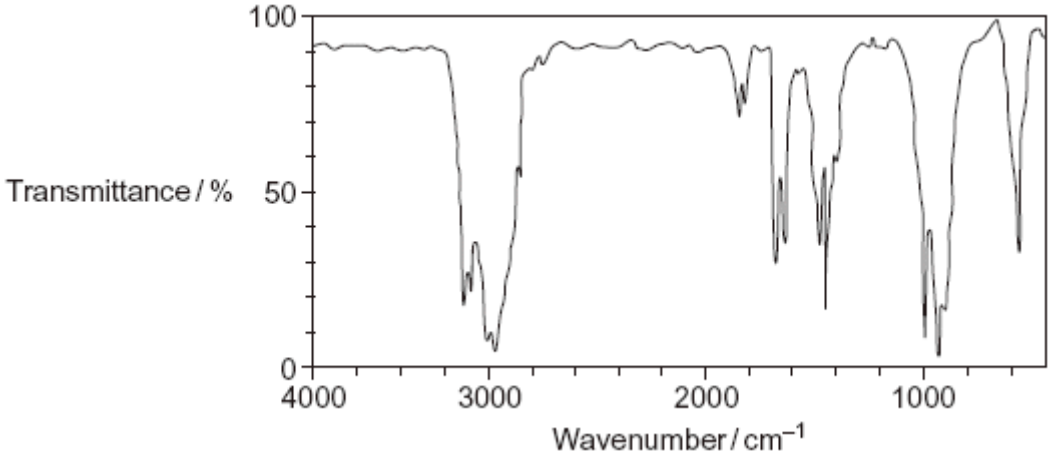
(2)

(c) Haloalkanes also undergo elimination reactions to produce alkenes.

(i) Outline a mechanism for the elimination reaction in which 2-bromopropane reacts with potassium hydroxide to form propene.

(3)

(ii) A student obtained the following infrared spectrum for the product from this elimination reaction.



Use information from the infrared spectrum to state and explain how the

student deduced that the product was an alkene.
You may find it helpful to refer to **Table 1** on the Data Sheet.

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(2)
(Total 11 marks)