Zig Zag Education

Chemistry

A Level | OCR A | H432

Practice Exams

for A Level OCR Chemistry A

Paper 2

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Contents

Teacher's Introduction

This pack contains four Practice Paper 2s for the OCR A Level Chemistry (A) specifi
2017). The papers and corresponding mark schemes in this pack are modelled on
material provided by the board.

Paper 2 is entitled 'Synthesis and analytical techniques' and covers:

- Module 1: Development of practical skills in chemistry
- Module 2: Foundations in chemistry
- Module 4: Core organic chemistry
- Module 6: Organic chemistry and analysis

This paper is designed so it can be used as either a mock examination or a revision
designed with both students and teacher support in mind, allowing students to mark their
progress. Otherwise, the mark scheme resembles that produced by OCR in their s

Each practice paper contains both short and longer questions in proportion to sample assessment material. This includes factual recall, explanation and discussion questions, with two 6-mark Level of Response questions per paper indicated with an asterisk (*).

Papers have been designed to ensure that the Mathematical Skills and Practical Activity Groups (PAGs) specified in the new syllabus are assessed, as well as 'how science works' aspects of the syllabus.

Across the three Practice Paper packs (Papers 1, 2 and 3), coverage of the specific
specification analysis grid is also included, enabling teachers to identify questions
technique activities, or as homework assignments.

The author has aimed to include a spread of material from the relevant topics in e
obtain an overview of their students' knowledge and understanding for each unit.

I hope you and your students find this pack useful.

Mark Distribution across all Pap

		TOTAL	1A	1B	1C	1D	2A
Atoms, Equations & Formulae		13	8	4		6	4
Reacting Masses & Gases		36	3		6	4	3
Acids, bases & redox	Titrations	24		3	7	1	
	Redox	10	1	3	1		
	Structure	31	2	7	2	5	
	Bonding	31	3	3	3	3	1
Periodicity, Group 2 & Group 7	Periodicity	43	5	5	5	15	
Qual Tests		8	1		4	1	
Enthalpy	Enthalpy Calculation	14		1		6	
	Bond Enthalpies	12			1		
	Hess	[illegible]	1	5	1	3	
Rates & Eqm	Rates	[illegible]	6	2	6	1	
	Le Ch[illegible]	11		4		1	
Basic Concepts		19					6
Alk[illegible]		15					
	Properties & Reactions	24					7
	Addition Polymers	13					4
Alcohols & Halogenoalkanes	Alcohols	16					5
	Halogenoalkanes	15					2
Synthesis	Practical Techniques	5					
Analytical Techniques	IR	13					3
	Mass Spec	9					1
Rates & Eqm (quant)	How fast	41	13	11	7	3	
	RDS	13		2	3		
	Arrhenius	13				8	
	Kc	14		3	6		
	Kp	25	6	9	2	5	
	Ka and pH	30	8	6	6	2	
	Buffers	31			6	10	
	Neutralisation & Indicators	9	1	4	1		
Energy	Lattices	12	6		2		
	Born-Haber	25	6	6	4	1	
	Gibbs and Entropy	18	3	1	6	2	
Redox & Electrode Potentials	Redox Titrations	15	6	9			
	Electrode Potential setup	18	4		5		
	Electrode Potential theory	17	4	1	3	2	
	Fuel Cells	13	1			7	
Transition Elements	Complexes	37	7	8	2	9	
	Reactions	20	1	2	6	5	
	Analysis	17		1	5		
Aromatics	Theory	21					6
	Reactions	17					9
	Phenol	9					
Carbonyls	Reactions	14					
	Tests	[illegible]					1
Carboxylic acids		[illegible]					1
Esters & Acyl Chlorides		10					5
Nitrogen Compounds	Amin[illegible]	22					6
	[illegible]ids & Amides	9					2
	Chirality	11					2
Conden[illegible]		12					3
C-C bo[illegible]ion	Nitriles	11					2
Synthesis	Reflux	9					1
	Purification	20					6
	Synthetic Routes	27					3
Analysis	Chromatography	16					2
	Qualitative Tests	12					6
	NMR	29					9
	Combined Techniques	16					
	MATHS		32	31	35	37	8
	PRACTICAL		21	18	15	14	15

Mark Distribution across Pa

			Paper 2A								Paper 2B						
			MC	Q16	Q17	Q18	Q19	Q20	Q21		MC	Q16	Q17	Q18	Q19	Q20
Atoms, Equations & Formulae		4	1						3							
Reacting Masses & Gases		3	1		2					5	2			3		
Acids, bases & redox	Titrations															
	Redox									1	1					
Structure and bonding	Structure									4				4		
	Bonding	1	1							4	1	3				
Basic Concepts		6		3	2		1			2		2				
Alkanes																
Alkenes	Properties & Reactions	7	1	3					3	3	1					2
	Addition Polymers	4	1				3			7			7			
Alcohols & Halogenoalkanes	Alcohols	5		5						3	1					2
	Halogenoalkanes	2	2							7	1	4		2		
Synthesis	Practical Techniques															
Analytical Techniques	IR	3		3												
	Mass Spec	1	1							4		4				
Aromatics	Theory	6						6		3	1				2	
	Reactions	9						9		2					2	
	Phenol									7					7	
Carbonyls	Reactions									5				5		
	Tests	1	1							5	1					4
Carboxylic acids		1	1													
Esters & Acyl Chlorides		5					5			1	1					
Nitrogen Compounds	Amines	6	1		5					6		6				
	Amino acids & Amides	2	1			1				1	1					
	Chirality	2			2					4	1	3				
Condensation polymers		3					3			4	1		3			
C-C bond formation	Nitriles	2			2											
Synthesis	Reflux	1	1							6				6		
	Purification	6					6									
	Synthetic Routes	3	1		2					2						2
Analysis	Chromatography	2	1		1					1	1					
	Qualitative Tests	6							6							
	NMR analysis	9				8			1	9	1					8
	Combined Techniques									4			4			
	Total	100	15	14	16	9	18	15	13	Total	100	15	22	14	20	11	18
	Maths	8	3		2				3	Maths	8	3		2	3		
	Prac	15	2		1		6		6	Prac	13	2	2		6		3

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

Paper 2B

SECTION A

You should aim to finish this section within 20 m

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

A 78 %

B 79 %

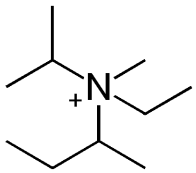
C 80 %

D 81 %

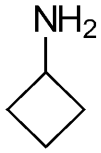
Your answer

3 Which of the following structures has a chiral carbon?

A



B



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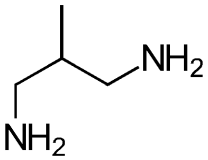
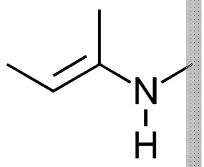


D



Your answer

4 The li[illegible]olecule 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 amin

B $CDCl_3$ is used because deuterium does not appear in the same regi as hydrogen.

