Q1. (a) Name and outline a mechanism for the reaction of 2-bromo-2-methylpropane with ethanolic potassium hydroxide to form the alkene 2-methylpropene, $(CH_3)_2C=CH_2$

Name of mechanism .....

Mechanism

(4)

(b) Two stereoisomers of but-2-ene are formed when 2-bromobutane reacts with ethanolic potassium hydroxide.

(i) Explain what is meant by the term *stereoisomers*.

.....

.....

(ii) Draw the structures and give the names of the **two** stereoisomers of but-2-ene.

Stereoisomer 1 *Stereoisomer 2*

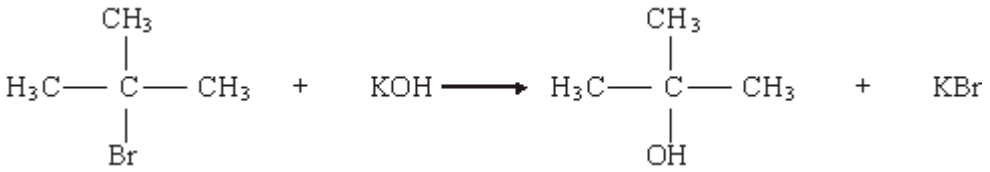
Name ..... *Name* .....

(iii) Name this type of stereoisomerism.

.....

(5)

(c) When 2-bromo-2-methylpropane reacts with aqueous potassium hydroxide, 2-methylpropan-2-ol is formed as shown by the following equation.



State the role of the hydroxide ions in this reaction.

.....

(1)

(d) Write an equation for the reaction that occurs when $CH_3CH_2CH_2CH_2Br$ reacts with an excess of ammonia. Name the organic product of this reaction.

Equation .....

Name of product .....

(3)

(Total 13 marks)

Q2. (a) Chloromethane can be made by the reaction of chlorine with methane.

(i) Give **one** essential condition for this reaction.

.....

(ii) Name the mechanism for this reaction.

.....

(iii) Further substitution can occur during this reaction. Identify the main organic product when a large excess of chlorine is used in this reaction.

.....

(3)

(b) Ethanenitrile can be made by reacting chloromethane with potassium cyanide.

(i) Write an equation for this reaction.

.....

(ii) Name the mechanism for this reaction.

.....

(iii) Explain, in terms of bond enthalpies, why bromomethane reacts faster than chloromethane with potassium cyanide.

.....

.....

.....

(3)

(c) Ethanenitrile can be hydrolysed to a carboxylic acid by heating it under reflux with a dilute acid. Identify the carboxylic acid formed in this reaction.

.....

(1)

(d) Chloromethane can react with ammonia to produce a primary amine.

(i) What feature of the chloromethane molecule makes it susceptible to attack by an ammonia molecule?

.....

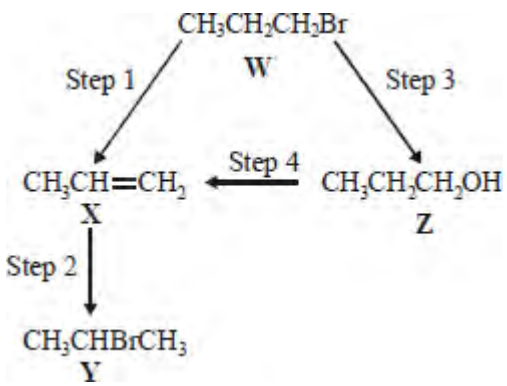
(ii) Name the amine produced in this reaction.

.....

(iii) Outline a mechanism for this reaction.

(6)
(Total 13 marks)

Q3. For this question refer to the reaction scheme below.



Which one of the following reagents would **not** bring about the reaction indicated?

A Step 1 : alcoholic KOH

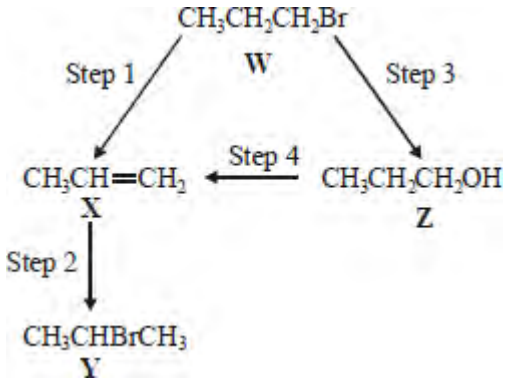
B Step 2 : aqueous Br_2

C Step 3 : aqueous NaOH

C Step 4 : concentrated H_2SO_4

(Total 1 mark)

Q4. For this question refer to the reaction scheme below.



Which one of the following statements is **not** correct?

A Reaction of **W** with sodium cyanide followed by hydrolysis of the resulting product gives propanoic acid.

