

A- level  
Chemistry  
Organic Chemistry

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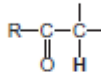
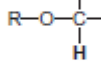
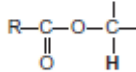


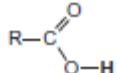
Total number of marks: 49

0 7

This question is about NMR spectroscopy.

Table B from Data Booklet

**Table B**  
<sup>1</sup>H NMR chemical shift data

Type of proton	$\delta$ /ppm
ROH	0.5–5.0
RCH <sub>3</sub>	0.7–1.2
RNH <sub>2</sub>	1.0–4.5
R <sub>2</sub> CH <sub>2</sub>	1.2–1.4
R <sub>3</sub> CH	1.4–1.6
	2.1–2.6
	3.1–3.9
RCH <sub>2</sub> Cl or Br	3.1–4.2
	3.7–4.1
	4.5–6.0
	9.0–10.0
	10.0–12.0

0 7 . 2

Deduce the splitting pattern for each of the peaks given by the H atoms labelled **x**, **y** and **z** in the <sup>1</sup>H NMR spectrum of the compound shown.



[3 marks]

**x** \_\_\_\_\_

**y** \_\_\_\_\_

**z** \_\_\_\_\_

0 7 . 3

Suggest why it is difficult to use **Table B** in the Data Booklet to predict the chemical shift ( $\delta$  value) for the peak given by the H atom labelled **y**.

[1 mark]

\_\_\_\_\_

\_\_\_\_\_

0 7 . 4

Two isomers of  $\text{CH}_3\text{CHClCOCH}(\text{CH}_3)_2$  each have two singlet peaks only in their  $^1\text{H}$  NMR spectra.

In both spectra the integration ratio for the two peaks is 2:9

Deduce the structures of these two isomers.

[2 marks]

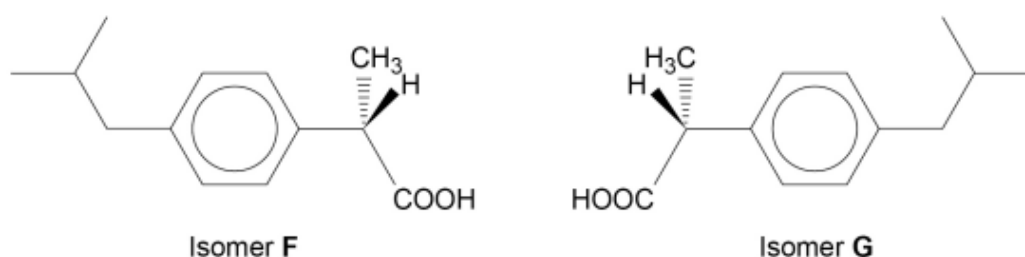
Isomer 1

Isomer 2

0 2 . 4

Figure 4 shows optical isomers **F** and **G**.

Figure 4



Isomer **F** is the active compound in the medicine ibuprofen.

In the manufacture of ibuprofen both isomers **F** and **G** are formed. An enzyme is then used to bind to isomer **G** and catalyse its hydrolysis.

After the products of hydrolysis of **G** are removed, a pure sample of isomer **F** is collected.

Explain how a structural feature of this enzyme enables it to catalyse the hydrolysis of isomer **G** but not the hydrolysis of isomer **F**.

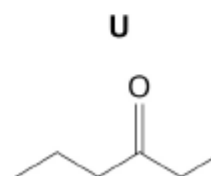
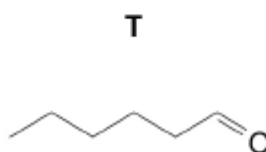
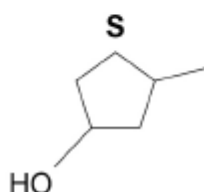
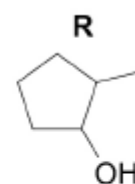
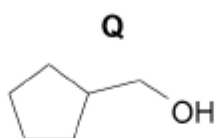
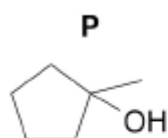
[2 marks]

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0 3

This question is about the structural isomers shown.



0 3 . 1

Identify the isomer(s) that would react when warmed with acidified potassium dichromate(VI).

State the expected observation when acidified potassium dichromate(VI) reacts.

[2 marks]

Isomer(s) \_\_\_\_\_

Expected observation \_\_\_\_\_

0 3 . 2

Identify the isomer(s) that would react with Tollens' reagent.

State the expected observation when Tollens' reagent reacts.

[2 marks]

Isomer(s) \_\_\_\_\_

Expected observation \_\_\_\_\_

0 3 . 4

State the type of structural isomerism shown by isomers **P**, **Q**, **R** and **S**.