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

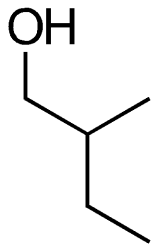
D $CDCl_3$ is used because it can successfully react with most compou using ^1H NMR.

Your answer ☐

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

A

B



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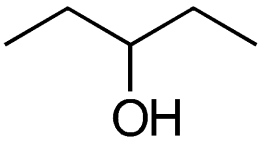
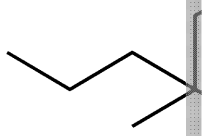


D



Your answer ☐

7 Which of the following correctly identifies the oxidation states in the i 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 pr... ec... g of product in a reaction that efficiency is improve... and the amount of starting material inc... of produ... wi... ...ined?

A 9...

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 provid
structure?

A The bond lengths are all shorter than expected.

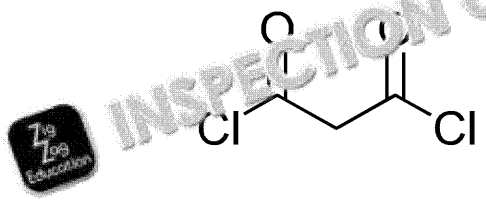
B The bond lengths are all longer than expected.

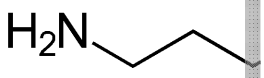
C Some bonds are longer than others.

D The bonds are all the same length.

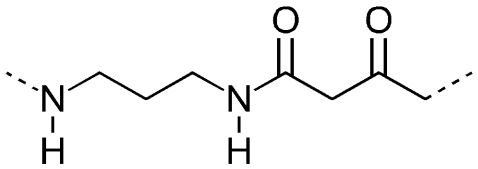
Your answer ☐

10 What is the correct structure of the repeat unit formed from the followi





A



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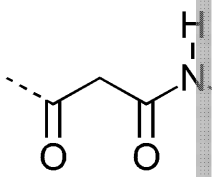

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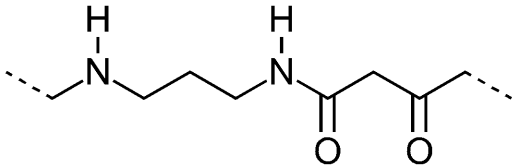

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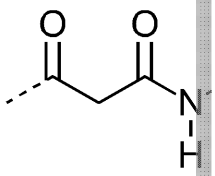


Your answer ☐

11 What are the products if cyclohexyl ethanoate is reacted with hot aque

A $C_6H_{11}ONa + CH_3COOH$

B $C_6H_{11}OH + CH_3COONa$

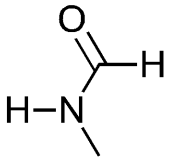
C $C_6H_{11}COOH + CH_3CH_2ONa$

D $C_6H_{11}COONa + CH_3CH_2OH$

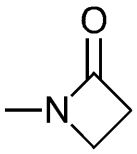
Your answer ☐

12 Which of the following is a secondary amide?

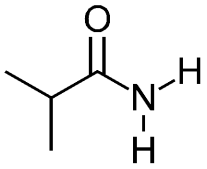
A



B



C



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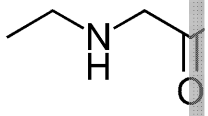
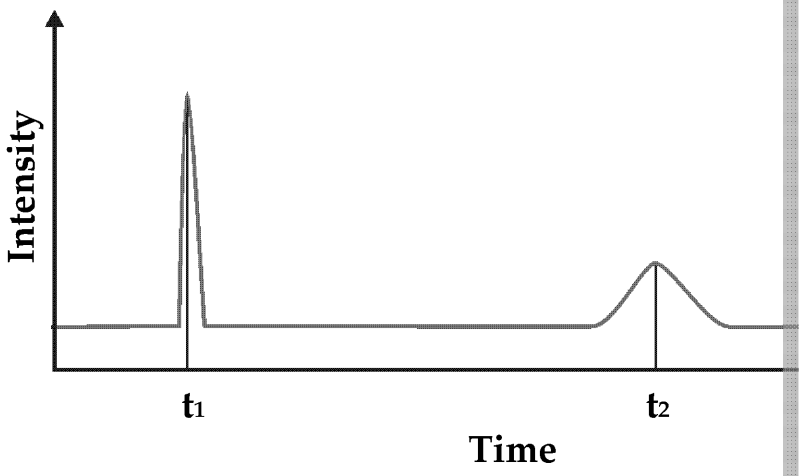


Your answer ☐

13 A sam[illegible]nt[illegible]ng the amino acids tyrosine and phenylalanine was a chrom[illegible]phy. The results are shown below.



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

Which of the following is a valid conclusion?

1. Tyrosine binds more strongly than phenylalanine to the stationary
2. Tyrosine dissolves in the mobile phase better than it binds to the s
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

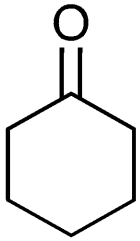
B 1 and 3 only

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

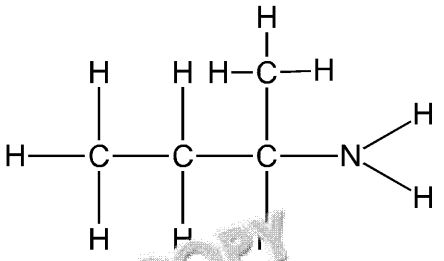
C 2 only

D None of 1, 2 or 3

Your answer ☐

SECTION B

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



Sec-butylamine

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

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ii) Give the skeletal formula for sec-butylamine.

