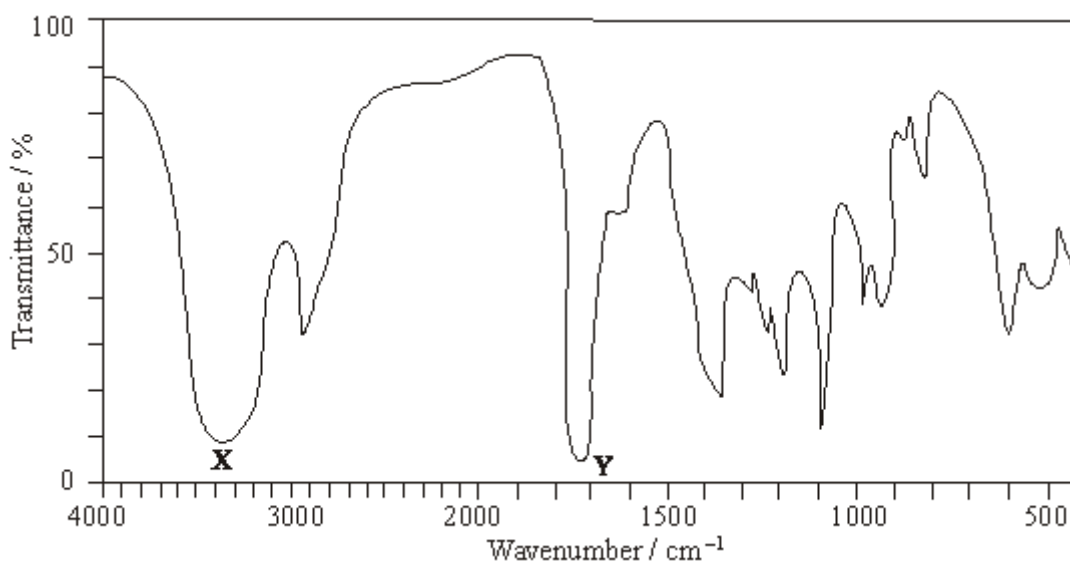


Q1. Which one of the following statements about but-2-enal, $\text{CH}_3\text{CH}=\text{CHCHO}$, is **not** true?

- A It has stereoisomers.
- B It shows a strong absorption in the infra-red at about 1700 cm^{-1} .
- C It will turn an acidified solution of potassium dichromate(VI) green.
- D It can be dehydrated by concentrated sulphuric acid.

(Total 1 mark)

Q2. (a) The infra-red spectrum of compound A, $\text{C}_3\text{H}_6\text{O}_2$, is shown below.



Identify the functional groups which cause the absorptions labelled X and Y.

Using this information draw the structures of the three possible structural isomers for A.

Label as A the structure which represents a pair of optical isomers.

(6)

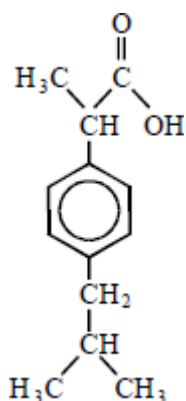
(b) Draw the structures of the three **branched-chain** alkenes with molecular formula C_5H_{10}

Draw the structures of the three dibromoalkanes, $\text{C}_5\text{H}_{10}\text{Br}_2$, formed when these three alkenes react with bromine.

One of these dibromoalkanes has only three peaks in its proton n.m.r. spectrum. Deduce the integration ratio and the splitting patterns of these three peaks.

Q3. Ibuprofen is a drug used as an alternative to aspirin for the relief of pain, fever and inflammation.

The structure of ibuprofen is shown below.

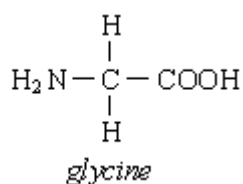
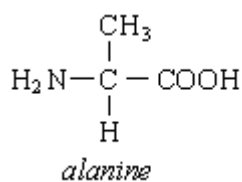


Which one of the following statements is **not** correct?

- A** It has optical isomers.
- B** It liberates carbon dioxide with sodium carbonate solution.
- D** It undergoes esterification with ethanol.
- D** It undergoes oxidation with acidified potassium dichromate(VI).

