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3

91391



913910



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Level 3 Chemistry, 2017

91391 Demonstrate understanding of the properties of organic compounds

2.00 p.m. Wednesday 15 November 2017
Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the properties of organic compounds.	Demonstrate in-depth understanding of the properties of organic compounds.	Demonstrate comprehensive understanding of the properties of organic compounds.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

A periodic table is provided on the Resource Sheet L3-CHEMR.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Achievement

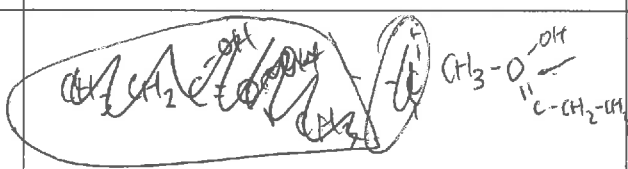
TOTAL

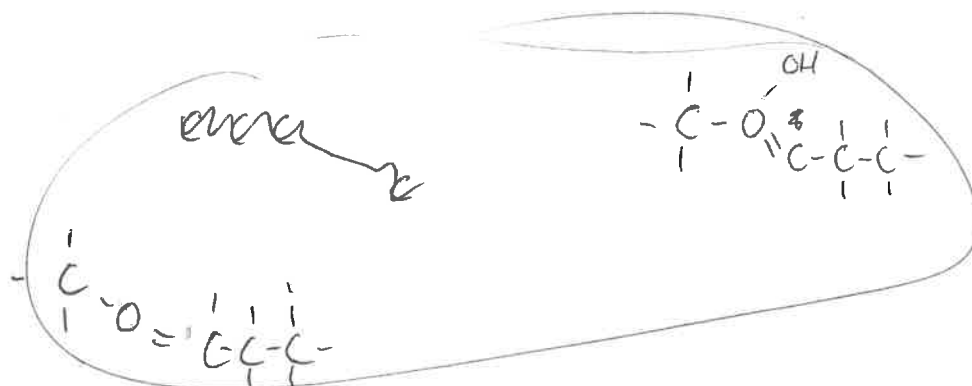
09

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QUESTION ONE

- (a) Complete the table below to indicate the IUPAC name, functional group, and/or the structural formula for organic compounds that contain **only four carbon atoms**. The first row has been completed for you.

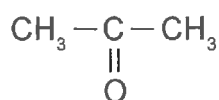
Functional group	Structural formula	IUPAC (systematic) name
Alkene	$\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$	but-1-ene
Amine	$\text{CH}_3 - \overset{\text{CH}_3}{\underset{ }{\text{CH}_2}} - \text{CH}_2\text{NH}_2$	2-methylpropan-1-amine
Acyl chloride	$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \overset{\text{O}}{\underset{ }{\text{C}}} - \text{Cl}$	butanoyl chloride
Ester		propyl methanoate
Ketone	$\text{CH}_3\text{CH}_2 - \overset{\text{O}}{\underset{ }{\text{C}}} - \text{CH}_3$	butan-2-one
Aldehyde	$\text{CH}_3\text{CH}_2\text{CH}_2 - \overset{\text{O}}{\underset{ }{\text{C}}} - \text{H}$	butanal
Amide	$\text{CH}_3\text{CH}_2\text{CH}_2 - \overset{\text{O}}{\underset{ }{\text{C}}} - \text{NH}_2$	butanamide



- (b) Complete the following reaction scheme by drawing the structural formulae of both organic compounds **A** and **B**, as well as the major and minor products **C** and **D**.

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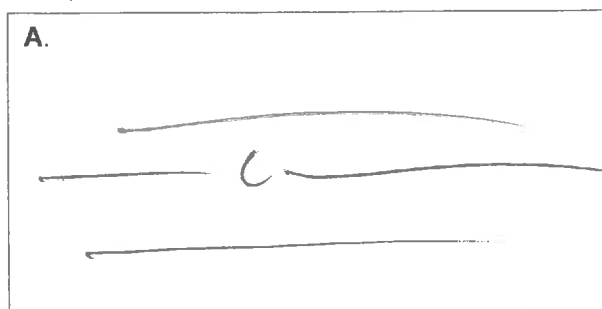
Identify both reagents 1 and 2, and indicate the type of reaction occurring at each step.



