Write-on

Chemistry A
Unit H432

Practice Paper 2B

Name	

Time allowed
2 hours 15 minutes

Information
- The total marks available for this paper is 100. The number of marks available for each question is shown in brackets.
- Answer all questions and show all working

You will need:
An OCR A Chemistry data sheet

You may use:
- A scientific or graphical calculator
- A pencil for graphs and drawings
- A ruler

Question	Mark
MCQs	
16	
17	
18	
19	
20	
21	
Total	

Paper 2B

SECTION A

You should aim to finish this section within 20 minutes.

1 Which of the following has not been a use of chlorofluorocarbons?

A Aerosol propellant

B Refrigerator coolant

C 'Blowing agent' – an inert gas for expanding plastics

D Fuel for light aircraft

Your answer ☐

2 What is the atom economy of the dehydration of cyclopentanol to form cyclopentene?

A 78 %

B 79 %

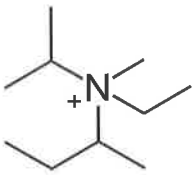
C 80 %

D 81 %

Your answer ☐

3 Which of the following structures has a chiral carbon?

A



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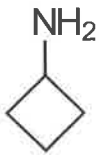

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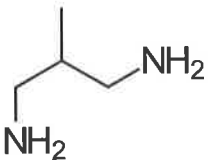

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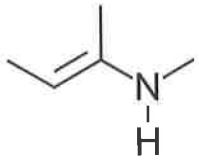


Your answer ☐

4 The linear molecule C_3H_6 contains how many of each type of bond?

A 8 σ and 1 π

B 8 σ and 2 π

C 7 σ and 1 π

D 7 σ and 2 π

Your answer ☐

5 Which of these correctly explains the use of the solvent in ^1H NMR?

A $CDCl_3$ is used because it exchanges protons with alcohol and amine groups.

B $CDCl_3$ is used because deuterium does not appear in the same region of an NMR spectrum as hydrogen.

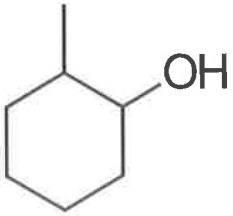
C $CDCl_3$ is used because it has a shift that can easily be used as a standard.

D $CDCl_3$ is used because it can successfully react with most compounds so they can be analysed using ^1H NMR.

Your answer ☐

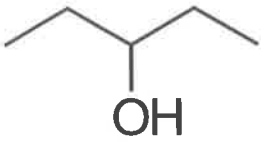
6 Which of the following could be dehydrated to give an alcohol with E/Z isomers?

A



B

C



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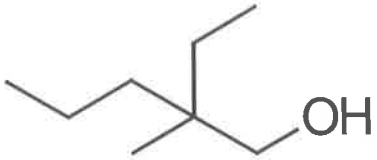


Your answer ☐

7 Which of the following correctly identifies the oxidation states in the important redox chemicals NaH and H_2O_2?

A NaH: Na = +1 H = -1; H_2O_2 H = +1 O = -2

B NaH: Na = -1 H = +1; H_2O_2 H = -1 O = +1

C NaH: Na = +1 H = -1; H_2O_2 H = +1 O = -1

D NaH: Na = -1 H = +1; H_2O_2 H = +1 O = -2

Your answer ☐

8 5.00 g of starting material produced 3.70 g of product in a reaction that was 25 % efficient. If the efficiency is improved to 33 % and the amount of starting material increased to 100 g, what amount of product will be obtained?

A 97.7 g

B 132 g

C 56.1 g

D 75.8 g

Your answer ☐

9 Which of the following facts about the bond lengths in benzene provides evidence of its delocalised structure?

A The bond lengths are all shorter than expected.

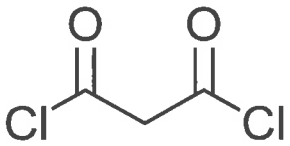
B The bond lengths are all longer than expected.