.....

iii) Give the IUPAC name for sec-butylamine.

.....

b) The four carbons in sec-butylamine have similar bond angles arou
different bond angle around the nitrogen.

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

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

i) Define the term 'enantiomers'.

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

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

i) [illegible] conditions needed for the reaction and draw a me[illegible] X to represent the halogen, and showing any relevant di

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ii) Explain the difference in rate of this transformation if a bromo chloroalkane.

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ii[illegible] how the rate of reaction for the bromoalkane compare[illegible] measured.

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

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

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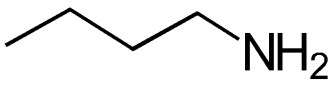
ii) Draw the fragment responsible for a peak at 57.

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



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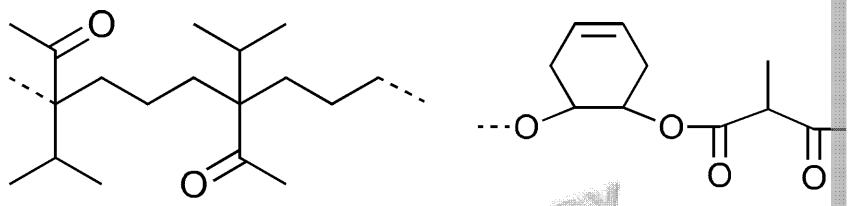
17 Polymers come in a variety of forms, but may be broadly split into add
condensation polymers. As well as this, polymers can be made from o

a) The diagrams shown below show two repeat units of two polymer
to make each polymer, and state the type of polymerisation involv



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

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ii) Describe two advantages of usin , p lv ers that are biodegra

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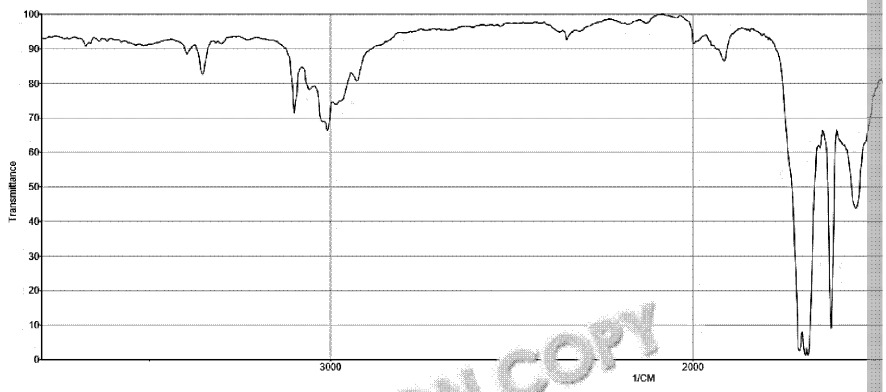
c) An addition polymer with the following IR spectrum was found t
57.1 % carbon by mass, and one other element.



Given that th n has three peaks in its ^{13}C NMR, suggest it
re ng

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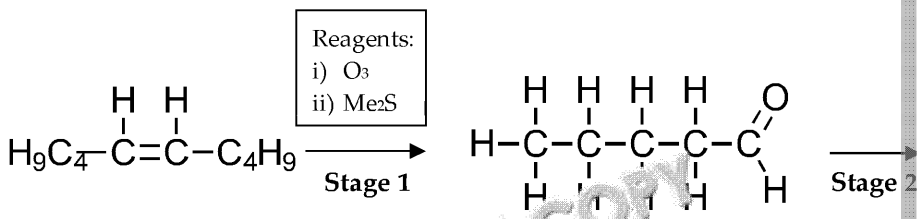
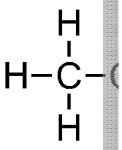
18 Ozonolysis is an important reaction in synthesis that allows the incorp molecules. Crude oil can be processed to produce many hydrocarbons can be turned into aldehydes using ozonolysis, and these aldehydes ca other functional groups.

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

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

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b) i) [illegible] reagent needed to reduce pentanal to pentan-1-ol

.....

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

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

c) Water is often used as a solvent for the reagent involved in Stage 2 does not boil easily compared to similar molecules. Explain these using a labelled diagram to support your answer.

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d)* Stage 3 may be completed using reflux apparatus and an acid anh
Describe how this process may be carried out, using an experimen
to support your answer. You do not need to include details of pu

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e) Aside from its role in the ozonolysis reaction, ozone may be decon
•NO radical.

Write two equations to show how this happens.

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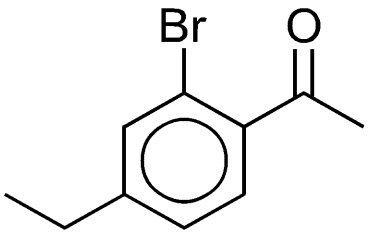
19 Aromatic compounds are an extremely important set of compounds w
branches of organic chemistry. Compound **B** is an example of an arom



Compound B

Com

Compound **C**, phenol, is also an example of an aromatic compound. P
compounds, have some different reactions to benzene. For instance, p
is not.

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

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.....

b) Compound **B**, shown above, can be prepared through a reaction o
chloride and a $FeCl_3$ catalyst.

Draw and name compound **A**.

.....

c) W n equation for the reaction of phenol, C_6H_5OH, with an alk

.....

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

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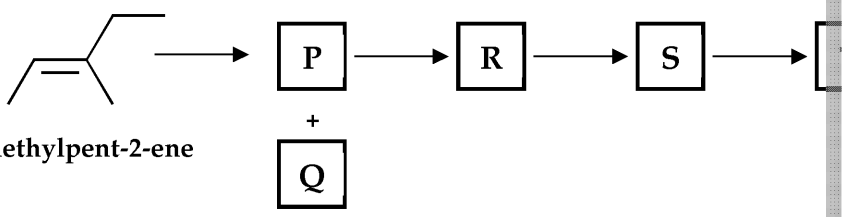
20 Synthesis often involves reactions with many steps. The scheme below
of a synthesis pathway from one organic compound to another.