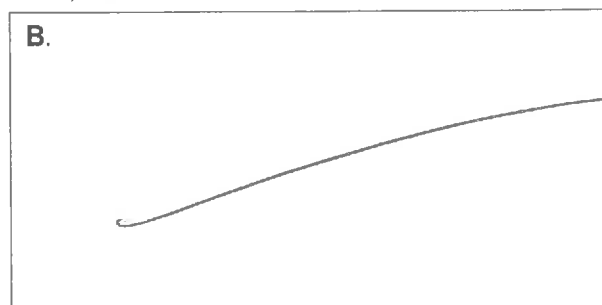
Propanone

Type of reaction: additionReagent 1: H₂O

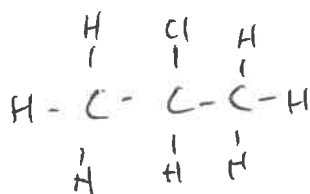
A.

Type of reaction: eliminationReagent 2:

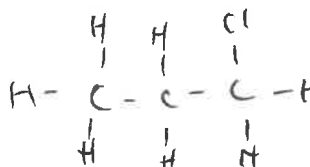
B.

Type of reaction: substitutionReagent 3: HCl

C. Major product



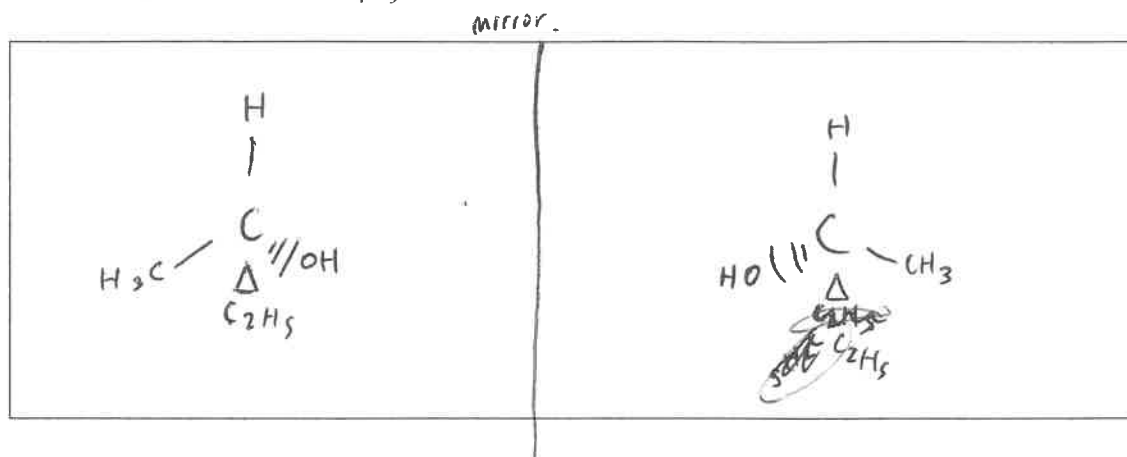
D. Minor product



(c) Some organic compounds can exist as enantiomers (optical isomers).

An example is a secondary alcohol with the molecular formula C_4H_9OH .

(i) Draw the enantiomers of C_4H_9OH in the box below.



(ii) Explain what is meant by the term enantiomers (optical isomers).

In your answer, you should:

- identify the structural requirement for a molecule, such as C_4H_9OH , to exist as enantiomers
- explain how enantiomers can be distinguished from each other.

// For an molecule such as C_4H_9OH to exist as an enantiomer it must be a secondary alcohol. Enantiomers must have four different functional groups surrounding the central chiral carbon hence C_4H_9OH must be secondary alcohol. Enantiomers can reflect plain polarised ~~light~~ light in opposite ~~effects~~ directions and this is how they can be distinguished from one another. //

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A3

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The examination continues on the following page.**

QUESTION TWO

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- (a) Compound **P** and compound **Q** are straight-chain constitutional (structural) isomers with the molecular formula $C_5H_{12}O$. Compound **P** can form optical isomers, whereas compound **Q** cannot.