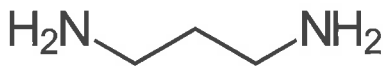
C Some bonds are longer than others.

D The bonds are all the same length.

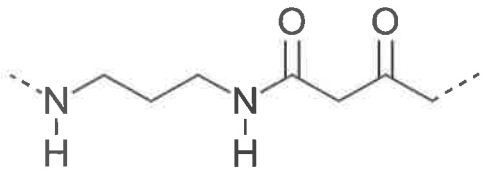
Your answer ☐

10 What is the correct structure of the repeat unit formed from the following monomers?





A



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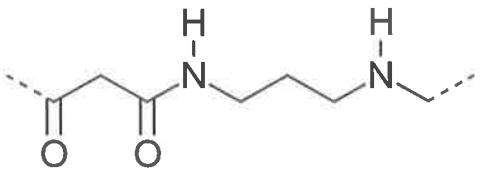

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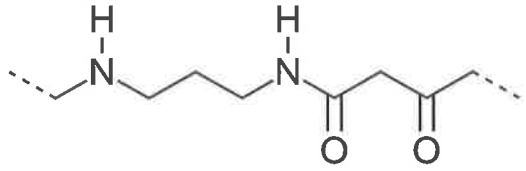

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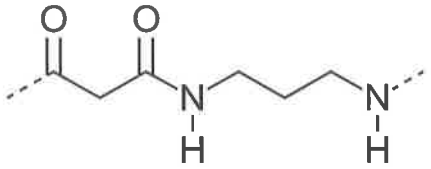


Your answer ☐

11 What are the products if cyclohexyl ethanoate is reacted with hot aqueous alkali?

A $C_6H_{11}ONa + CH_3COOH$

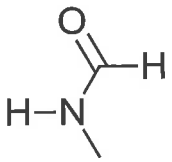
B $C_6H_{11}OH + CH_3COONa$

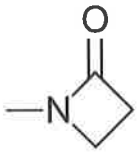
C $C_6H_{11}COOH + CH_3CH_2ONa$

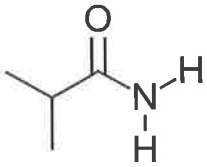
D $C_6H_{11}COONa + CH_3CH_2OH$

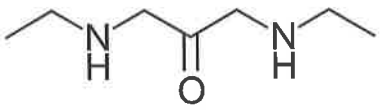
Your answer ☐

12 Which of the following is a secondary amide?

A 

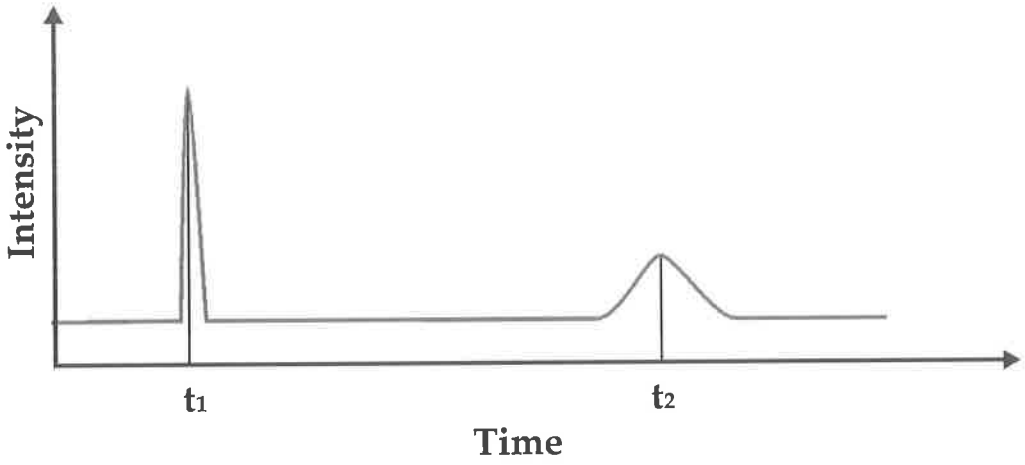
B 

C 

D 

Your answer ☐

13 A sample containing the amino acids tyrosine and phenylalanine was analysed using gas chromatography. The results are shown below.



