OCR
RECOGNISING ACHIEVEMENT

Wednesday 19 June 2013 – Morning

A2 GCE CHEMISTRY A

F324/01 Rings, Polymers and Analysis

Candidates answer on the Question Paper.

OCR supplied materials:
- *Data Sheet for Chemistry A* (inserted)

Other materials required:
- Scientific calculator

Duration: 1 hour 15 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- The Insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
  This means for example you should:
  - ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
  - organise information clearly and coherently, using specialist vocabulary when appropriate.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry A* is provided as an Insert with this Question Paper.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

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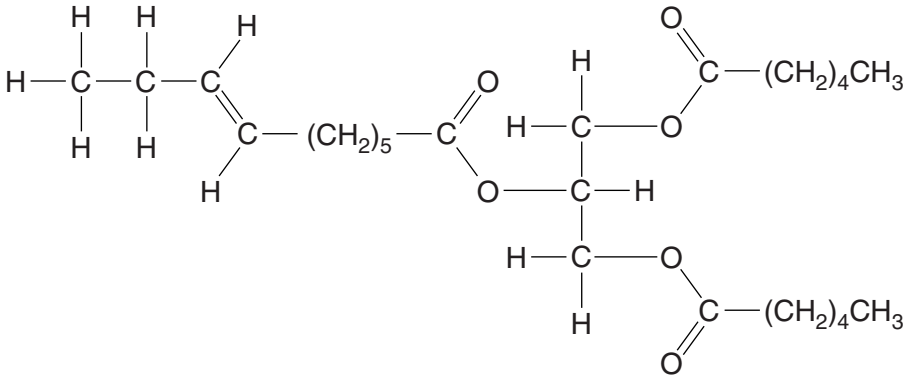
Answer **all** the questions.

1 Triglycerides are triesters and are found in fats and oils.

The structure of a triglyceride found in some goats' milk is shown below.



(a) This triglyceride is hydrolysed with hot aqueous sodium hydroxide.

(i) Give the systematic name of the alcohol that is formed by this hydrolysis.

..... **[1]**

(ii) Draw the structures of the other organic products of this hydrolysis.

[3]

(b) Suggest why people who consume a large quantity of this type of goats' milk might be more at risk of suffering from coronary heart disease.

In your answer, you should use appropriate technical terms, spelled correctly.

.....

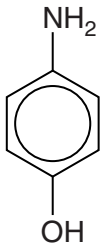
.....

.....

..... **[2]**

[Total: 6]

2 4-Aminophenol is an organic compound that can behave as an acid and a base.



4-aminophenol

(a) State how 4-aminophenol can behave as a base.

.....

..... **[1]**

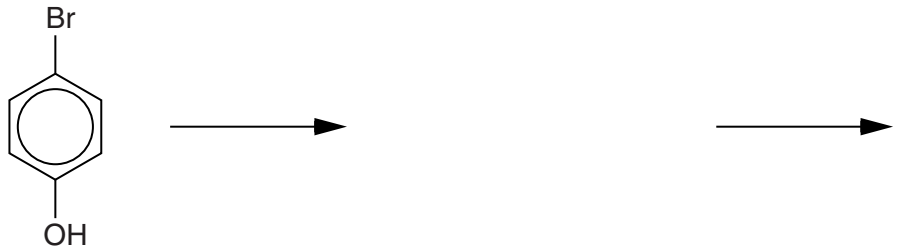
(b) 4-Aminophenol is produced by the reduction of 4-nitrophenol.

Write an equation to show the production of 4-aminophenol from 4-nitrophenol.
Use **[H]** to represent the reducing agent.

