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Level 3 Chemistry, 2018

91391 Demonstrate understanding of the properties of organic compounds

2.00 p.m. Thursday 15 November 2018
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 in the Resource Booklet 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.

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QUESTION ONE

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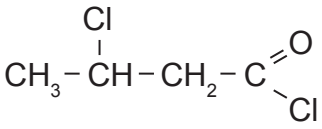
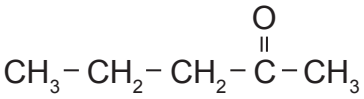
(a) Complete the table below to show either the structural formula or the IUPAC (systematic) name for each organic molecule.

Structural Formula	IUPAC (systematic) name
	
	
	4-methylhexanal
	propanamide

(b) Three bottles, each containing a different colourless liquid, have been incorrectly labelled. The three colourless liquids are known to be:

pentanal	$CH_3CH_2CH_2CH_2CHO$
pentan-1-ol	$CH_3CH_2CH_2CH_2CH_2OH$
pentanoyl chloride	$CH_3CH_2CH_2CH_2COCl$

Develop a procedure to identify each of the three colourless liquids using only the following reagents:

- water
- Tollens' reagent
- acidified potassium dichromate, $H^+/K_2Cr_2O_7$.

Your procedure should include:

- observations linked to the species involved
- the type of reaction occurring
- structural formulae of any organic products.

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(c) Unknown X has the molecular formula $C_4H_8O_3$ and undergoes the following reactions:

- It reacts with sodium carbonate solution to release carbon dioxide gas.
- When X is heated with acidified potassium dichromate, the colour changes from orange to green, but the product does not react with Benedict's solution.
- X undergoes an elimination reaction with concentrated sulfuric acid to produce two organic products.

Based on the information above, draw the structural formula of Unknown X.

Justify your structural formula of X, including:

- structural formulae of any organic products
- an explanation of any major and minor products.

Structural formula for Unknown X:

QUESTION TWO

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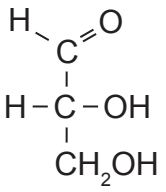
(a) The structural formula of 2,3-dihydroxypropanal, more commonly known as glyceraldehyde, is shown below.



Glyceraldehyde can exist as enantiomers (optical isomers).

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

(ii) Explain why glyceraldehyde can exist as enantiomers.

(iii) How could the two enantiomers of glyceraldehyde be distinguished?

Explain your answer.

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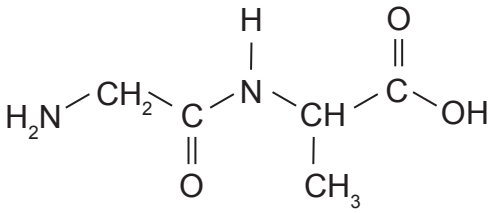
(b) Dipeptides are made from two amino acids joined by an amide (peptide) bond. The dipeptide shown below is made from glycine and alanine:



(i) Circle the amide (peptide) bond.

(ii) Compare and contrast the acidic and basic hydrolysis of the above dipeptide.

Your answer should include:

- an explanation of the hydrolysis reaction
- structural formulae of the products formed when the dipeptide undergoes acidic and basic hydrolysis, in the two boxes provided.

Acidic hydrolysis:

Basic hydrolysis:

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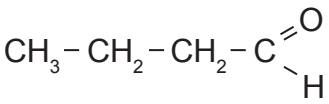
(c) The structural formula of butanal is:



Devise a reaction scheme to convert butanal into butanone.

For each step include:

- the reagents and conditions
- structural formula of the organic product after each step.

QUESTION THREE

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Glycolic acid can be used to make polyglycolic acid (PGA), a polyester used to make dissolvable stitches. The structure of glycolic acid is shown below:

$HO - CH_2 - COOH$

(a) (i) In the box below, draw a section of the PGA polymer chain to show THREE repeating units.

(ii) Identify and explain the type of reaction occurring in the formation of PGA.

(b) Many organic synthesis reactions are heated under reflux.

(i) In the box below, draw the structural formula and name the ester formed from heating ethanol and butanoic acid under reflux in the presence of concentrated sulfuric acid.

CH_3CH_2OH
ethanol

$CH_3CH_2CH_2COOH$
butanoic acid

Name: _____

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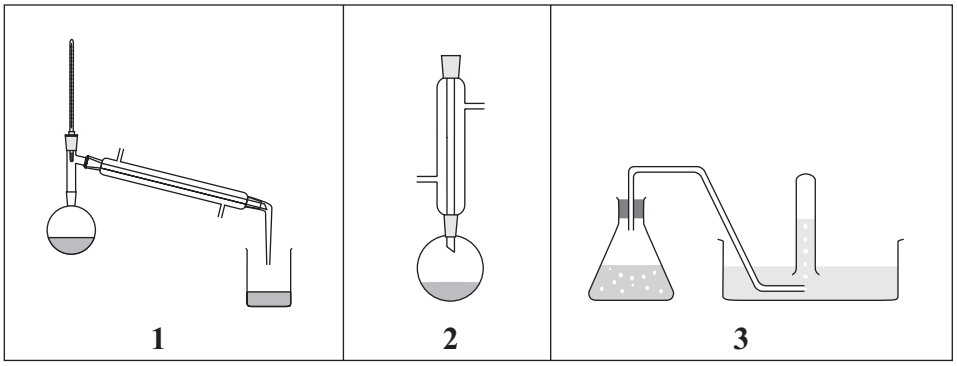
(ii) From the diagrams below, give the number of the apparatus used for heating under reflux.



(iii) Outline the advantages of heating under reflux in the preparation of the ester in part (i).

(iv) From the diagrams above, give the number of the apparatus and explain the process that could be used to purify (separate) the ester in part (i) from the reaction mixture.

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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