The sample obtained at t_1 was determined to contain tyrosine, and the sample obtained at t_2 was found to contain phenylalanine.

Which of the following is a valid conclusion?

1. Tyrosine binds more strongly than phenylalanine to the stationary phase.
2. Tyrosine dissolves in the mobile phase better than it binds to the stationary phase.
3. There is a little more than twice as much tyrosine as phenylalanine.

A 1 only

B 2 only

C 3 only

D None of 1, 2 or 3

Your answer ☐

14 Which of the following is true of the substance H–F?

1. It can form hydrogen bonds
2. One molecule contains 11 electrons
3. It produces water when it reacts with copper oxide

A 1 and 2 only

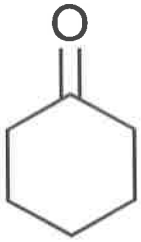
B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

Your answer ☐

15 Which of the following is true of the molecule below?



1. It can react with $AlCl_3$ and Cl_2 in a Friedel–Crafts reaction.
2. It is aliphatic.
3. It forms a silver mirror with Tollens' reagent.

A 1 and 2 only

B 1 and 3 only

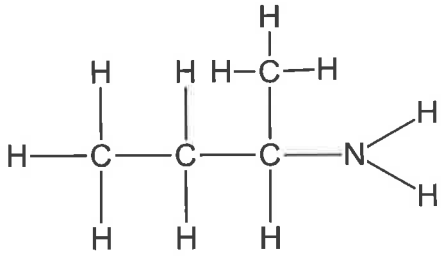
C 2 only

D None of 1, 2 or 3

Your answer ☐

SECTION B

16 Sec-butylamine is a common name for the compound shown below. This compound is occasionally used as a fungicide to present fungal growth on citrus fruit in fruit farming.



Sec-butylamine

a) i) Give the structural formula for sec-butylamine.

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(1)

ii) Give the skeletal formula for sec-butylamine.

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(1)

iii) Give the IUPAC name for sec-butylamine.

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(1)

b) The four carbons in sec-butylamine have similar bond angles around them, whereas there is a different bond angle around the nitrogen.

Suggest values for these bond angles and explain why there is a difference.

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(3)

c) Sec-butylamine exists as a pair of enantiomers.

i) Define the term 'enantiomers'.

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(1)

ii) Draw two diagrams to show the two enantiomers of sec-butylamine.

(2)

d) Sec-butylamine can be prepared from a haloalkane, RX.

i) Identify the conditions needed for the reaction and draw a mechanism for this process, using X to represent the halogen, and showing any relevant dipoles.

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(5)

ii) Explain the difference in rate of this transformation if a bromoalkane is used instead of a chloroalkane.

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(2)

iii) Suggest how the rate of reaction for the bromoalkane compared to the chloroalkane can be measured.

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(2)

e) Mass spectrometry can be used to confirm the identity of sec-butylamine.

i) Explain the reason for a peak at 74 in the mass spectrum.

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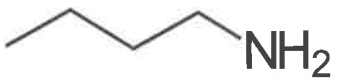
(2)

ii) Draw the fragment responsible for a peak at 57.

(1)

iii) Identify the value of a peak that would be found in the mass spectrum of the molecule below due to a single fragmentation, but not in sec-butylamine.



