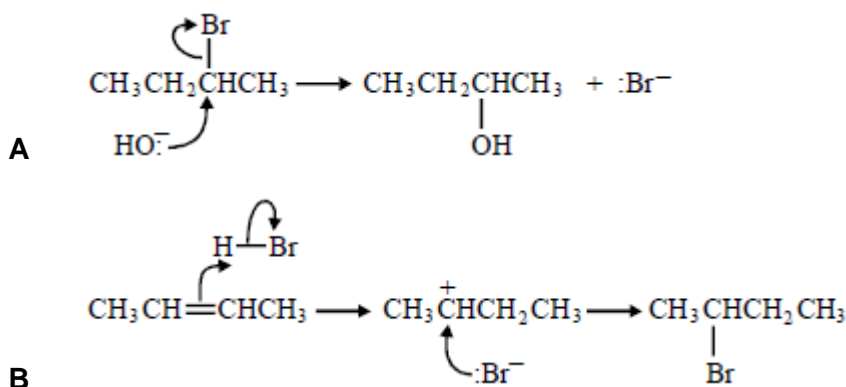
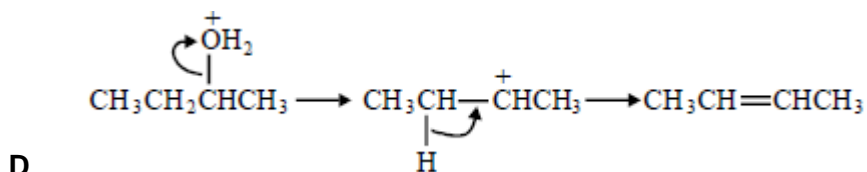
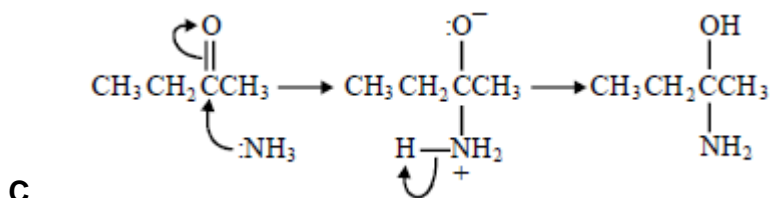


Q1. Butenedioic acid, $\text{HOOCCH}=\text{CHCOOH}$, occurs as two stereoisomers. One of the isomers readily forms the acid anhydride $\text{C}_4\text{H}_2\text{O}_3$ when warmed.

- (a) Draw the structures of the two isomers of butenedioic acid and name the type of isomerism shown.
Use the structures of the two isomeric acids to suggest why only one of them readily forms an acid anhydride when warmed. Draw the structure of the acid anhydride formed. (6)
- (b) Identify one electrophile which will react with butenedioic acid and outline a mechanism for this reaction. (4)
- (c) Write an equation for a reaction which occurs when butenedioic acid is treated with an excess of aqueous sodium hydroxide. (2)
- (d) Describe and explain the appearance of the proton n.m.r. spectrum of butenedioic acid. (3)
- (Total 15 marks)**

Q2. In which of the following is a curly arrow used incorrectly?





(Total 1 mark)

Q3. Which one of the following mechanisms is **not** involved in the reaction sequence below?



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

(Total 1 mark)

Q4. Propene reacts with hydrogen bromide to form a mixture of saturated organic products. The proton n.m.r. spectrum of the major organic product has

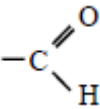
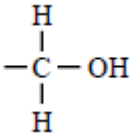
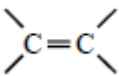
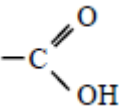
- A 3 peaks with relative intensities 3 : 2 : 2
- B 2 peaks with relative intensities 3 : 4
- C 3 peaks with relative intensities 3 : 1 : 3
- D 2 peaks with relative intensities 6 : 1

(Total 1 mark)

Q5. Certain chemical tests were performed on the pain-relief drug ibuprofen. The results of these tests are given in the table below.