When reacted with concentrated sulfuric acid, compound **P** forms two products, compounds **R** and **S**; compound **Q** forms only one product, compound **S**.

When compound **Q** is reacted with *Reagent 1*, it forms a chloroalkane, compound **T**.

Compound **T** reacts with concentrated NH_3 to form compound **U**.

Compound **Q** can also be oxidised to form compound **V**, which will turn moist blue litmus paper red.

Compound **V** can also be reacted with compound **Q** and *Reagent 2*, to form a sweet-smelling liquid, compound **W**.

Use the information above to identify compounds **P** to **W**, and *reagents 1* and *2*.

Space for planning/working is provided in the box below.

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- (b) (i) Adding an acidified potassium dichromate solution to propan-1-ol can produce either propanal or propanoic acid.

Explain the laboratory procedure used to convert propan-1-ol to **propanal**.

In your answer, you should:

- outline the procedure for the conversion, and describe any colour changes linked to the species involved
- state the type of reaction occurring
- explain how the procedure ensures only **propanal** is collected.

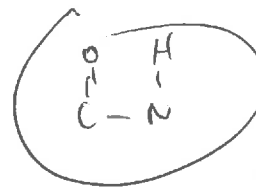
// To devise a test to form propanal (aldehyde) from propan-1-ol (primary alcohol).
We would use the distilling method.
This ensures only the aldehyde is collected //

- (ii) Explain how Benedict's solution can be used to distinguish between propanone and propanal.

In your answer, you should include:

- any observations made linked to the organic compounds involved
- the type of reaction occurring
- relevant equations showing any organic reactants and products involved.

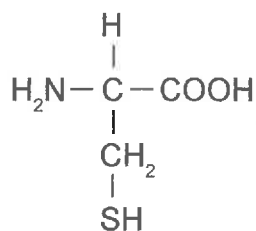
~~Benedict~~
// Aldehydes react with Benedict's solution so if added the solution will turn blue
ketones won't react with Benedict's solution but will readily react with water //



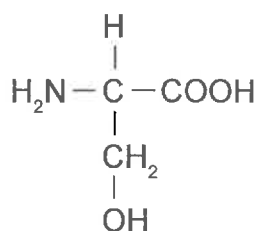
QUESTION THREE

Peptides are molecules that form when amino acids combine.

The following structures show the amino acids cysteine and serine.



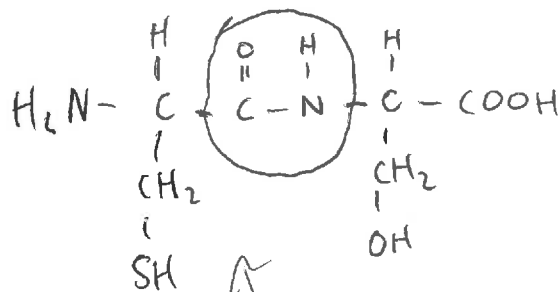
cysteine



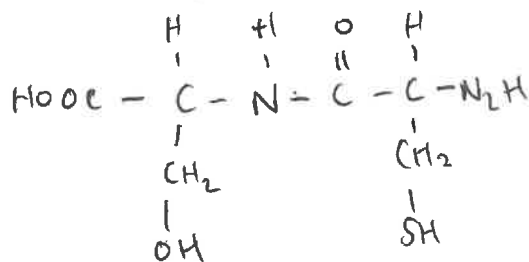
serine

- (a) (i) In the boxes below, show two possible dipeptides that can be formed by combining the two amino acids shown above.