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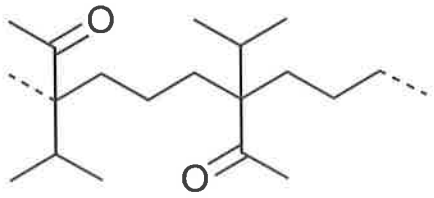
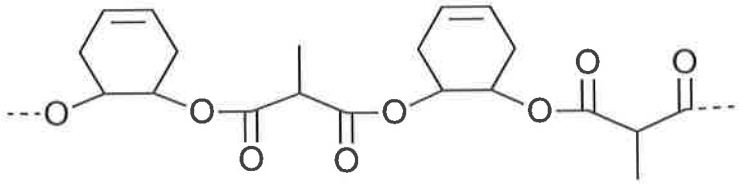
(1)

QUESTION TOTAL: 22 MARKS

17 Polymers come in a variety of forms, but may be broadly split into addition polymers and condensation polymers. As well as this, polymers can be made from one, two or more monomers.

a) The diagrams shown below show two repeat units of two polymers. Draw the monomers used to make each polymer, and state the type of polymerisation involved in each.





(6)

b) i) Explain what is meant if a polymer is described by the term 'biodegradable' and by the term 'photodegradable'.

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(2)

ii) Describe two advantages of using polymers that are biodegradable or photodegradable.

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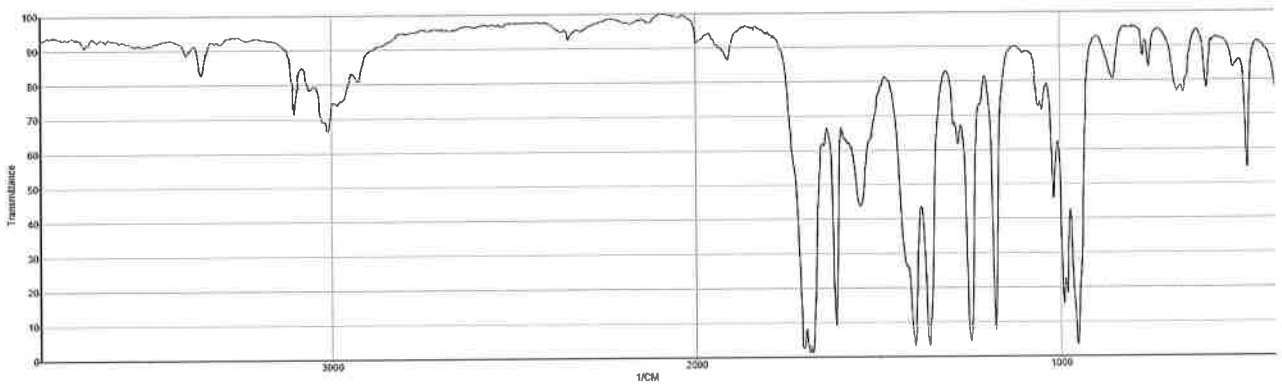
(2)

c) An addition polymer with the following IR spectrum was found to contain 4.8 % hydrogen and 57.1 % carbon by mass, and one other element.



Given that the monomer has three peaks in its ^{13}C NMR, suggest its structure, giving your reasoning.

