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Level 3 Chemistry, 2019

91391 Demonstrate understanding of the properties of organic compounds

2.00 p.m. Thursday 14 November 2019
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.

TOTAL

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QUESTION ONE

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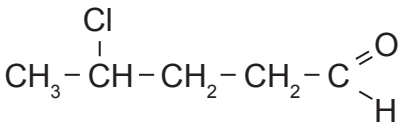
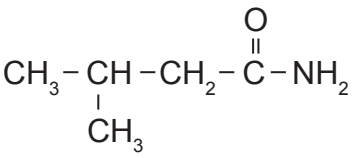
(a) (i) Complete the table below to show either the structural formula or the IUPAC (systematic) name for each organic molecule.

Structural formula	IUPAC (systematic) name
	
	Ethyl hexanoate
	

(ii) Propanal, CH_3-CH_2-CHO, can be formed from the oxidation of a primary alcohol.

Draw the structural formula of the primary alcohol, and explain why distillation is required to obtain the aldehyde product during the oxidation process.

Primary alcohol:

(b) Describe and explain a chemical test to distinguish the following pairs of organic molecules.

Your answer should include:

- reagents and conditions required
- observations
- the reaction type used to distinguish each pair
- structural formulae of any organic products.

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(i) propan-1-ol and propene

(ii) butanal and butan-1-ol

(iii) ethanoyl chloride and ethyl pentanoate

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(c) Unknown **W** is a straight-chain organic molecule with the molecular formula $C_4H_6OCl_2$.
Unknown **W** shows the following properties and reactions:

- does not exist as enantiomers (optical isomers)
- produces steamy fumes with water
- reacts with an excess of ammonia to form product **X**. Product **X** turns damp litmus blue.

Product **X** undergoes acidic hydrolysis to produce product **Y**. Bubbles are released when product **Y** reacts with sodium carbonate solution.

Draw the structural formulae for the organic molecules **W**, **X**, and **Y** in the table below.

Organic molecule	Structural formula
W	
X	
Y	

QUESTION TWO

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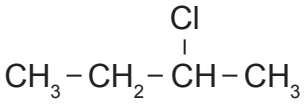
(a) 2-chlorobutane can exist as enantiomers (optical isomers).



(i) Draw the enantiomers of 2-chlorobutane in the box below.

(ii) Explain how the two enantiomers of 2-chlorobutane could be distinguished.

