**Q1.**Which one of the following can react both by nucleophilic addition and by nucleophilic substitution?



(Total 1 mark)

Q2.Which one of the following reactions involves nucleophilic addition?

- $\textbf{A} \qquad \textbf{CH}_{3}\textbf{CH} = \textbf{CH}_{2} + \textbf{HBr} \rightarrow \textbf{CH}_{3}\textbf{CHBrCH}_{3}$
- $\mathbf{B} \qquad \mathsf{CH}_3\mathsf{CH}_2\mathsf{CH}_3 + \mathsf{Cl}_2 \rightarrow \mathsf{CH}_3\mathsf{CHCICH}_3 + \mathsf{HCI}$
- $\textbf{C} \qquad CH_3CH_2CH_2Br + NaOH \rightarrow CH_3CH_2CH_2OH + NaBr$
- **D**  $CH_3CH_2CHO + HCN \rightarrow CH_3CH_2CH(OH)CN$

(Total 1 mark)

Q3.Which one of the following is not a suitable method for the preparation of ethanol?

- **A** oxidation of ethane
- **B** hydration of ethene
- **C** reduction of ethanal
- **D** hydrolysis of bromoethane

(Total 1 mark)

Q4.In which one of the following are the curly arrows not used correctly?



Q5.In which of the following is a curly arrow used incorrectly?



(Total 1 mark)

Q6.Which one of the following mechanisms is not involved in the reaction sequence below?

 $\mathsf{CH}_3\mathsf{CH}_3 \to \mathsf{CH}_3\mathsf{CH}_2\mathsf{CI} \to \mathsf{CH}_3\mathsf{CH}_2\mathsf{OH} \to \mathsf{CH}_2\texttt{=}\mathsf{CH}_2 \to \mathsf{CH}_3\mathsf{CH}_2\mathsf{Br}$ 

- **A** electrophilic addition
- **B** electrophilic substitution
- **C** nucleophilic substitution
- **D** free-radical substitution

(Total 1 mark)

- **Q7.** (a) Compounds with double bonds between carbon atoms can exhibit geometrical isomerism.
  - (i) Draw structures for the two geometrical isomers of 1,2-dichloroethene.

Isomer 1

Isomer 2

(ii) What feature of the double bond prevents isomer 1 from changing into isomer 2?

.....

(3)

(b) When 2-chloropropane reacts with sodium hydroxide, two different reactions occur. Each reaction produces a different organic product.

**Reaction 1** 
$$CH_3 - C - CH_3 + NaOH \rightarrow CH_3 - CH - CH_3 + NaCl$$
  
 $| \\Cl OH$   
**Reaction 2**  $CH_3 - C - CH_3 + NaOH \rightarrow CH_3 - CH = CH_2 + NaCl + H_2O$   
 $| \\Cl$ 

(i) Outline a mechanism for **Reaction 1** and state the role of the hydroxide ion in this reaction.

Mechanism

Role of the hydroxide ion .....

(ii) Outline a mechanism for **Reaction 2** and state the role of the hydroxide ion in this reaction.

Mechanism

Role of the hydroxide ion .....

(7) (Total 10 marks)

**Q8.** (a) Propene reacts with hydrogen bromide by an electrophilic addition mechanism

forming 2-bromopropane as the major product.

The equation for this reaction is shown below.

$$H_{3}C = C H + HBr \rightarrow H_{3}C - C - C - H H HBr \rightarrow H_{4}C - C - C - H H H H$$

(i) Outline the mechanism for this reaction, showing the structure of the intermediate carbocation formed.

(ii) Give the structure of the alternative carbocation which could be formed in the reaction between propene and hydrogen bromide.

- (5)
- (b) A substitution reaction occurs when 2-bromopropane reacts with aqueous sodium hydroxide.
  - (i) Draw the structure of the organic product of this reaction and give its name.

Structure

Name .....

(ii) Name and outline the mechanism for this reaction.
 *Name of mechanism ...... Mechanism*

(5)

(c)	Unde produ	Inder different conditions, 2-bromopropane reacts with sodium hydroxide to roduce propene.	
	(i)	Name the mechanism for this reaction.	
	(ii)	State the role of sodium hydroxide in this reaction.	

**Q9.** (a) The equation below shows the reaction of 2-bromopropane with an excess of ammonia.

 $CH_{3}CHBrCH_{3}$  +  $2NH_{3}$   $\rightarrow$   $CH_{3}CH(NH_{2})CH_{3}$  +  $NH_{4}Br$ 

Name and outline the mechanism involved.

Name of mechanism .....

Mechanism

(b) When 2-bromopropane is heated with ethanolic potassium hydroxide, an elimination reaction occurs. State the role of potassium hydroxide and outline a mechanism for this reaction.

Role of potassium hydroxide .....

Mechanism

(5) (Total 10 marks)

**Q10.**Which one of the following types of reaction mechanism is **not** involved in the above sequence?



- **B** nucleophilic substitution
- **C** elimination

Α

**D** nucleophilic addition-elimination

(Total 1 mark)

- Q11. Reaction of 2-bromobutane with potassium hydroxide can produce two types of product depending on the solvent used. In aqueous solution, the formation of an alcohol, E, is more likely but in ethanolic solution the formation of alkenes is more likely.
  - (a) For each type of product, name the type of reaction occurring and state the role of the potassium hydroxide.

(4)

(b) Name alcohol **E** and draw its structural formula. By reference to the structure of the halogenoalkane, explain why the initial step in the mechanism of the reaction

(c) When 2-bromobutane reacts with ethanolic potassium hydroxide, two structurally isomeric alkenes are produced, one of which shows stereoisomerism.

Outline the mechanism for the formation of one of the structurally isomeric alkenes. Explain why two structurally isomeric alkenes are formed and draw the structure of the second structural isomer. Draw the structural formulae of the two stereoisomers.