3-methylpent-2-ene

- Compounds P and Q are produced as a mixture, with P being used
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 [illegible] with bromine water.

a) E[illegible] w[illegible]-methylpent-2-ene exists as a pair of cis/trans isome

.....

.....

b) Draw the structures of P and Q, explaining whether you would ex
major product.

.....

.....

.....

c) i) Draw the structure of R.

ii) Explain how the product of R and 2,4-DNP can be used to posit

.....

.....

.....

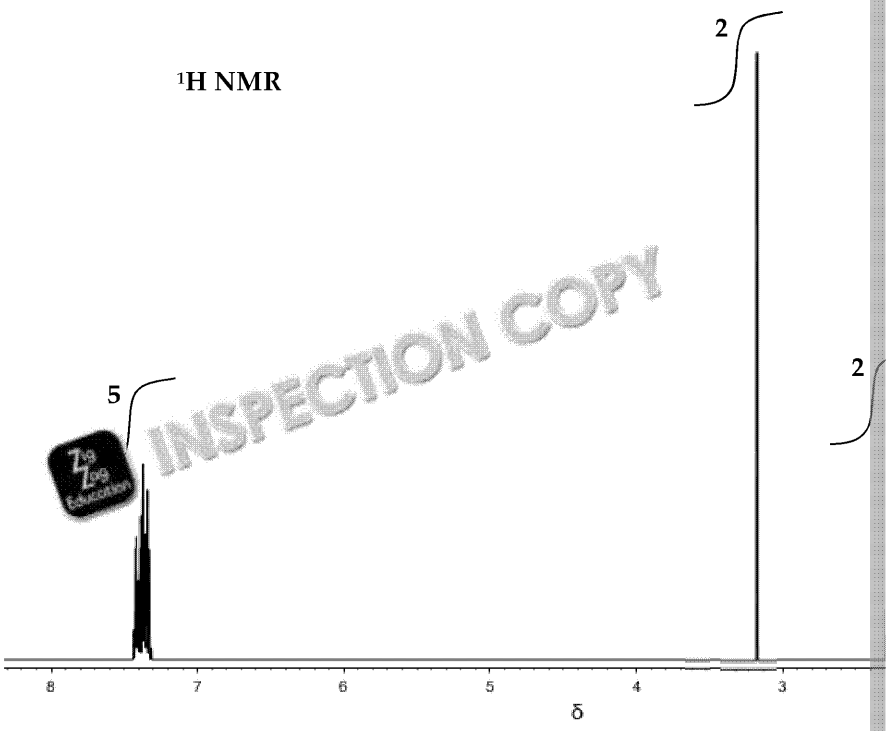
.....

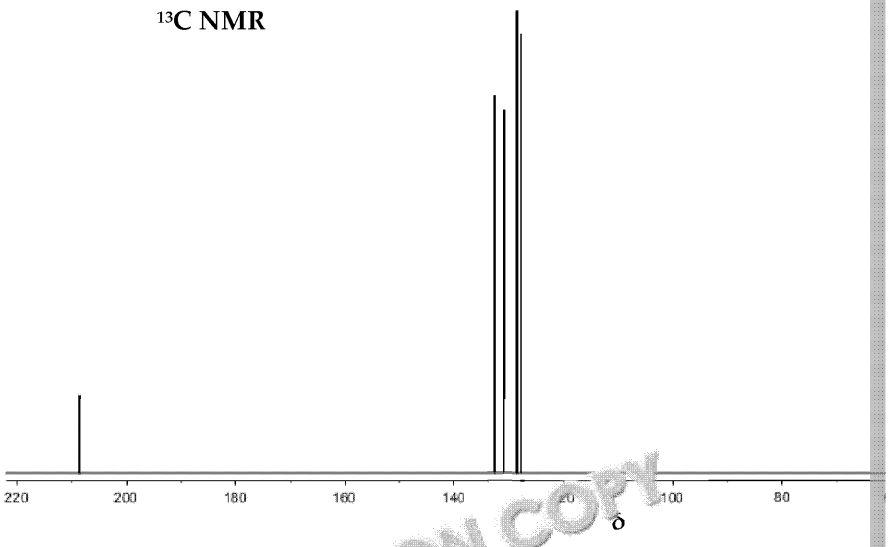
.....

.....

d) Complete the synth s s p. t way by suggesting the identities of S

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





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

Paper 2B

SECTION A

You should aim to finish this section within 20

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

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

A 78 %

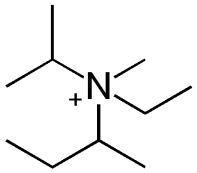
B 79 %

C 80 %

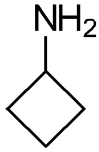
D 81 %

3 Which of the following structures has a chiral carbon?

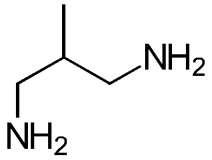
A



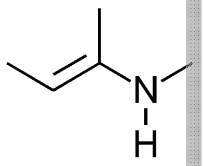
B



C



D



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

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

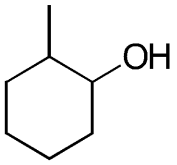
A $CDCl_3$ is used because it exchanges protons with alcohol and amin

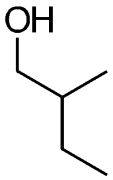
B $CDCl_3$ is used because deuterium does not appear in the same regi as hydrogen.

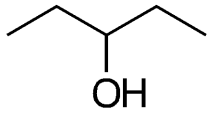
C $CDCl_3$ is used because it has a shift that can easily be used as a sta

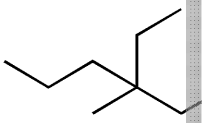
D $CDCl_3$ is used because it can successfully react with most compou using ^1H NMR.

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

A 

B 

C 

D 

7 Which of the following correctly identifies th[illegible]ation states in the i[illegible] NaH and H_2O_2?

A NaH: Na = +1 H = [illegible] H_2O_2 H = +1 O = -2

B NaH: Na = [illegible] H_2O_2 H = -1 O = +1

C N[illegible] H = -1; H_2O_2 H = +1 O = -1

D N[illegible] Na = -1 H = +1; H_2O_2 H = +1 O = -2

8 5.00 g of starting material produced 3.70 g of product in a reaction that efficiency is improved to 33 % and the amount of starting material incr of product will be obtained?