[1 mark]

0 3 . 5

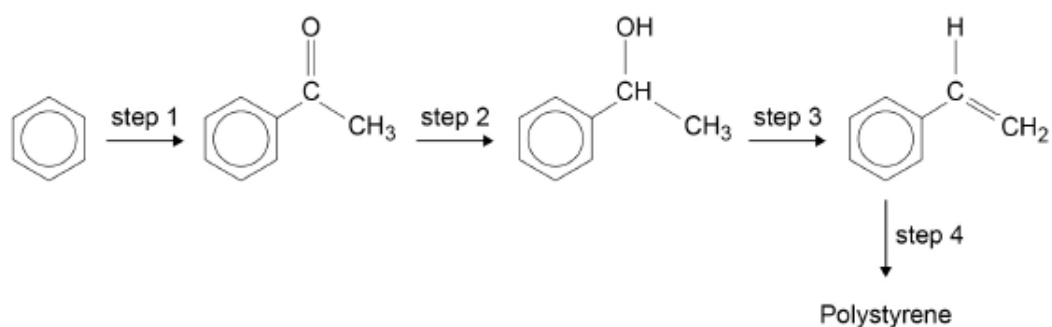
Describe fully how infrared spectra can be used to distinguish between isomers **R**, **S** and **T**.

Use data from **Table A** in the Data Booklet in your answer.

[4 marks]

0 6

Polystyrene can be made from benzene in the series of steps shown.



0 6 . 1 State the type of reaction in step 1.

Identify the reagent(s) and conditions needed for step 1.

[3 marks]

Type of reaction \_\_\_\_\_

Reagent(s) \_\_\_\_\_

Conditions \_\_\_\_\_

0 6 . 2 State the name of the mechanism for the reaction in step 2.

Identify the inorganic reagent needed for step 2.

Name the organic product of step 2.

[3 marks]

Name of mechanism \_\_\_\_\_

Inorganic reagent \_\_\_\_\_

Name of organic product \_\_\_\_\_

0 6 . 3 The organic product of step 2 is reacted with concentrated sulfuric acid in step 3.

Outline the mechanism for step 3.

[3 marks]

0 5

This question is about 2-bromopropane.

0 5

2

Outline the mechanism for the reaction of 2-bromopropane with an **excess of ammonia**.

[4 marks]

0 5

3

Draw the skeletal formula of the main organic species formed in the reaction between a **large excess of 2-bromopropane** and ammonia.

Give a use for the organic product.

[2 marks]

Skeletal formula

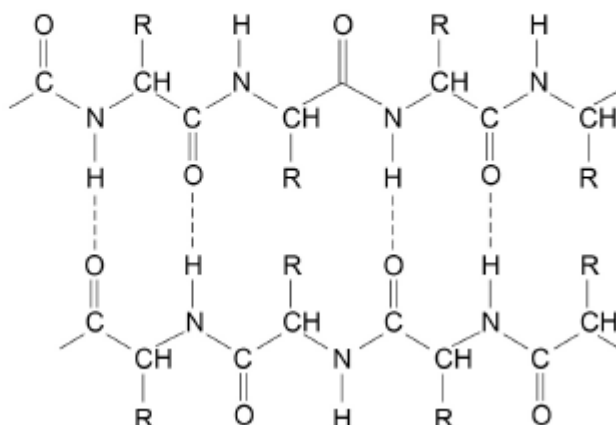
Use \_\_\_\_\_

0 8

Use the Data Booklet to help you answer this question about amino acids.

**Figure 1** shows parts of two polypeptide chains in a beta-pleated sheet of a protein.

**Figure 1**



0 8 . 2

A different type of bond can form between two polypeptide chains when the chains each contain the amino acid cysteine.

Complete the structure to show the bond that forms between the side chains of two cysteine molecules.

[1 mark]



0 8 . 3

The type of bond in Question 08.2 between two polypeptide chains influences the three-dimensional structure of the protein.

Name this type of protein structure.

[1 mark]

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0 8 . 4

Draw the structure of the zwitterion of a dipeptide formed by alanine and serine.

[2 marks]

0 9

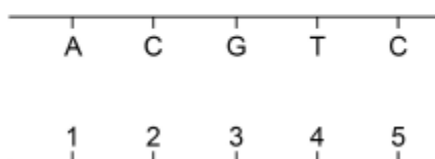
Use the Data Booklet to help you answer this question about DNA.

**Figure 2** shows a fragment of a DNA double helix.

The letters A, C, G and T represent the four bases in one strand.