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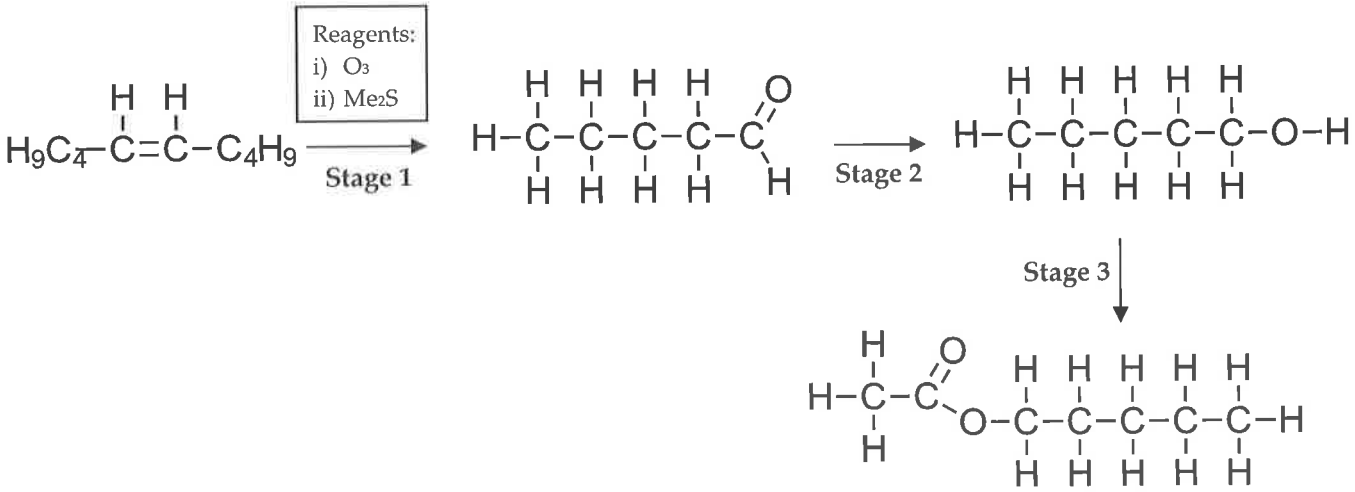
(4)

QUESTION TOTAL: 14 MARKS

18 Ozonolysis is an important reaction in synthesis that allows the incorporation of oxygen into organic molecules. Crude oil can be processed to produce many hydrocarbons, including alkenes, which can be turned into aldehydes using ozonolysis, and these aldehydes can then be converted into other functional groups.

The reactions below provide an example of how this may be done.



a) Stage 1 involves:

- The reaction of dec-5-ene with a molecule of ozone
- Followed by breaking up of the intermediate with Me_2S
- Yielding two molecules of pentanal for each molecule of dec-5-ene

What volume of ozone at RTP is needed to form 2.00 g of pentanal using ozonolysis if the overall reaction has a 29.00 % yield?

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(3)

b) i) Identify the reagent needed to reduce pentanal to pentan-1-ol in Stage 2.

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(1)

ii) Name the mechanism by which this reaction takes place.

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(1)

iii) Draw a curly arrow mechanism for this process, labelling any relevant dipoles.

(3)

c) Water is often used as a solvent for the reagent involved in Stage 2 as it dissolves ions well and does not boil easily compared to similar molecules. Explain these two properties of water, using a labelled diagram to support your answer.

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(4)

d)* Stage 3 may be completed using reflux apparatus and an acid anhydride as the other reagent. Describe how this process may be carried out, using an experimental diagram and an equation to support your answer. You do not need to include details of purification.

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(6)

e) Aside from its role in the ozonolysis reaction, ozone may be decomposed catalytically by an •NO radical.

Write two equations to show how this happens.

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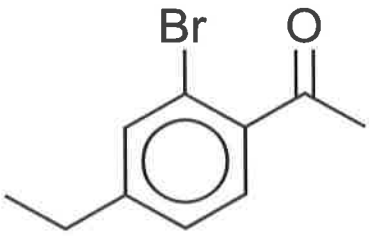
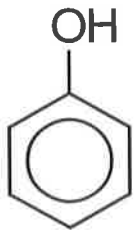
QUESTION TOTAL: 20 MARKS

19 Aromatic compounds are an extremely important set of compounds which are encountered in many branches of organic chemistry. Compound **B** is an example of an aromatic compound.



Compound B



Compound C

Compound **C**, phenol, is also an example of an aromatic compound. Phenol, and related compounds, have some different reactions to benzene. For instance, phenol is acidic and benzene is not.

a) Explain the difference between the terms 'aromatic' and 'alicyclic'.

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(2)

b) Compound **B**, shown above, can be prepared through a reaction of compound **A** with ethanoyl chloride and a $FeCl_3$ catalyst.

Draw and name compound **A**.

