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NZQA

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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.

Achievement

TOTAL 10

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QUESTION ONE

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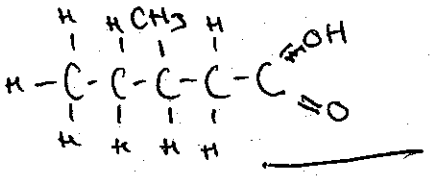
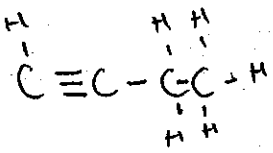
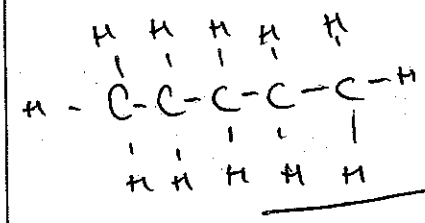
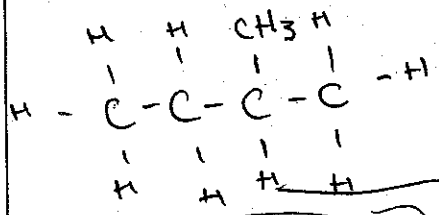
(a) (i) Complete the following table.

Structural formula	IUPAC (systematic) name
$CH_3-CH_2-CH_2-CH_2-\underset{\displaystyle I}{CH}-CH_3$	2-iodo hexane
	3-methylpentanoic acid
	but-1-yne
$CH_3-CH_2-CH_2-N\begin{matrix}H\\H\end{matrix}$	prop-1-amine

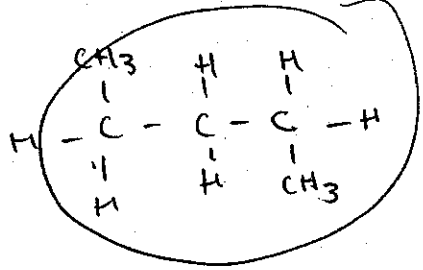
(ii) Draw and name the THREE constitutional (structural) isomers of the organic compound C_5H_{12}.



pentane



2-methylbutane



2,3-dimethyl propane

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

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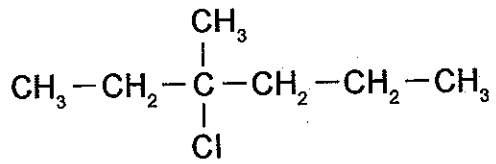
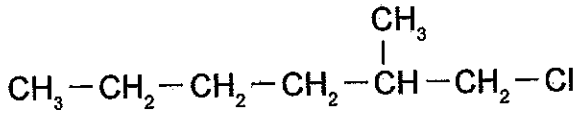
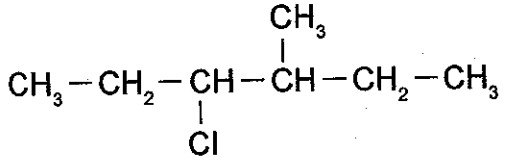
	Haloalkane	Classification
A		tertiary
B		primary
C		secondary

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

Because the carbon that is bonded to the halogen atom, is itself bonded to 3 other carbons.

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

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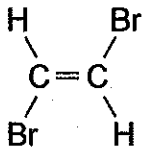
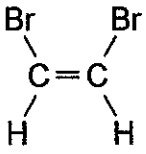
(i) Complete the names of structures **A** and **B** in the table below.

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.

1,2-dibromoethene, contains a double bond which is able to rotate, swapping the sides of the molecule. This molecule has functional groups to the left and right of the double bond. This placement of functional groups means that they are able to be on the same, or opposite sides of the double bond. for a molecule to form geometric isomers, it must be symmetrical.