Dipeptide 1:



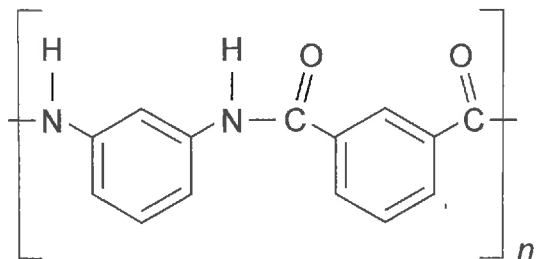
Dipeptide 2:

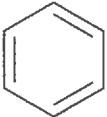


- (ii) Circle the amide functional group on ONE of the dipeptides drawn in part (i).

- (b) Nomex® is a polymer used in firefighters' suits. Nomex® is made up of two different monomers bonded together to form the polymer chain.

A small portion of the structure of Nomex® is shown below.

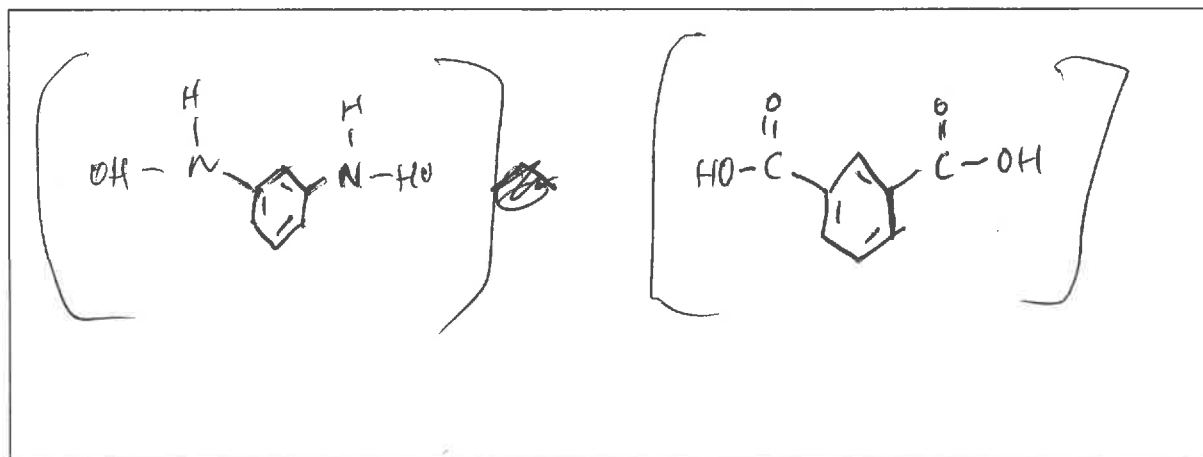


Note:  is a benzene ring and does not change when the monomers bond together to form the polymer.

Explain the structure of the polymer, Nomex®.

In your answer, you should include:

- the name of the functional group linking the monomers
- a drawing of both monomers
- a classification of the type of polymer formed, with an explanation to justify your choice.



// The functional group holding the monomers is known as the amide linkage this joins monomers together to form the chain

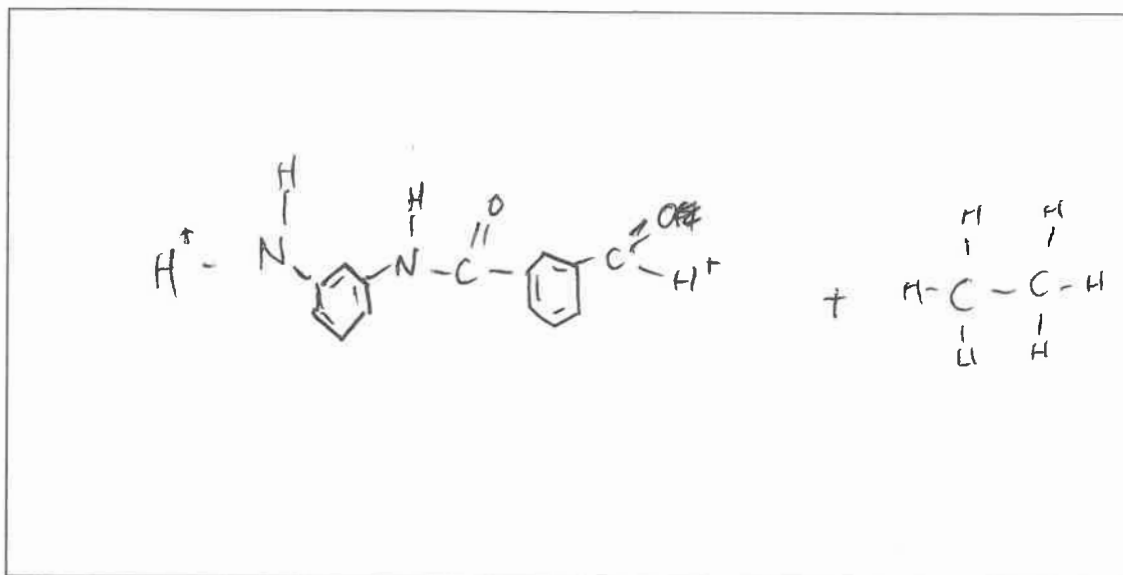
The polymer is formed through condensation, condensation is where monomers join together and produce a water molecule. //