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(2)

c) Write an equation for the reaction of phenol, C_6H_5OH, with an alkali to show it is an acid.

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(1)

d)* Explain, with at least two examples other than its reaction as an acid, how the reactions of phenol are different to benzene, and explain the reason for this.

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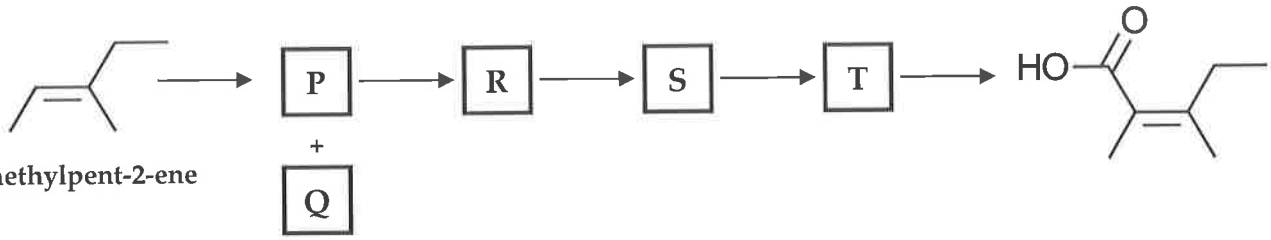
(6)

QUESTION TOTAL: 11 MARKS

20 Synthesis often involves reactions with many steps. The scheme below represents a simple example of a synthesis pathway from one organic compound to another.



3-methylpent-2-ene

- Compounds P and Q are produced as a mixture, with P being used to make R and subsequent compounds.
- Q does not react with $K_2Cr_2O_7$, but P does.
- R reacts with 2,4-DNP.
- None of P, Q, R, S or T react with bromine water.

a) Explain why 3-methylpent-2-ene exists as a pair of cis/trans isomers.

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(1)

b) Draw the structures of P and Q, explaining whether you would expect P or Q to be the major product.

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(3)

c) i) Draw the structure of R.

(1)

ii) Explain how the product of R and 2,4-DNP can be used to positively confirm the identity of R.

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(3)

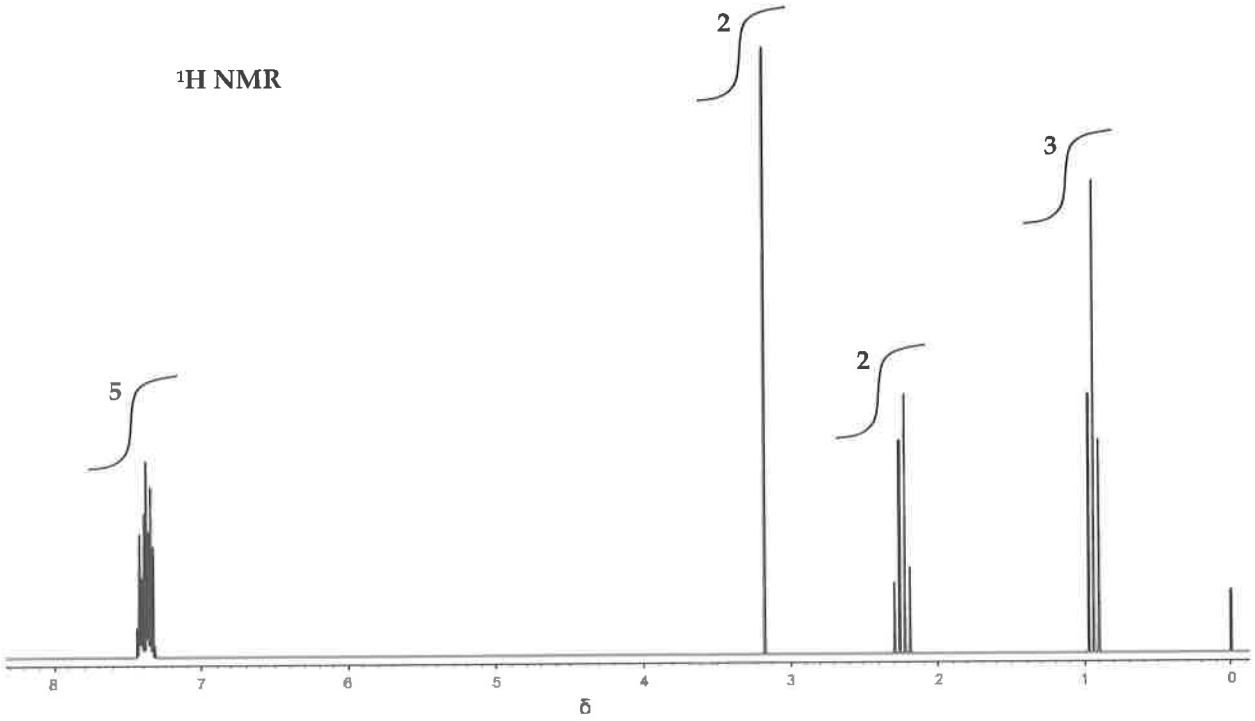
d) Complete the synthesis pathway by suggesting the identities of S and T