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A

QUESTION TWO

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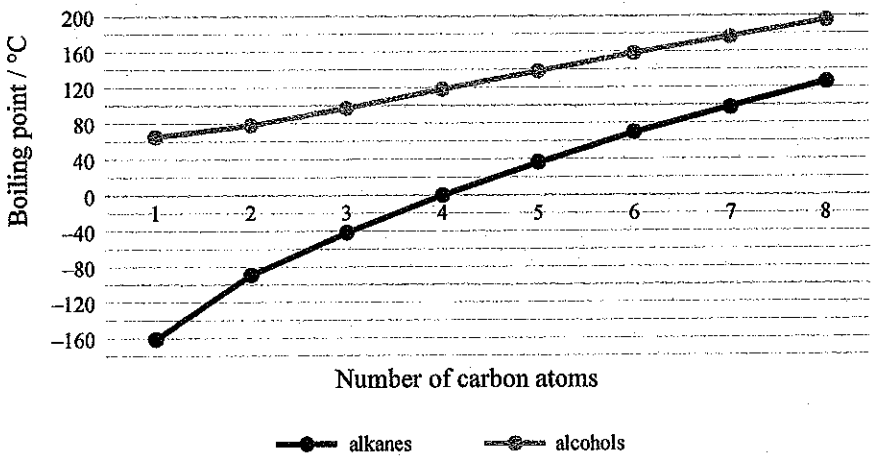
(a) **Boiling points of straight chain alkanes and primary alcohols**



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

In both alcohols and alkanes, the boiling point rises as the number of carbons is increased.

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

methane, ethane, propane and butane will all be gaseous at room temperature, approximately 25°C

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

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

$CH_3CH_2NH_2(aq) + HCl(aq) \rightarrow$ $CH_3CH_2NHCl(aq) + H_2(g)$

(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.

Carboxylic acids contain a $COOH^+$ functional group. Because of the added H^+ ion, the solution is a weak acid. When ethanoic acid reacts with water, ethanoate ions will be produced, as will hydronium ions. $CH_3COOH(aq) + H_2O \rightarrow CH_3COO^-(aq) +$ H_3O^+.

(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.

When ethane reacts with bromine water, a substitution reaction will take place. This will take place when UV light is used as a reagent. The solution will change from brownish-red to clear as $C_2H_4Br_2$ and H_2 are produced. When ethene reacts with bromine water, an addition reaction will take place. The double bonds between the carbon atoms will be broken, leaving two new bonds open to receive Br atoms. KOH will need to be used as a reagent, otherwise the reaction will not take place. During this reaction, the brownish-red bromine water will turn colourless.

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A4

QUESTION THREE

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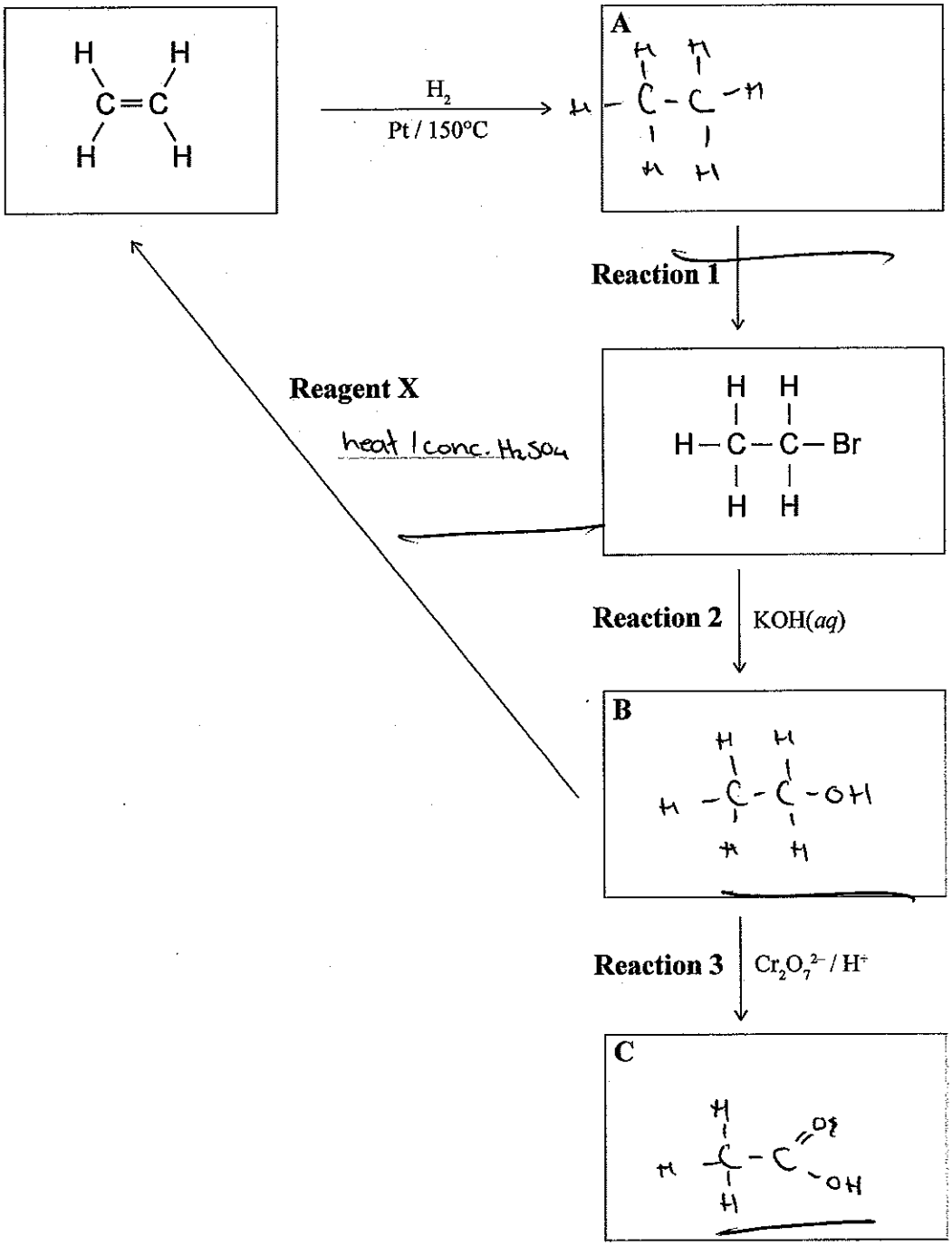
(a) (i) Complete the following chart by drawing the structural formulae for the organic compounds **A**, **B**, and **C** and identifying reagent **X**.



