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NZQA

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QUALIFY FOR THE FUTURE WORLD
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Level 2 Chemistry, 2016

91165 Demonstrate understanding of the properties of selected organic compounds

9.30 a.m. Monday 21 November 2016
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the properties of selected organic compounds.	Demonstrate in-depth understanding of the properties of selected organic compounds.	Demonstrate comprehensive understanding of the properties of selected 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 L2–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.

Merit

TOTAL 16

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QUESTION ONE

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(a) (i) Complete the following table.

Structural formula	IUPAC (systematic) name
$CH_3-CH_2-CH_2-CH_2-CH(I)-CH_3$	2-iodohexane
$CH_3-CH_2-CH(CH_3)-CH_2-C(=O)OH$	3-methylpentanoic acid
$CH\equiv C-CH_2-CH_3$	but-1-yne
$CH_3-CH_2-CH_2-NH_2$	1-aminopropane

(ii) Draw and name the THREE constitutional (structural) isomers of the organic compound C_5H_{12}.

$CH_3-CH_2-CH_2-CH_2-CH_3$

pentane

$CH_3-CH(CH_3)-CH_2-CH_3$

2-methylbutane

$CH_3-C(CH_3)_2-CH_3$

2,2-dimethylpropane.

(b) (i) Classify the following haloalkanes as primary, secondary or tertiary.

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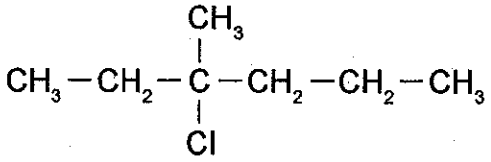
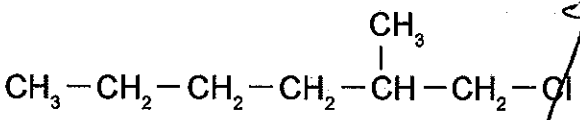
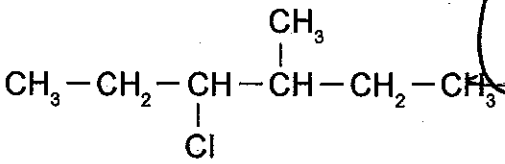
	Haloalkane	Classification
A		tertiary
B		primary
C		secondary.

(ii) Explain your choice for haloalkane **A**.

The carbon atom that is attached to Cl atom is also attached to three other carbon atoms.

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(c) Some alkenes are able to form *cis* and *trans* (geometric) isomers.

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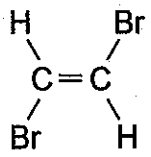
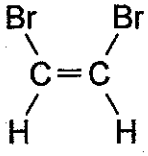
(i) Complete the names of structures **A** and **B** in the table below.

A	B
	
trans - 1,2-dibromoethene	cis - 1,2-dibromoethene

(ii) Elaborate on the structure of the organic compound 1,2-dibromoethene to explain why it is able to form *cis* and *trans* (geometric) isomers.

In order to form cis and trans geometric isomers, the carbon atom attached to the double bond must have different atoms on its ~~carbon~~ end. ✓

In trans - 1, 2 - dibromoethene, the atoms on each carbon atoms are different - H and Br atoms but different atoms are on the same side of both carbon atoms. ✓✓

In cis - 1, 2 - dibromoethene, the atoms on each carbon atoms are different - H and Br atoms but the same atoms are on the same side of both carbon atoms. ✓✓

QUESTION TWO

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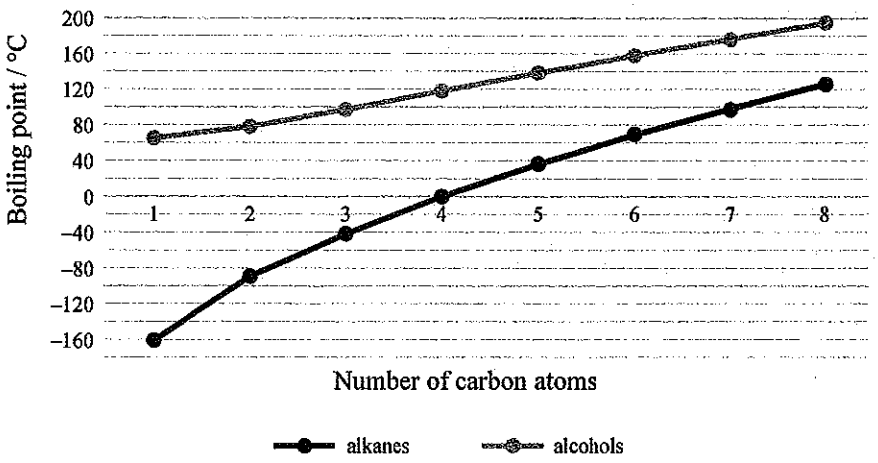
(a) **Boiling points of straight chain alkanes and primary alcohols**



(i) Identify the trends shown on the graph above.