A 97.7 g

B 132 g

C 56.1 g

D 75.8 g

9 Which of the following facts about the bond lengths in benzene provid structure?

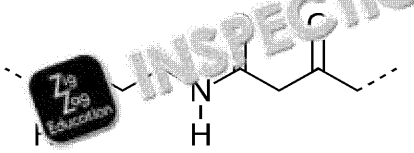
A The bond lengths are all shorter than expected.

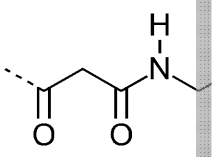
B The bond lengths are all longer than expected.

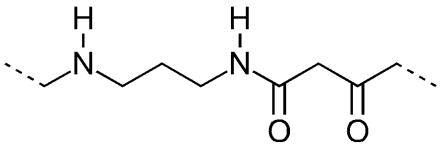
C Some bonds are longer than others.

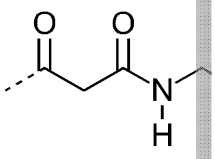
D The bonds are all the same length.

10 What is the correct structure of the repeat unit formed from the followi

A 

B 

C 

C 

11 What are the products if cyclohexyl ethanoate is reacted with hot aque

A $C_6H_{11}ONa + CH_3COOH$

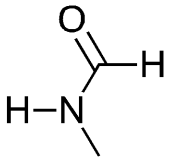
B $C_6H_{11}OH + CH_3COONa$

C $C_6H_{11}COOH + CH_3CH_2ONa$

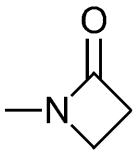
D $C_6H_{11}COONa + CH_3CH_2OH$

12 Which of the following is a secondary amide?

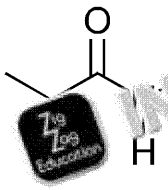
A



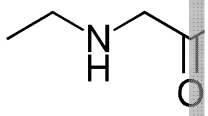
B



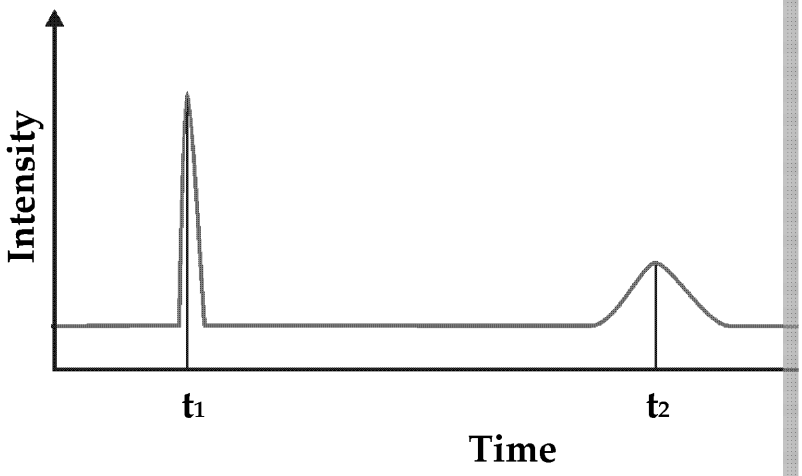
C



D



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



The sample obtained at t_1 was determined to contain tyrosine, and the found to contain phenylalanine.
Which of the following is a valid conclusion?

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

A 1

B 2 only

C 3 only

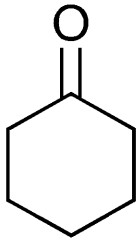
D None of 1, 2 or 3

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

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

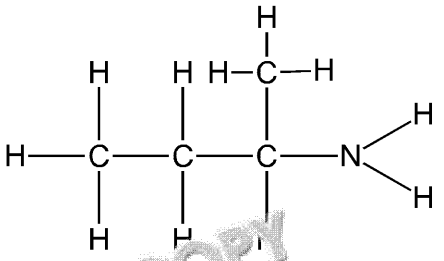


1. It can react with $AlCl_3$ and Cl_2 in a Friedel–Crafts reaction.
2. It is aliphatic.
3. It forms a silver mirror with Tollens' reagent.

A 1 and 2 only
B 1 and 3 only
C 2 only
D None of 1, 2 or 3

SECTION B

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



Sec-butylamine

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

ii) Give the skeletal formula for sec-butylamine.

iii) Give the IUPAC name for sec-butylamine.

b) The four carbons in sec-butylamine have similar bond angles arou
different bond angle around the nitrogen.

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

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

i) Define the term 'enantiomers'.

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

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

i) Identify the conditions needed for the reaction and draw a me
using X to represent the halogen, and showing any relevant di

ii) Explain the difference in rate of this transformation if a bromo
chloroalkane.

iii) Suggest how the rate of reaction for the bromoalkane compare
measured.

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

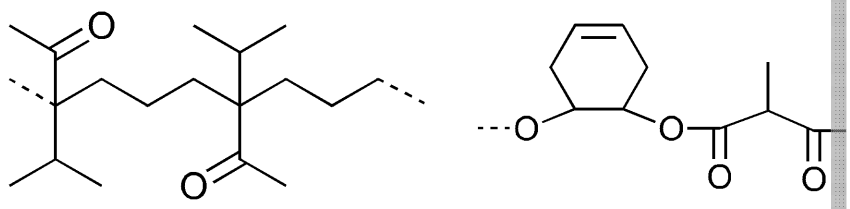
i) Explain the reason for a peak at 74 in the mass spectrum.