[1]

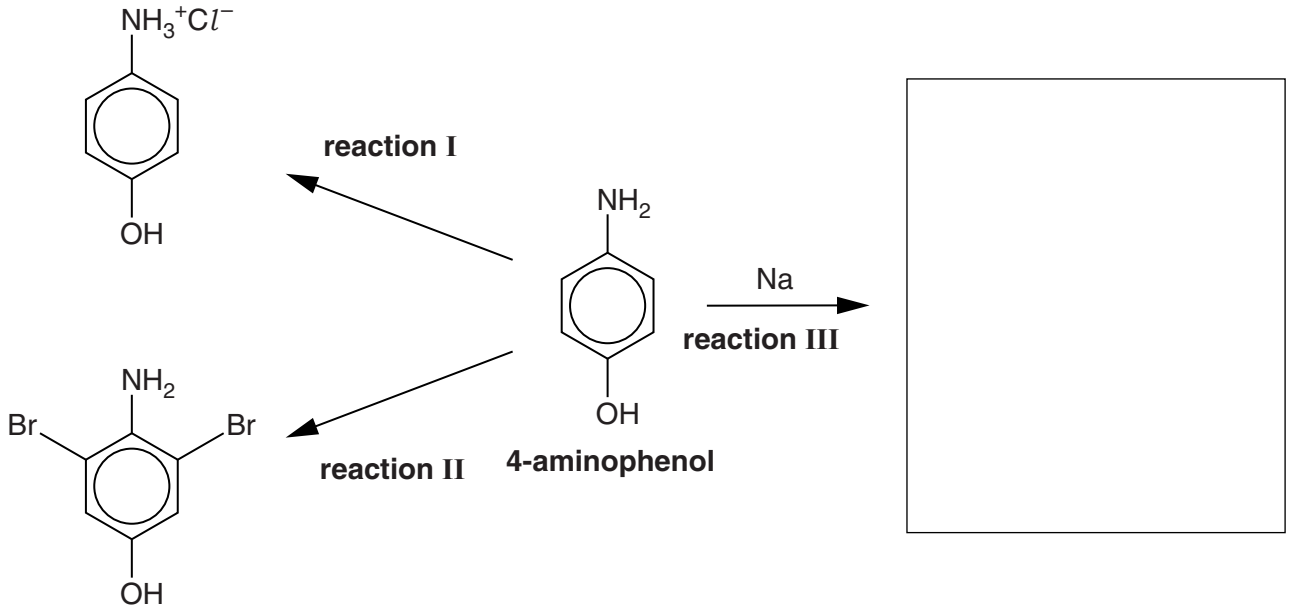
(c) 4-Nitrophenol can be produced from 4-bromophenol.

- Complete the mechanism for this reaction.
- Use $^{+}NO_2$ as the electrophile. Include any intermediate and the products.
- In the mechanism for this reaction, NO_2 substitutes for Br on the ring.



[4]

(d) The flowchart below shows some reactions of 4-aminophenol.



(i) Identity the reagent in **reaction I**.

..... **[1]**

(ii) Name the organic product of **reaction II**.

..... **[1]**

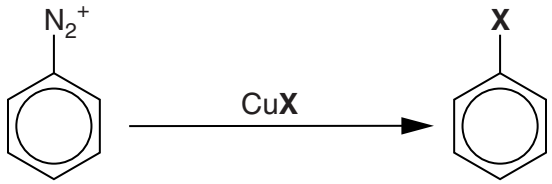
(iii) Write the equation for **reaction II**.

[1]

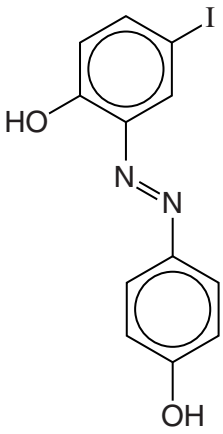
(iv) In the box on the flowchart, draw the structure of the organic compound formed by **reaction III**. **[1]**

(e) The Sandmeyer reaction can be used to replace a diazonium group, N_2^+, with a halogen atom, **X**, on an aromatic ring.

The reagent used for the reaction is a copper(I) halide, Cu**X**.



Compound **C**, shown below, can be synthesised using **only** 4-aminophenol and other standard laboratory reagents. The flowchart on the next page shows this synthesis.



compound C

(i) State a possible use for compound **C**.