The boiling points of straight chain alkanes and primary alcohols increases as number of carbon atoms are added to the chain. ✓

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(ii) Identify which alkanes will be gases at room temperature (20°C) according to the graph above.

All alkanes will be gases at room temperature (20°C) as the lowest boiling point of the alkane - methane is above 60°C. ✓

(b) Solutions of amines are described as bases, and solutions of carboxylic acids are described as acids.

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(i) Complete the balanced equation for the reaction between solutions of ethanamine, $CH_3CH_2NH_2(aq)$ and hydrochloric acid, $HCl(aq)$.

$CH_3CH_2NH_2(aq) + HCl(aq) \rightarrow$ $CH_3CH_2Cl^- + NH^{3+}$

(ii) Explain the statement 'carboxylic acids have acidic properties'.

Refer to the reaction between ethanoic acid, $CH_3COOH(aq)$, and water, $H_2O(\ell)$ in your answer.

$CH_3COOH + H_2O \longrightarrow CH_3COO^- + H_3O^+$

H^+ ion in CH_3COOH is dissociated in H_2O, making the water acidic. Acids can donate H^+ protons.

Aqueous of CH_3COOH will turn blue litmus paper to red.

If react with Na_2CO_3, CO_2 gas will release. It can be seen by if buzzling occur.

(c) Ethane gas, $C_2H_6(g)$, and ethene gas, $C_2H_4(g)$, will both react with bromine water, $Br_2(aq)$.

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Compare and contrast these two reactions.

In your answer you should refer to:

- any conditions required
- the observations made
- the types of reactions occurring
- structural formulae of the organic products formed.

~~Add bromine~~

Reaction 1 : ethane and bromine water

$C_2H_6 + Br_2 \xrightarrow{\text{UV light}} C_2H_5Br + HBr$

UV light is required for the reaction to proceed. The solution will decolourise slowly from brown to colourless.

The reaction above is substitution as H atom in C_2H_6 is replaced with Br atom.

Reaction 2 : ethene and bromine water

$C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$

The solution will decolourise immediately from brown to colourless

The reaction above is ~~substitution~~ addition as the double bond is broken to add Br atoms with each C atoms.

Both ethane and ethene can react with Br_2 water and decolourise from brown to colourless but ethane takes a longer time to react and needs to react under UV light.

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M5

QUESTION THREE

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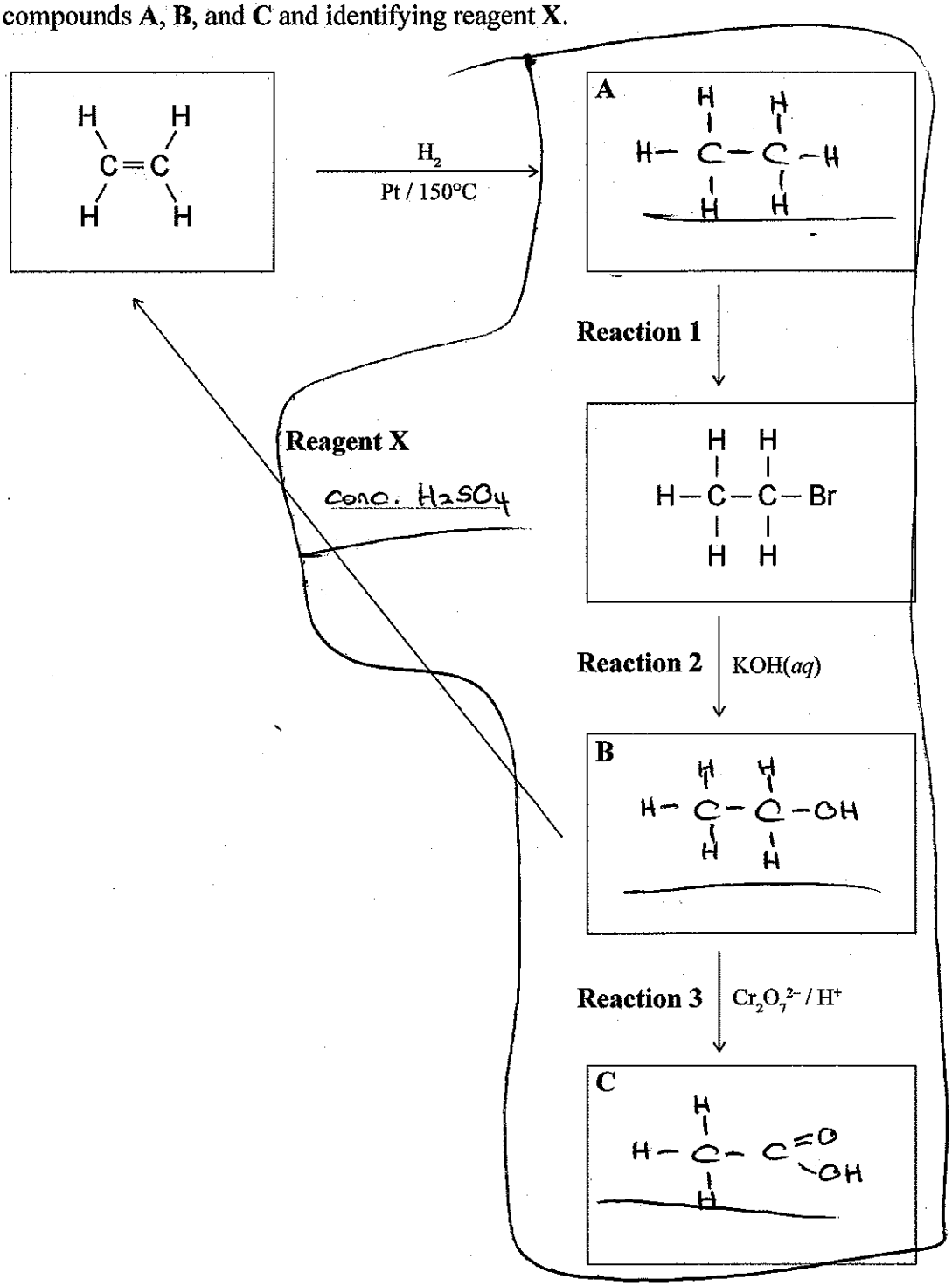
(a) (i) Complete the following chart by drawing the structural formulae for the organic compounds **A**, **B**, and **C** and identifying reagent **X**.