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

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

17 Polymers come in a variety of forms, but may be broadly split into add condensation polymers. As well as this, polymers can be made from o

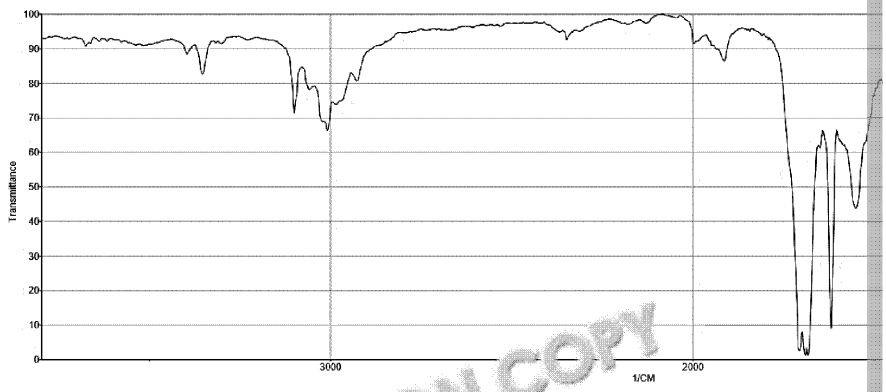
a) The diagrams shown below show two repeat units of two polymer to make each polymer, and state the type of polymerisation involv



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

ii) Describe two advantages of using polymers that are biodegra

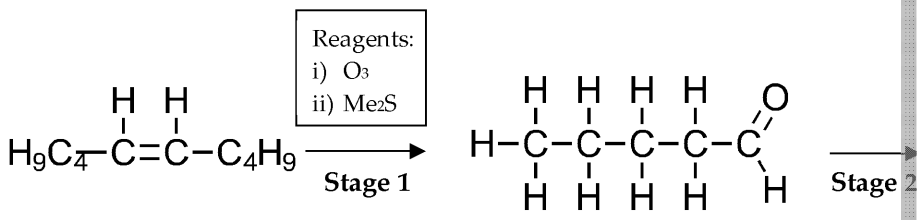
c) An addition polymer with the following IR spectrum was found t
57.1 % carbon by mass, and one other element.

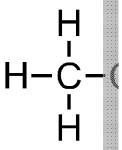


Given that th[illegible]ner has three peaks in its ^{13}C NMR, suggest it
re[illegible]ng

18 Ozonolysis is an important reaction in synthesis that allows the incorp
molecules. Crude oil can be processed to produce many hydrocarbons
can be turned into aldehydes using ozonolysis, and these aldehydes ca
other functional groups.

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





a) Stage 1 involves:

- The r[illegible]of dec-5-ene with a molecule of ozone
- [illegible]owed by breaking up of the intermediate with Me_2S
- Yielding two molecules of pentanal for each molecule of dec-5

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

b) i) Identify the reagent needed to reduce pentanal to pentan-1-ol

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

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

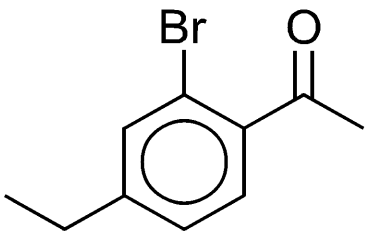
c) Water is often used as a solvent for the reagent involved in Stage 2 does not boil easily compared to similar molecules. Explain these using a labelled diagram to support your answer.

d)* Stage 3 must be completed using reflux apparatus and an acid anhy Describe how this process may be carried out, using an experimen to support your answer. You do not need to include details of pur

e) Aside from its role in the ozonolysis reaction, ozone may be decon •NO radical.

Write two equations to show how this happens.

19 Aromatic compounds are an extremely important set of compounds w branches of organic chemistry. Compound **B** is an example of an arom



Compound B

Com

Compound **C**, phenol, is also an example of an aromatic compound. P compounds, have different reactions to benzene. For instance, ph is not

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

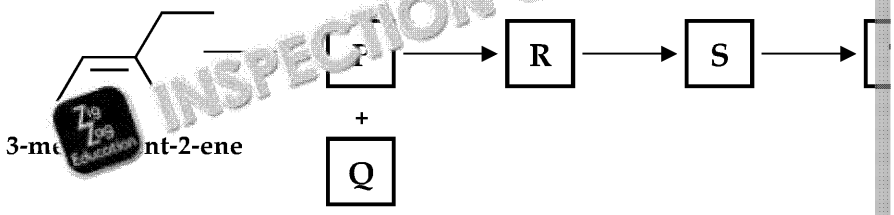
b) Compound **B**, shown above, can be prepared through a reaction o chloride and a $FeCl_3$ catalyst.

Draw and name compound **A**.

c) Write an equation for the reaction of phenol, C_6H_5OH, with an alk

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

20 Synthesis often involves reactions with many steps. The scheme below
of a synthesis pathway from one organic compo[illegible] to another.



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- 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 isome

b) Draw the structures of P and Q, explaining whether you would ex
major product.

c) i) Draw the structure of R.