(Total 1 mark)

Q4. The structures of the amino acids *alanine* and *glycine* are shown below.



(a) Give the systematic name for *alanine*.

.....

(1)

(b) *Alanine* exists as a pair of stereoisomers.

(i) Explain the meaning of the term *stereoisomers*.

.....
.....
.....

(ii) State how you could distinguish between the stereoisomers.

.....
.....
.....

(4)

(c) Give the structural formula of the species formed by *glycine* at pH 14.

(1)

(d) When two amino acids react together, a dipeptide is formed. Give the structural formulae of the **two** dipeptides which are formed when *alanine* and *glycine* react together.

Dipeptide 1

Dipeptide 2

(2)

- (e) Give the structural formula of the organic compound formed when *glycine* reacts with methanol in the presence of a small amount of concentrated sulphuric acid.

(1)

(Total 9 marks)

Q5. Each of the parts (a) to (e) below concerns a different pair of isomers.

Draw one possible structure for each of the species **A** to **J**, using Table 2 on the Data

Sheet where appropriate.

- (a) Compounds **A** and **B** have the molecular formula C_5H_{10}
A decolourises bromine water but **B** does not.

A **B**

(2)

- (b) Compounds **C** and **D** have the molecular formula $C_2H_4O_2$

Each has an absorption in its infra-red spectrum at about 1700 cm^{-1} but only **D** has a broad absorption at 3350 cm^{-1}

C **D**

(2)

- (c) Compounds **E** and **F** are esters with the molecular formula $C_5H_{10}O_2$

The proton n.m.r. spectrum of **E** consists of two singlets only whereas that of **F** consists of two quartets and two triplets.

E **F**

(2)

- (d) Compounds **G** and **H** have the molecular formula $C_3H_6O_2$. **G** shows optical activity but **H** does not.

G **H**

(2)

- (e) Compounds **I** and **J** have the molecular formula C_6H_{12}

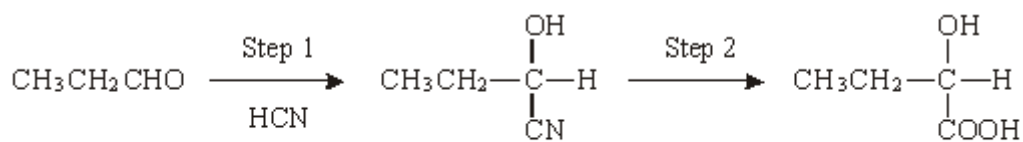
Each has an absorption in its infra-red spectrum at about 1650 cm^{-1} and neither shows geometrical isomerism. The proton n.m.r. spectrum of **I** consists of a singlet only whereas that of **J** consists of a singlet, a triplet and a quartet.

I **J**

(2)

(Total 10 marks)

Q6. Consider the reaction sequence shown below.



propanal

Q

- (a) Name and outline a mechanism for the reaction in Step 1.

Name of mechanism

Mechanism

(5)

- (b) (i) Name compound **Q** formed in Step 2.

.....

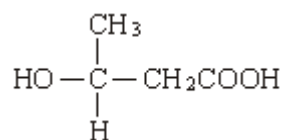
- (ii) Two stereoisomers are formed by the dehydration of **Q**. Give the structures of these two isomers and name the type of stereoisomerism shown.

Structures of isomers

Type of stereoisomerism

(4)

- (c) An isomer of **Q** which has the structure shown below is polymerised to form the biodegradable polymer known as PHB.



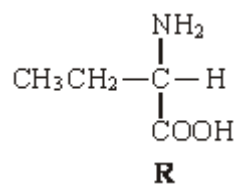
- (i) Draw the repeating unit of the polymer PHB.

- (ii) Suggest a reason why the polymer is biodegradable.

.....
.....

(2)

- (d) The amino acid **R** is shown below.



- (i) Draw the structure of the zwitterion formed by **R**.

(ii) Draw the structure of the major organic product formed when an excess of **R** is reacted with bromomethane.

(iii) Name the mechanism of the reaction which results in the formation of the product given in part (ii).

.....

(3)
(Total 14 marks)