- (c) Polymers such as Nomex® can be hydrolysed by either aqueous acid or base.

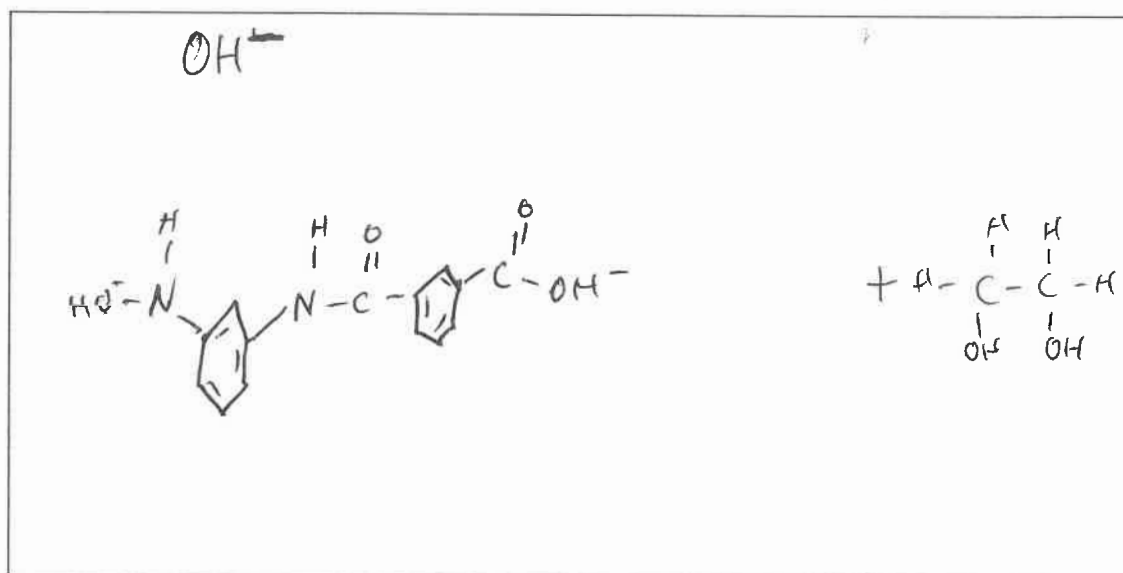
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Show the products of the hydrolysis of Nomex® using:

- (i) aqueous acid H_2SO_4^-



- (ii) aqueous base.



AB

Subject:	Chemistry	Standard:	91391	Total score:	09
Q	Grade score	Annotation			
1	A3	This response provides enough evidence for achievement because they can draw or name structures with reasonable accuracy and do show some understanding of optical isomerism.			
2	A3	This response provides enough evidence for achievement because they can follow through a series of reactions and draw structures with good accuracy but they have limited knowledge of reagents and practical work.			
3	A3	This response provides enough evidence for achievement because the candidate shows understanding of condensation polymerisation but has made some errors. The candidate has a limited understanding of hydrolysis.			