ii) Explain how the product of R and 2,4-DNP can be used to posit

d) Complete the synthesis p[illegible]way by suggesting the identities of S a

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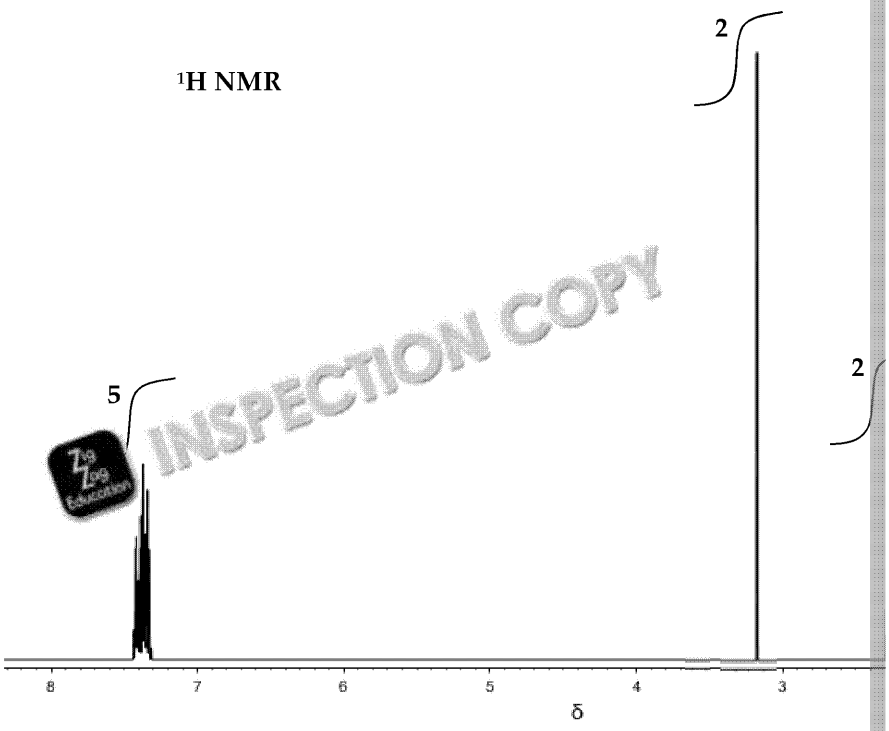
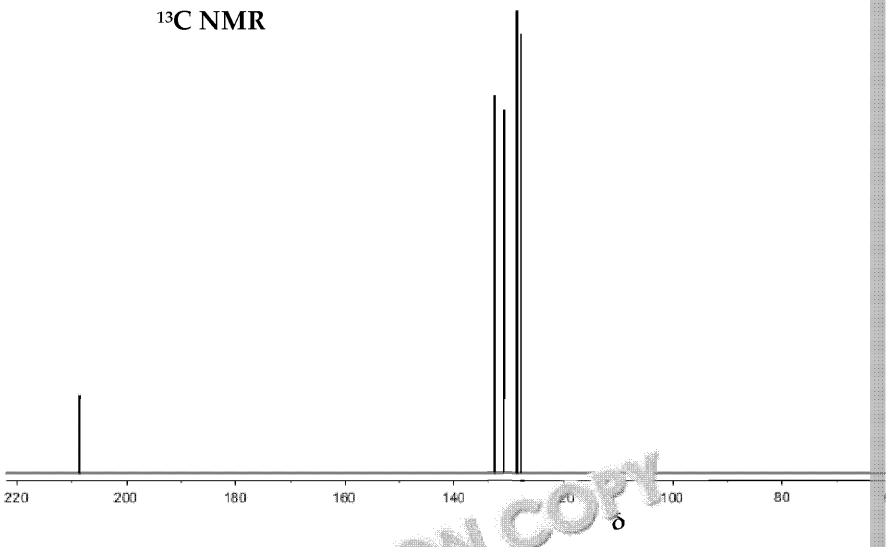




Preview of Questions Ends Here

Practice Paper 2A

Section A

1	B	9	B
2	D	10	D
3	A	11	C
4	D	12	C
5	B	13	D
6	C	14	A
7	A	15	C
8	A		

Section B

16 a) T[illegible] of a molecule responsible for its reactions ✓

b) i) Oxidising agent ✓

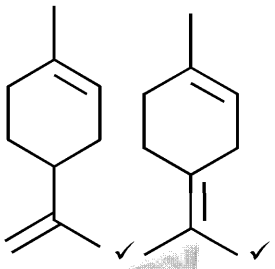
ii) $C_{10}H_{18}O + [O] \rightarrow C_{10}H_{16}O + H_2O$ Organic product correct ✓ Rest of e

iii) For each mark both the peak AND the bond must be mentioned
Peak at 1630–1820 shows C=O formed ✓
No (broad) peak at 3200–3600 shows O–H / alcohol group has reacte
No (very broad) peak at 2500–3300 shows no carboxylic acid O–H h

c) E/Z isomerism caused by restricted rotation (around a C=C bond) ✓
Must be two different groups on each side of the double bond AND this
double bond A has two CH_3 groups on one side ✓

d) Same molecular formula ✓ but different structural formula ✓

e)

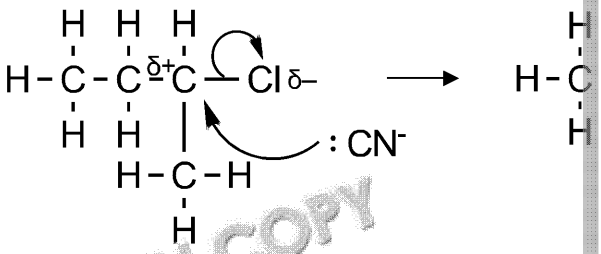


17 a) 2-methylbutan-1-amine ✓ (IGNORE spaces / incorrect use of hyphen)

b) $CH_3CH_2CH(CH_3)CH_2NH_2$ ✓

c) Excess ✓ ethanolic ammonia ✓ (Excess ammonia scores 1 mark only)

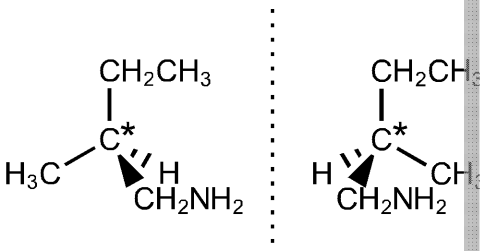
d) i)



Arrow from CN– n[illegible] to carbon ✓
Chlorine l[illegible] correctly drawn chloroalkane ✓
[illegible]duct of the reaction drawn ✓
[illegible]anism: nucleophilic <u>substitution</u> ✓

ii) Nickel AND H_2 ✓ (ACCEPT $LiAlH_4$)

e)

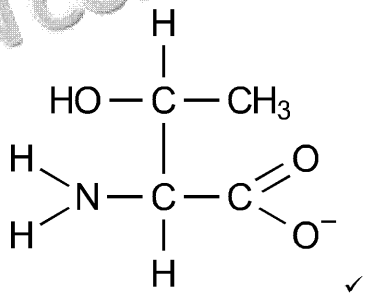


f) i) M_r of CH_3Cl = 50.5
Moles = $\frac{3}{50.5}$ = 0.05941
Moles amine product = 0.05941 ÷ 2 = 0.02970
Product M_r = 115
Theoretical mass of amine product = 115 × 0.02970 = 3.416 g ✓
Percentage yield = $\frac{\text{Actual Mass}}{\text{Theoretical Mass}} \times 100 = \frac{3.00}{3.416} \times 100 = 87.8\ \%$ ✓ (AL

ii) The product is basic, and so reacts with / neutralises acidic SiO_2 ✓

iii) Tetrachloromethane is symmetrical ✓ so dipoles cancel out ✓

18 a)