(2)

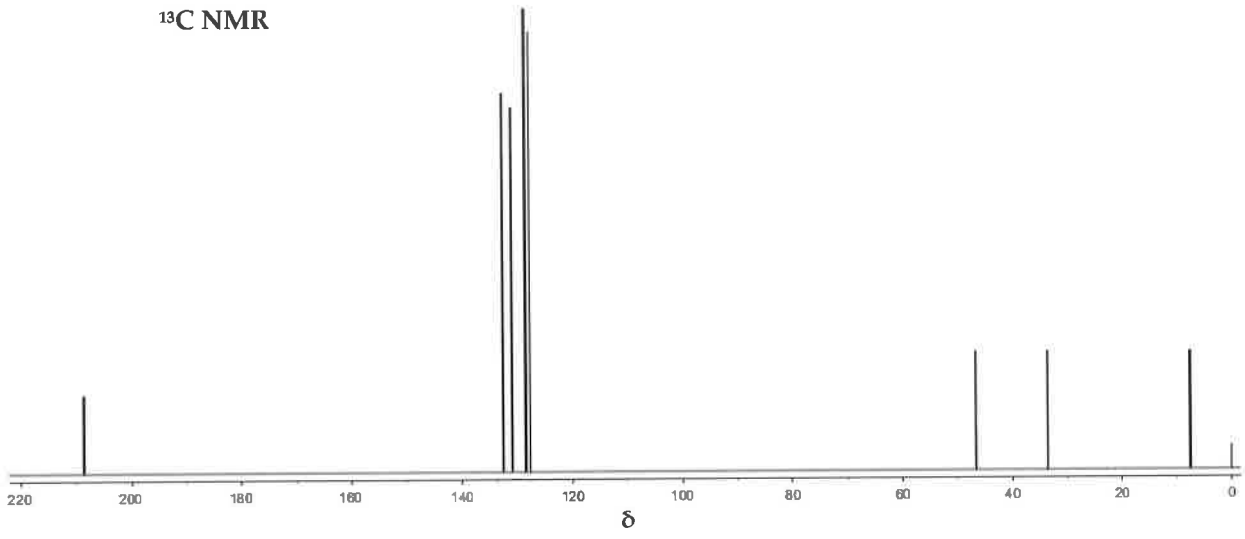
QUESTION TOTAL: 10 MARKS

21 The ^{1}H and ^{13}C data are shown below for a compound using a TMS standard. The mass spectrum of this compound had a molecular ion peak at 148. Use this information to deduce the structure of the compound, explaining your deductions on the following page.

^{1}H NMR



^{13}C NMR



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QUESTION TOTAL: 8 MARKS