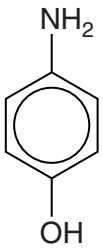
..... **[1]**

(ii) On the flowchart on the next page:

- state the reagents and conditions used for **reaction 1**
- suggest the structure of compound **B**
- suggest the reagent used for **reaction 2**
- state the conditions used for **reaction 3**.

[5]

7

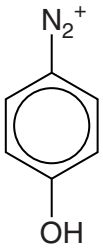


4-aminophenol

reaction 1

reagents .....

conditions .....



compound A

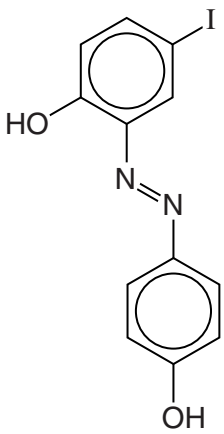
reaction 2

reagent .....

compound B

reaction 3

conditions .....



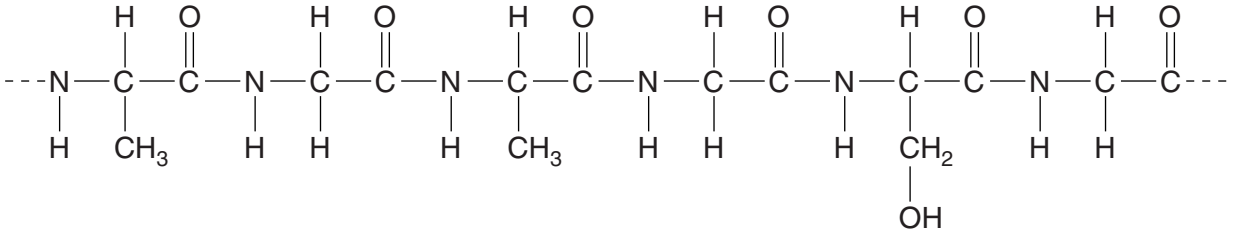
compound C

[Total: 16]

3 Many modern textiles are created using a mixture of natural and synthetic polymers.

(a) Silk is a natural fibre. It is made up of two main proteins, fibroin and sericin.

A section of a **fibroin** strand is shown below.



(i) Proteins are natural condensation polymers.

State what is meant by a *condensation polymer*.

.....

..... **[1]**

(ii) A student hydrolysed a sample of fibroin protein. She analysed the amino acids that were formed from the hydrolysis. She found that fibroin contained the amino acid glycine, H_2NCH_2COOH.

Draw the structures of the **two** other amino acids that make up the section of fibroin shown in the diagram above.

[2]

(iii) The isoelectric point of glycine is 5.8.

Define the term *isoelectric point* and draw the structure of glycine at its isoelectric point.

isoelectric point .....

.....

[2]

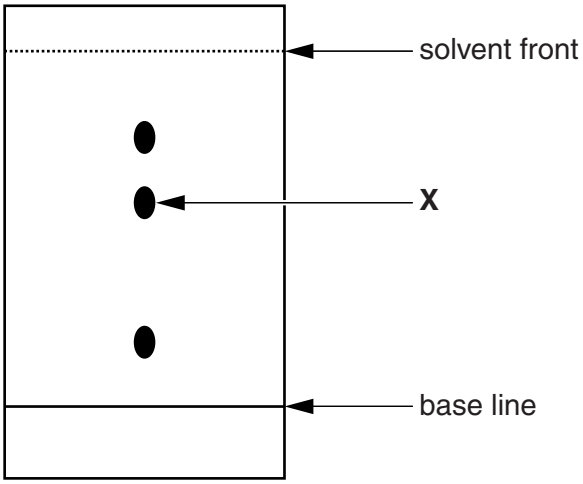
(b) The student then hydrolysed a section of sericin protein. She analysed the amino acids formed using Thin-Layer Chromatography (TLC).

(i) Name the process by which TLC separates amino acids.