B Mild oxidation of **Z** produces a compound that reacts with Tollens' reagent, forming a silver mirror.

C **Z** reacts with ethanoic acid to produce the ester propyl ethanoate.

C **W** undergoes addition polymerisation to form poly(propene).

(Total 1 mark)

Q5. (a) Bromomethane, CH_3Br, can be formed by a reaction between bromine and methane.

The mechanism for this reaction is similar to the mechanism for the chlorination of methane.

(i) Name the mechanism for this reaction.

.....

(ii) Give the name of, and state an essential condition for, the first step in the mechanism for this reaction.

Name .....

Essential condition .....

(iii) Write an equation for a termination step in the mechanism for this reaction which gives ethane as a product.

.....

(iv) Bromomethane can undergo further substitution. Write an overall equation for the reaction between bromomethane and bromine in which dibromomethane is formed.

.....

(5)

(b) Bromomethane reacts with the nucleophile ammonia according to the following equation.

$CH_3Br + 2NH_3 \rightarrow CH_3NH_2 + NH_4Br$

(i) Explain what is meant by the term *nucleophile*.

.....

.....

(ii) Name the organic product of this reaction.

.....

(iii) Outline a mechanism for this reaction.

(6)
(Total 11 marks)

Q6. Which one of the following statements explains best why fluoroalkanes are the least reactive haloalkanes?

A Fluorine is much more electronegative than carbon.

B The F^- ion is the most stable halide ion.

C The C–F bond is the most polar carbon–halogen bond.

D The C–F bond is the strongest carbon–halogen bond.

(Total 1 mark)

Q7. Which one of the following reactions does **not** involve donation of an electron pair?

A $H^+ + CH_3NH_2 \rightarrow CH_3NH_3^+$

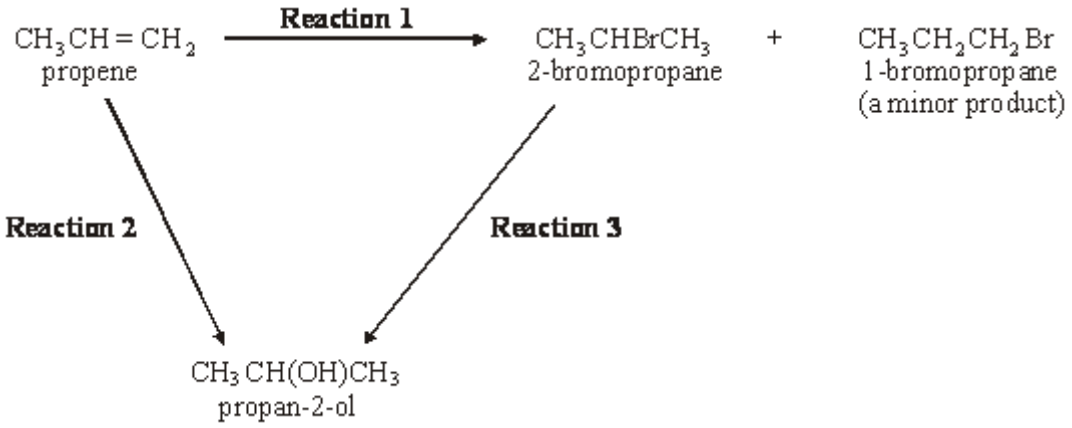
B $AlCl_3 + Cl^- \rightarrow A1C1_4^-$

C $CH_3Cl + CN^- \rightarrow CH_3CN + Cl^-$

D $\frac{1}{2}Cl_2 + I^- \rightarrow Cl^- + \frac{1}{2}I_2$

(Total 1 mark)

Q8. Consider the following reaction scheme.



(a) (i) Name the mechanism for **Reaction 1**.

.....

(ii) Explain why 1-bromopropane is only a minor product in **Reaction 1**.

.....

.....

.....

(3)

(b) Give a suitable reagent and state the essential conditions required for **Reaction 3**.

Reagent .....

Conditions .....

(2)

(c) The reagent used for **Reaction 3** can also be used to convert 2-bromopropane into propene. State the different conditions needed for this reaction.

.....

(1)

(d) **Reaction 2** proceeds in two stages.

Stage 1 $CH_3CH{=}CH_2 + H_2SO_4 \rightarrow CH_3CH(OSO_2OH)CH_3$

Stage 2 $CH_3CH(OSO_2OH)CH_3 + H_2O \rightarrow CH_3CH(OH)CH_3 + H_2SO_4$

(i) Name the class of alcohols to which propan-2-ol belongs.

.....

(ii) Outline a mechanism for Stage 1 of **Reaction 2**, using concentrated sulphuric acid.

(iii) State the overall role of the sulphuric acid in **Reaction 2**.

.....

(6)
(Total 12 marks)