The numbers 1, 2, 3, 4 and 5 represent the bases in the complementary strand.

**Figure 2**



0 9

1

Complete **Table 4** to show the correct sequence of bases in the complementary strand represented by the numbers 1 to 5

[1 mark]

**Table 4**

1	2	3	4	5

0 9

2

Deduce the total number of hydrogen bonds formed between the five bases in each strand.

Tick (✓) **one** box.

[1 mark]

10	12	13	15

0 9

3

Base A is part of a nucleotide in the DNA strand shown in **Figure 2**.

A nucleotide contains a 2-deoxyribose molecule.

An incomplete 2-deoxyribose molecule is shown.

Complete the structure to show the nucleotide that contains base A.

You should represent base A by the letter A.

[2 marks]

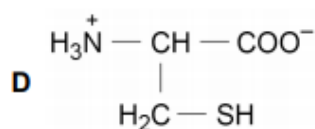
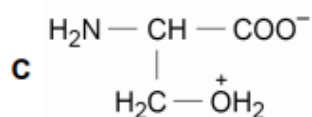
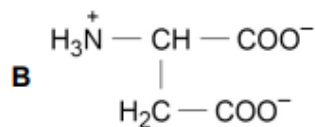
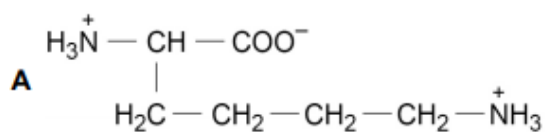




3 0

Which structure shows the zwitterion of an amino acid?

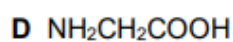
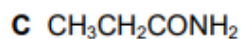
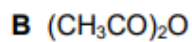
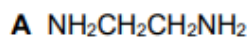
[1 mark]



2 9

Which forms a polymer with  $\text{ClOC}(\text{CH}_2)_8\text{COCl}$ ?

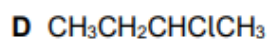
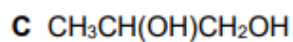
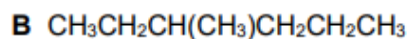
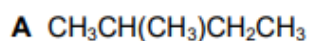
[1 mark]



2 6

Which does **not** contain an asymmetric carbon atom?

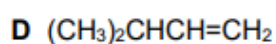
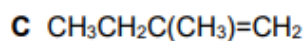
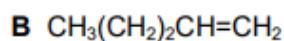
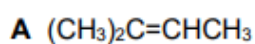
[1 mark]



2 8

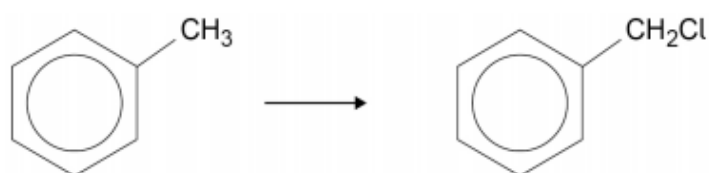
Which compound reacts with hydrogen bromide to give 2-bromo-3-methylbutane as the major product?

[1 mark]



2 3

Which is the mechanism for this conversion?



[1 mark]

A Addition-elimination

B Electrophilic substitution

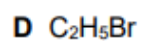
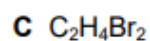
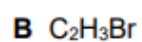
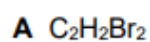
C Free-radical substitution

D Nucleophilic substitution

2 2

Which has *E-Z* isomers?

[1 mark]

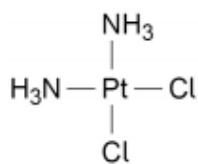


1 5

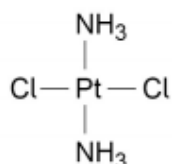
Cisplatin is an anti-cancer drug.

Which structure represents a stereoisomer of cisplatin?

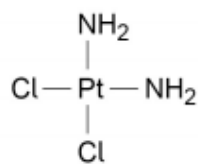
[1 mark]



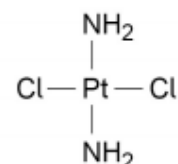
A



B



C



D

A

B

C

D

2 5

Which compound can form a polymer without needing another reagent?

[1 mark]

A HOCH<sub>2</sub>CH<sub>2</sub>OH

B HOOCCH<sub>2</sub>CH<sub>2</sub>COOH

C HOCH<sub>2</sub>CH<sub>2</sub>COCl

D ClCH<sub>2</sub>CH<sub>2</sub>COOH

2 4

Which compound does **not** show stereoisomerism?

[1 mark]

A 1,2-dichloropropene

B 1,2-dichloropropane

C 1,3-dichloropropene

D 1,3-dichloropropane