..... **[1]**

(ii) The chromatogram the student obtained, and a table of R_f values for amino acids, are shown below.

Estimate the R_f value for the amino acid found at **X**. Hence identify the amino acid found at **X**.



Amino acid	R_f value
alanine	0.38
aspartic acid	0.15
glycine	0.26
leucine	0.75
methionine	0.58
threonine	0.35

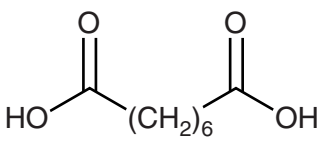
.....

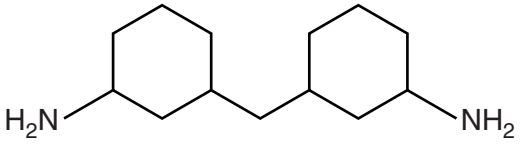
.....

..... **[2]**

(c) *Quiana* is a synthetic polymer that can be spun into a soft, silky fabric.

The monomers used to make *Quiana* are shown below.

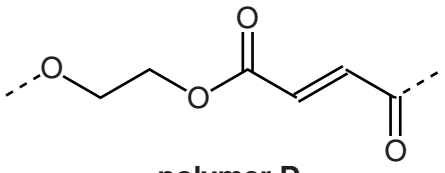




Draw the repeat unit of the polymer formed from these two monomers.

[2]

(d) Polymer **D** has been developed by the textile industry. The repeat unit of polymer **D** is shown below.



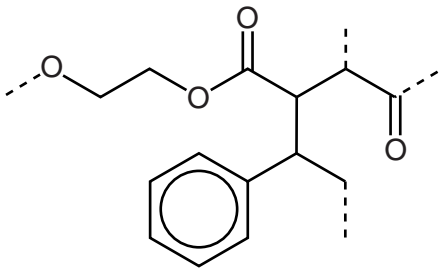
polymer D

(i) Polymer **D** is a condensation polymer.

Draw the structure of each of the monomers that make up polymer **D**.

[2]

(ii) Polymer **D** reacts with a third monomer to form an addition polymer. The repeat unit of this polymer is shown below.



addition polymer

Draw the structure of the third monomer.

[1]

[Total: 13]