✓

b) Protons on N–H and O–H undergo exchange with D_2O ✓
Can be identified because their peaks disappear if the NMR is run in D_2C

c)

Environment	Integration	Approximate shift	Splitting
A	1	3.5–4.2	Multiplet
B	3	0.9–2.0	Doublet

✓ for each column filled (ALLOW shift values rather than ranges, +/- 0.1

d) Four peaks ✓

✓✓ for all four of the following correct, ✓ for three out of four correct. M corresponds to which carbon

- Peak in range 160–220 (C=O)
- Peak in range 50–90 (C–O)
- Peak in range 30–70 (C–H)
- Peak in range 0–30 (C–C)

19 a) C ✓

b) i) $C_8H_{18}O_4 + 2NaOH \rightarrow C_6H_8O_4Na_2 + 2CH_3OH$

✓ for formation of $2CH_3OH$ ✓ for rest of equation

Hydrolysis ✓

ii)

LEVEL OF RESPONSE QUESTIO	
Level 3: (5–6 marks)	Answer is structured in an entirely or of both purification and identification correctly.
Level 2: (3–4 marks)	Answer is mostly structured in an ord practical stages are included, with co them.
Level 1: (1–2 marks)	Answer has limited structure. One or with limited detail.
0 marks	No creditworthy response.

Indicative Content

Purification

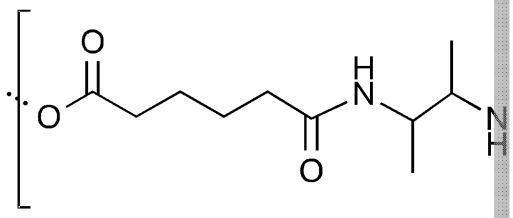
- Dissolve in the minimum amount of a hot solvent
- Filter while hot
- Allow to cool to form crystals
- Filter the crystals
- Use of reduced pressure filtration / Buchner apparatus

Identification

- Add a small quantity to a sealed glass tube / melting point tub
- Heat in a melting point apparatus
- Note temperature at which the solid just melts
- Repeat to get a more accurate value
- Compare value to database to determine the identity of the ac

c) i) Condensation (polymerisation) ✓

ii)



Correct amide bond ✓ rest of monomer correct ✓

iii) Any three from:

- Doesn't use up finite natural resource
- Can sell the product to make a profit ✓
- Doesn't take up landfill space ✓
- Avoids release of greenhouse gases from burning the unused m

d) i) $SOCl_2$ / thionyl chloride ✓

ii) More reactive / reaction occurs faster / doesn't require an acid catal temperature / is not reversible ✓

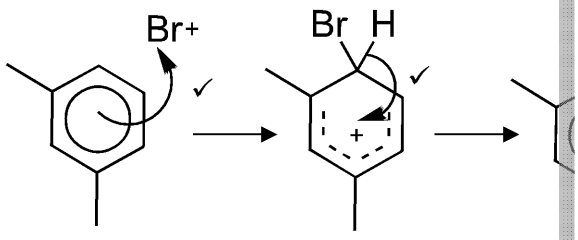
20 a)

	LEVEL OF RESPONSE QUESTION
Level 3: (5–6 marks)	Answer is structured in an entirely ordere all three pieces of evidence is included in relating to this evidence is mostly correct.
Level 2: (3–4 marks)	Answer is mostly structured in an ordered two pieces of evidence is included in the a to this evidence contains only a few omiss
Level 1: (1–2 marks)	Answer has limited structure. Answer inc significance of two of the pieces of eviden significance of one piece of evidence.
0 marks	No creditworthy response.

Indicative Content

- Bond lengths all the same within the ring
- Shows the structure does not contain alternating double and sing different bond lengths)
- Benzene does not react with electrophiles such as bromine (witho
- Alkenes do react with electrophiles such as bromine
- Shows that benzene has an added stability / a reduced electron
- Enthalpy of hydrogenation would be expected to be 3 × -120 kJ m was three isolated double bonds
- Shows that the benzene ring has additional stability

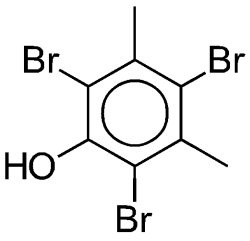
b) $FeBr_3 + Br_2 \rightarrow FeBr_4^- + Br^+$ ✓



✓ ✓ ✓ intermediate

$H^+ + FeBr_4^- \rightarrow FeBr_3 + HBr$ ✓

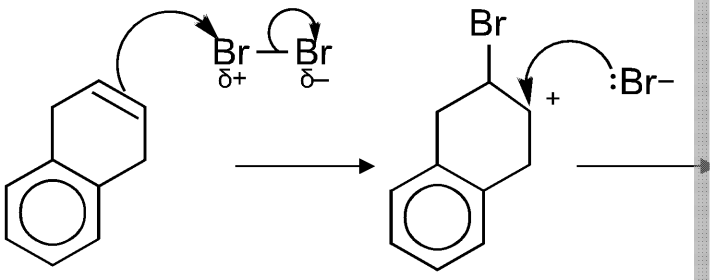
c) Lone pair from the oxygen is delocalised into th[illegible] ✓
Increased electron density in the ring in[illegible]eactivity ✓
Major product is:



✓

d) The nitro group is 3(,5) directing AND substitution would occur at one o

21 a) Use of bromine water ✓
Colour change from orange to colourless ✓



First two arrows correct ✓ Correct structure of intermediate ✓ Addition

b) (Formula is $C_{10}H_{14}N_2$) so $M_r = 162$ ✓
C $\frac{10\times12}{162} \times 100$ H $\frac{14\times1}{162} \times 100$ N $\frac{2\times14}{162} \times 100$ ✓
C 74 % H 9 % N 17 % ✓ (Correct final answer scores 3
given to the nearest whole number)

c) C reacts / produces hydrogen with [illegible] turns universal indicator
do not ✓
C does not react[illegible] carbonates AND carboxylic acids do react / p

d) A[illegible] D[illegible] (with methanol and sulfuric acid) ✓
Ye[illegible]/orange precipitate observed ✓

e) C AND 10 peaks ✓

Preview of Answers Ends Here