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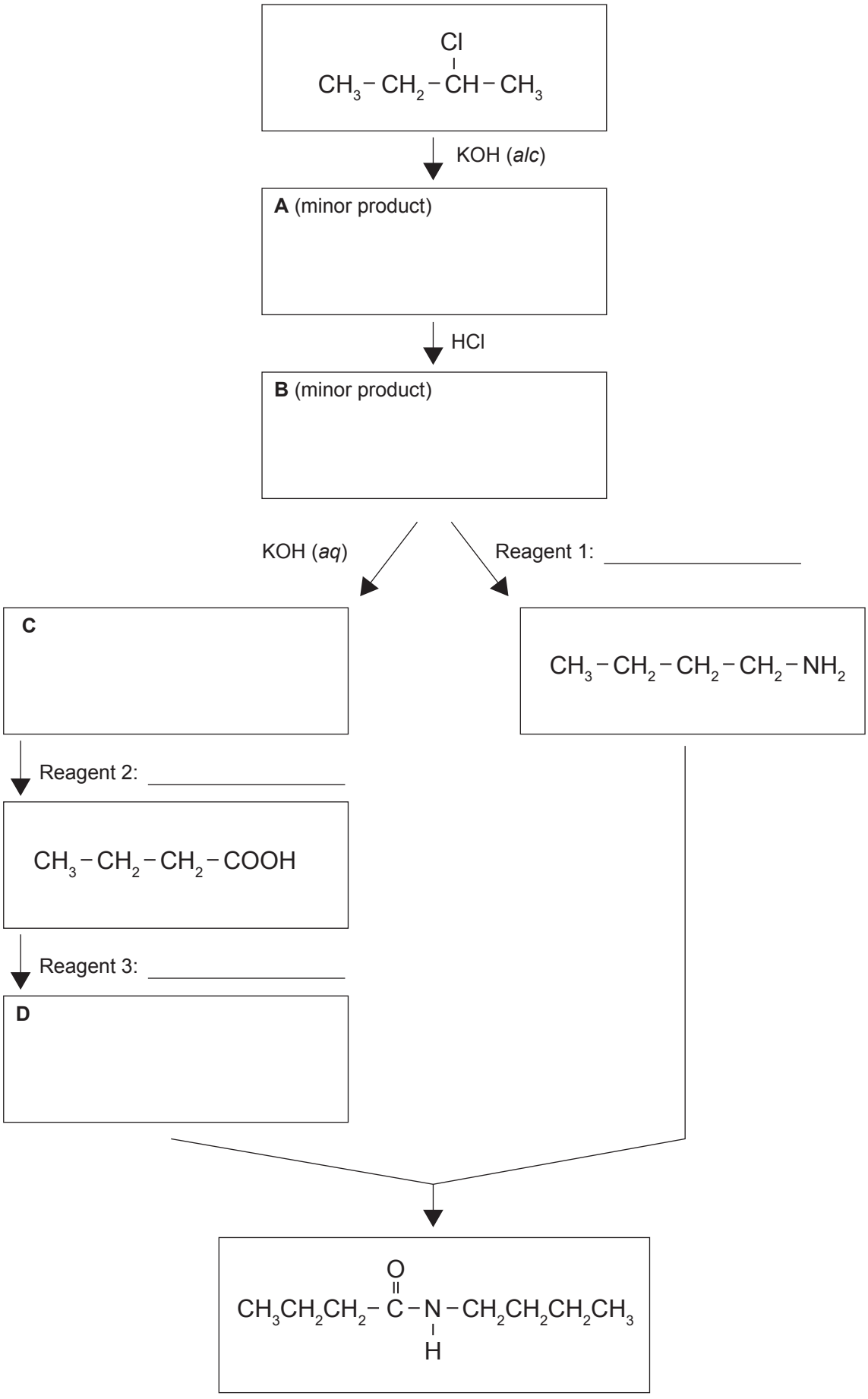
(b) Complete the following reaction scheme by drawing the structural formulae for organic products A, B, C, and D, and identifying reagents 1, 2, and 3.



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(c) $C_5H_{10}O$ can exist as a number of different constitutional (structural) isomers.

Draw the structural formulae for the isomers of $C_5H_{10}O$ that meet the following requirements.

(i) Straight-chain molecule that forms a silver mirror when heated with Tollens' reagent.

(ii) Branched-chain molecule that does not form a silver mirror when heated with Tollens' reagent.

(iii) Five-carbon ring cyclic molecule that forms steamy fumes when reacted with thionyl chloride, $SOCl_2$.

(iv) Straight-chain secondary alcohol that decolourises bromine water, and can exist as both *cis-trans* (geometric) isomers and enantiomers (optical isomers).

QUESTION THREE

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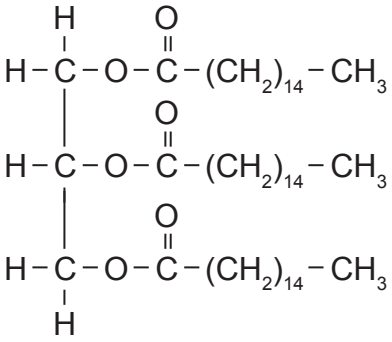
(a) Nylon 6,6 is used to make airbags. The monomers used to make nylon 6,6 are shown below:

(i) In the box below, draw a section of the nylon 6,6 polymer chain to show TWO repeating units.

(ii) Explain why nylon 6,6 is referred to as a condensation polymer.

(b) Triglycerides are found in fats and oils. Below is an example of a triglyceride.



(i) Put a circle around ONE of the ester groups in the triglyceride molecule shown above.

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(ii) Compare and contrast the acidic and basic hydrolysis of the triglyceride molecule shown on the previous page.

In your answer, you should include:

- an explanation of the hydrolysis reaction
- structural formulae of the products formed from both acidic and basic hydrolysis
- reagents and conditions required.

Question Three continues on the following page.

(c) Devise a reaction scheme to convert butanone into butan-2,3-dione.

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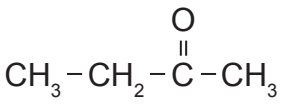
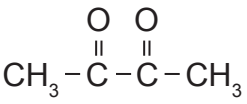


butanone



butan-2,3-dione

For each step include:

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

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

QUESTION NUMBER

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