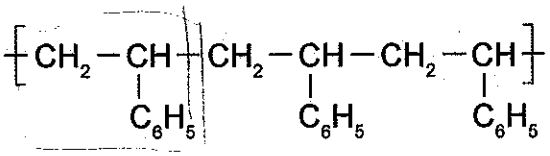
(ii) Identify the type of organic reaction occurring in each of Reactions 1, 2, and 3.

Reaction 1 Substitution. 1

Reaction 2 Substitution 1

Reaction 3 Oxidation 1

(b) Polystyrene is a polymer with the structure:



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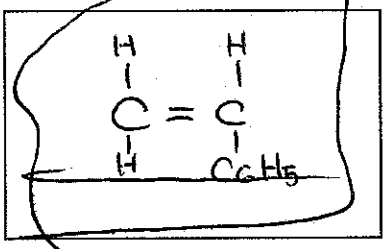
(i) Draw the monomer used to make the polymer polystyrene.



(ii) Explain why the formation of polystyrene from its monomer is classified as an addition polymerisation reaction.

The double bond in its monomer is broken down to join other monomers with two single covalent bond into a long polymer.

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(c) The reaction between propene, $C_3H_6(g)$, and hydrogen chloride, $HCl(g)$, produces a mixture of products.

One of these products, the major product, is made in higher proportions than the other, the minor product.

$$CH_2=CH-CH_3 + HCl \rightarrow$$

(i) Draw and name the major and minor products for this reaction.

Major Product	Minor Product
$CH_3 - CHCl - CH_3$.	$CH_2Cl - CH_2 - CH_3$
Name: 2-chloropropane	**Name:** 1-chloropropane.

(ii) Elaborate on the reaction that occurs between propene and hydrogen chloride.

The reaction that occurs is addition reaction. But the structure propene is asymmetrical, therefor it will form two kinds of products. Major product follows Markovnikoff's rule, where H atom is added to the C atom with the most H atoms attached to the double bond during a addition reaction. Minor product does not follow the rule.

In 2-chloropropane, hydrogen atom was added to the first C atom which had the most hydrogen atoms attached to the double bond.

In 1-chloropropane, hydrogen atom was added to the 2nd C atom which had the least hydrogen atom attached to the double bond.

M

M6

Merit exemplar 2016

Subject:	Chemistry	Standard:	91165	Total score:	16

Q	Grade score	Annotation
1	M5	The candidate in part (a), drew the correct structures and gave the correct names. In part (b), the candidate correctly classified the molecules, but failed to link this to the reason for their choice for molecule A. In part (c), the candidate gave an explanation as to why two different groups / atoms on the carbon atom are required for geometric isomerism. Unfortunately, the candidate failed to mention the role of double bonds.
2	M5	The candidate in part (a), correctly identified one trend from the graph, but was unable to name the gaseous alkanes at room temperature. In part (b), the candidate correctly wrote one equation and explained why carboxylic acids have acidic properties, which is due to the donation of H^+ ions and the formation of H_3O^+ ions. (evidence from the equation) In part (c), the candidate gave a good comparison and contrast for this question, but did not reach excellence, as the response lacked structural formulae (instead giving molecular formulae).
3	M6	The candidate in part (a), correctly identified formulae, reagent and the reaction type. In part (b), the candidate gave the correct monomer structure and explained that polymerisation reactions occur when double bonds in the monomer break allowing them to join with single bonds. In part (c), the candidate elaborated on the reaction by explaining how the two products are formed and discussed in detail, the positioning of H. Excellence could not be awarded as the candidate did not consider the positioning of the Cl atom.