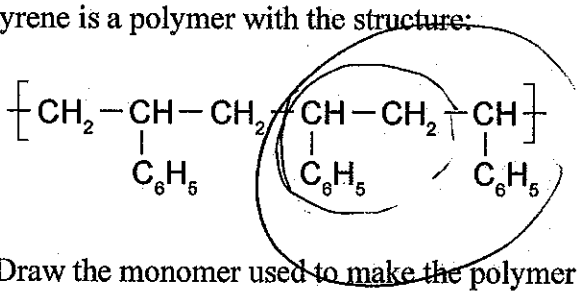
(ii) Identify the type of organic reaction occurring in each of Reactions 1, 2, and 3.

Reaction 1 ~~addition~~ substitution reaction

Reaction 2 substitution reaction

Reaction 3 Elimination reaction

(b) Polystyrene is a polymer with the structure:



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

$CH_2=CH-C_6H_5$

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

Because the double bonds of the monomer are broken, allowing other monomers to bond to each other. If this double bond did not break, then the polymerisation reaction could not occur.

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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
$CH_2Cl-CH-CH_2CH_3$	$CH_3-CHCl-CH_3$
Name: 1-chloroprops-ene	**Name:** 2-chloropropane.

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

When the major product is produced, a substitution reaction will take place, and when the minor product is produced, an addition reaction will take place. The major product is the most likely to form as according to Markovnikov's rule, the carbon with the most hydrogens bonded to it, will be the most likely to receive new atoms. This occurs in the majority of molecules, but not all of them, hence why the minor product is produced.

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A2

Achievement exemplar 2016

Subject:	Chemistry	Standard:	91165	Total score:	10

Q	Grade score	Annotation
1	A3	The responses for part (a) show correct structures and names for four or more, but less than nine of the ten possible answers. In part (b), a correct classification of molecules was given, but the response failed to link this to the reason for the candidate's choice for molecule A. In part (c), the correct isomers were identified, but a failure to make a correct statement about their formation was made.
2	A4	The responses for part (a) correctly identified one trend from the graph and named 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. In part (c), the candidate gave a correct observation and conditions for the reaction of ethane (ethene incorrect), and correctly identified both reaction types. Formulae were either missing or incorrect.
3	A3	In part (a), the candidate correctly identified formulae, reagent and reaction type, with only one error. In part (b), the candidate correctly drew the appropriate monomer and gave an explanation on how the polymerisation reaction occurs (the double C=C bonds in the monomer break allowing them to join). In part (c), the response was incorrect due to confusion of the reaction type.