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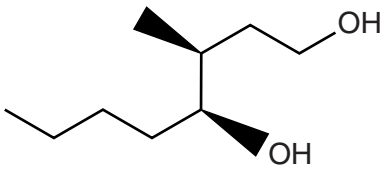
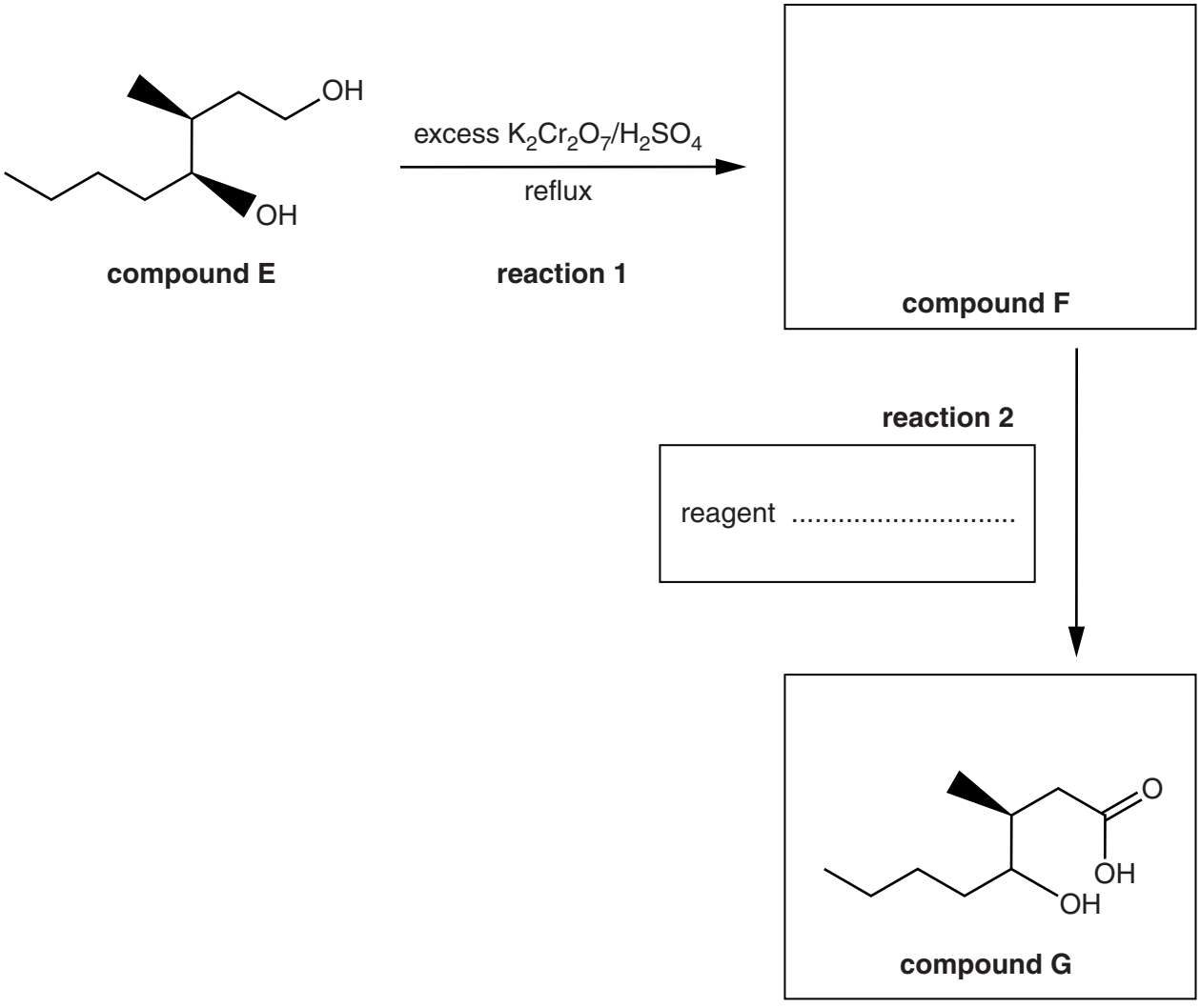
4 Compound **E**, shown below, is an alcohol that is found in oak wood. It is formed by the breakdown of cellulose.



compound E

Compound **E** can be converted into compound **G** as shown in the flowchart below.



(a) (i) Complete the flowchart to show the structure of the organic compound **F** and the reagent needed for **reaction 2**. **[1]**

(ii) What would you observe during **reaction 1**?

.....

..... **[1]**

(iii) In **reaction 1**, compound **E** was heated under reflux with excess $K_2Cr_2O_7/H_2SO_4$.

Suggest why these conditions were used, rather than the reaction mixture being distilled during the process.

.....

.....

..... **[1]**

(iv) Name the type of reaction taking place in **reaction 2**.

..... **[1]**

(b) Describe a chemical test that you could use to detect the presence of a carbonyl group in an organic compound.

Reagent .....

Observation .....

.....

..... **[2]**

(c) Compound **E** is a single stereoisomer.

(i) Draw the skeletal formula of one other stereoisomer of compound **E** and state the type of stereoisomerism.

type of stereoisomerism ..... **[2]**

(ii) 4.56 g of compound **E** was converted into compound **G** using the method shown in the flowchart on page 12.

3.15 g of compound **G** was formed.

Calculate the percentage yield of compound **G**.