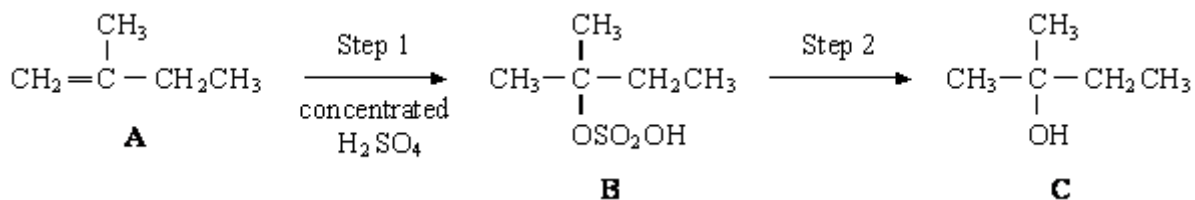
Test	Result
Aqueous sodium carbonate	Effervescence
Bromine water	Remained orange
Acidified potassium dichromate(VI) and heat	Remained orange
Fehling's solution and heat	Remained blue

Which one of the following functional groups do these results suggest that ibuprofen contains?

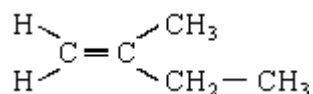
- A** 
- B** 
- C** 
- D** 

(Total 1 mark)

Q6. The reaction scheme below shows the conversion of compound **A**, 2-methylbut-1-ene, into compound **B** and then into compound **C**.



(a) The structure of **A** is shown below. Circle those carbon atoms which must lie in the same plane.



(1)

(b) Outline a mechanism for the reaction in Step 1.

(4)

(c) State the reagent and condition used in Step 2. Name compound **C**.

Reagent

Condition

Name of compound C

(3)

(d) When compound **A** is converted into compound **C**, a second alcohol, **D**, is also formed.

Alcohol **D** is isomeric with **C** but is formed as a minor product. Identify alcohol **D** and explain why it is formed as the minor product.

Identity of alcohol D

Explanation

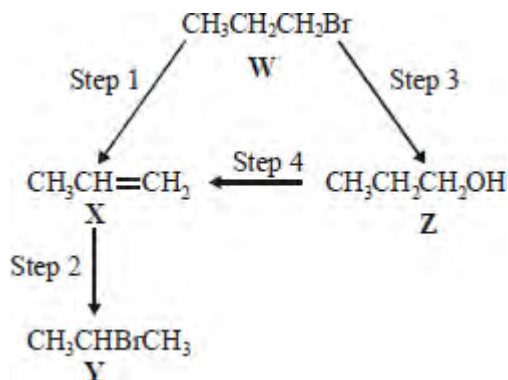
.....

.....

(3)

(Total 11 marks)

Q7.For this question refer to the reaction scheme below.

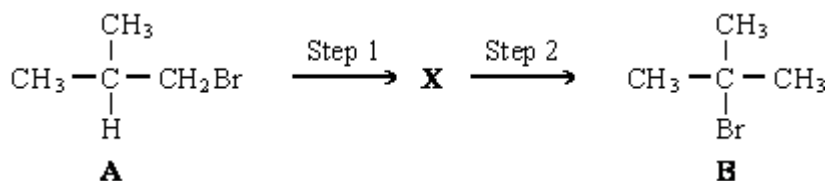


Which one of the following reagents would **not** bring about the reaction indicated?

- A Step 1 : alcoholic KOH
- B Step 2 : aqueous Br₂
- C Step 3 : aqueous NaOH
- C Step 4 : concentrated H₂SO₄

(Total 1 mark)

Q8. The conversion of compound **A** into compound **B** can be achieved in two steps as shown below.



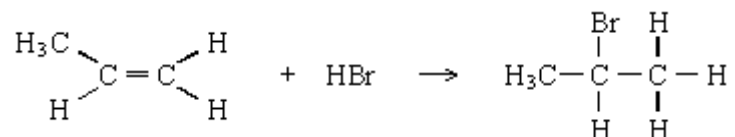
The intermediate compound, **X**, has an absorption at 1650 cm⁻¹ in its infra-red spectrum.

- (a) Identify compound **X**. Explain your answer. (2)
- (b) For each step in this conversion, give the reagents and essential conditions required and outline a mechanism. (11)
- (c) Show how the number of peaks in their proton n.m.r. spectra would enable you to distinguish between compounds **A** and **B**. (2)

(Total 15 marks)

- Q9.** (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.



- (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) Under different conditions, 2-bromopropane reacts with sodium hydroxide to produce propene.

(i) Name the mechanism for this reaction.

.....

(ii) State the role of sodium hydroxide in this reaction.

.....

(2)
(Total 12 marks)