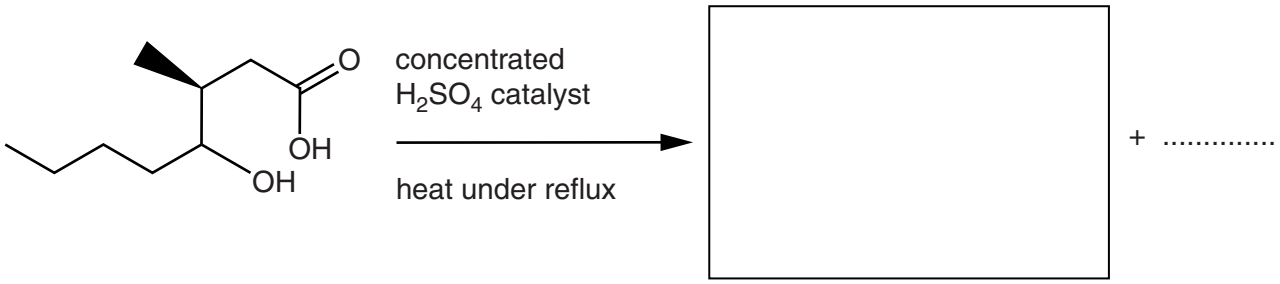
Give your answer to **three** significant figures.

The M_r of compound **E** is 160.0.

percentage yield of compound **G** = ... % **[3]**

(iii) Compound **G** is heated for several hours under reflux, in the presence of a concentrated sulfuric acid catalyst. An ester and a small inorganic molecule are formed.

Complete the equation below to show the **two** products formed by this reaction.



[2]

[Total: 13]

5 A chemist isolated compound **L** from the leaves of a common garden herb. He analysed the compound using a number of techniques.

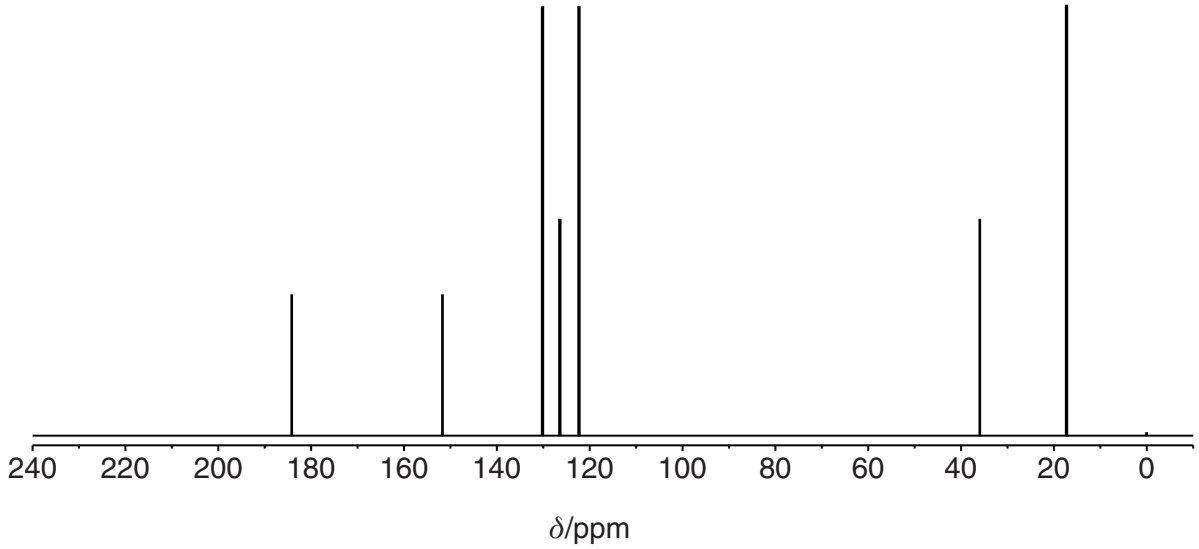
(a) Compound **L** contains C, H and O only. Elemental analysis shows that **L** has the percentage composition by mass: C, 73.15%; H, 7.37%.

The mass spectrum of **L** has a molecular ion peak at $m/z = 164$.

Show that the molecular formula of **L** is $C_{10}H_{12}O_2$.

[2]

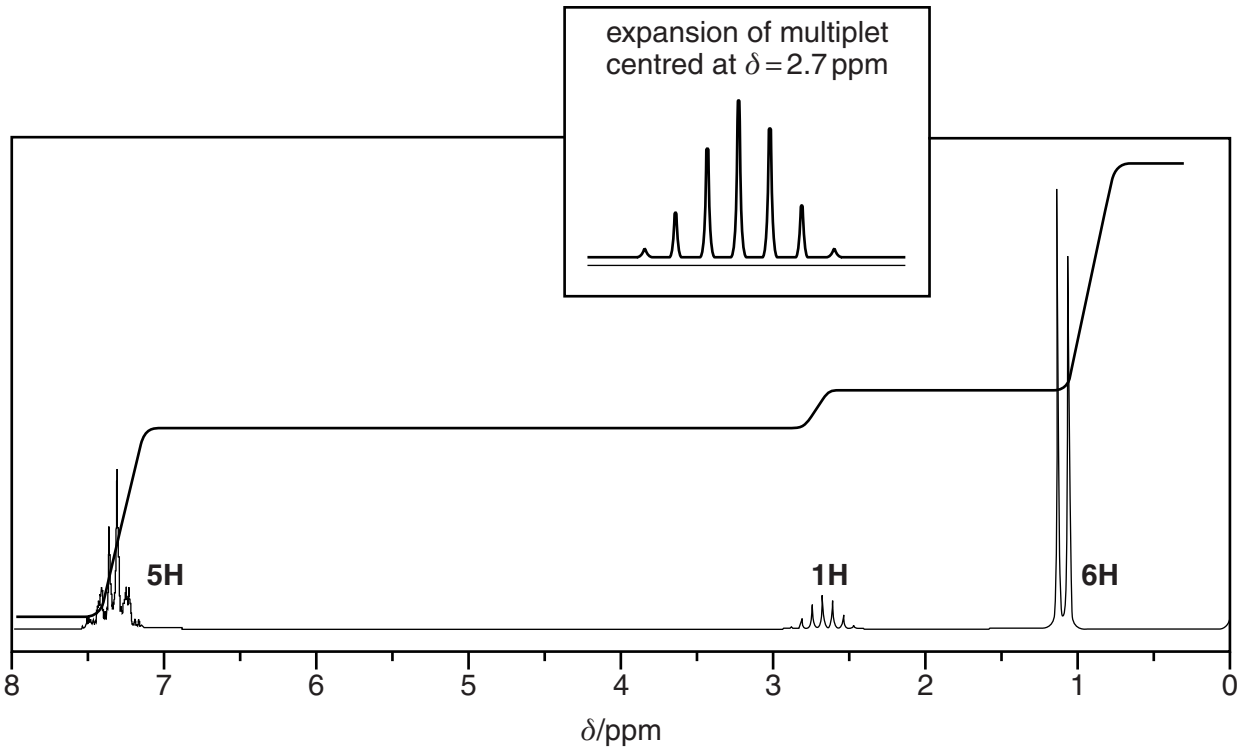
(b) The ^{13}C NMR spectrum of compound **L** is shown below.



How many different carbon environments (types of carbon) are present in a molecule of compound **L**?

..... **[1]**

(c) The ^{1}H NMR spectrum of compound **L**, $C_{10}H_{12}O_2$, is shown below. One of the signals has been enlarged to help its analysis.



(i) A signal at δ = 0 ppm results from tetramethylsilane (TMS). TMS had been added to the sample of compound **L** before the NMR spectrum was run.

State why TMS was added.

..... **[1]**

(ii) The ^{1}H NMR spectrum includes an integration trace.

What information can be deduced about compound **L** from the integration trace?

..... **[1]**

(iii) Using the information given in parts **(a)**, **(b)** and **(c)** of this question, determine the structure of compound **L**.

Show all your reasoning.

In your answer, you should use appropriate technical terms, spelled correctly.

structure of compound L

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.....

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.....

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.....

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[7]

[Total: 12]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.