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91165

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Level 2 Chemistry, 2017

91165 Demonstrate understanding of the properties of selected organic compounds

2.00 p.m. Thursday 16 November 2017
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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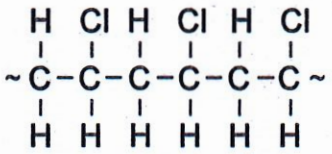
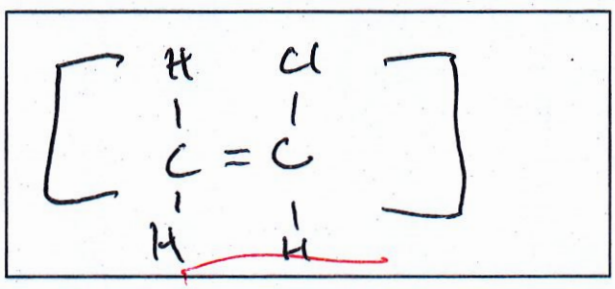
(a) Polyvinyl chloride (polychloroethene) is often used to make artificial leather. This can then be used to cover chairs, cover car seats, and make clothing.

A section of a polyvinyl chloride molecule is shown below.



(i) Draw the monomer from which the polymer polyvinyl chloride would be made.



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(ii) Explain the difference in the structures and chemical reactivity of the monomer and polymer, and why the difference is important for the uses of the polymer.

The monomer has a double bond which makes it much easier to react with. The polymer does not have a double bond and to react with something will need a catalyst because something will need to be substituted.

(iii) Making polyvinyl chloride (polychloroethene) from its monomer is called 'addition polymerisation'.

Explain the term 'addition polymerisation' using polyvinyl chloride as an example.

Include an equation in your answer.

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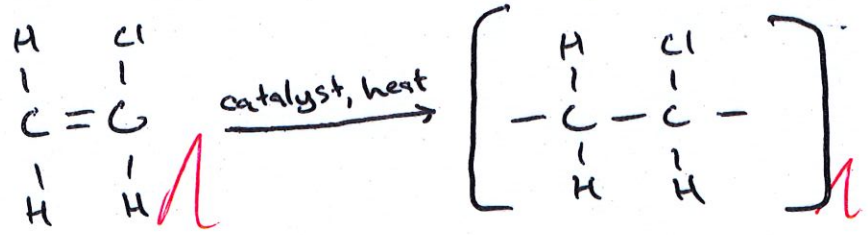
Addition polymerisation means that polymers can be added.
~~Testing~~ making Polyvinal chloride is an addition polymerisation reaction because it breaks the double bond between two double bonded C atoms and adds two single bonds to polymers.

Equation:



(b) A chemistry class was learning about the chemistry of haloalkanes. They were researching the effect of heat and concentrated potassium hydroxide in ethanol, conc. KOH(alc), on the haloalkane 2-chloropropane.

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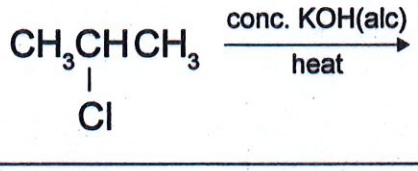
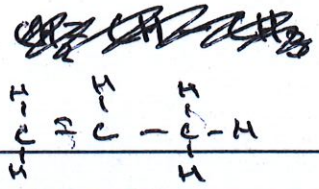
(i) Draw the organic product formed in the following reaction.





(ii) Explain how the functional group of the organic product drawn above could be identified.

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The functional group of the C=C organic product is the double bond. This could be identified by adding bromine water, the bromine water will immediately lose it's colour.

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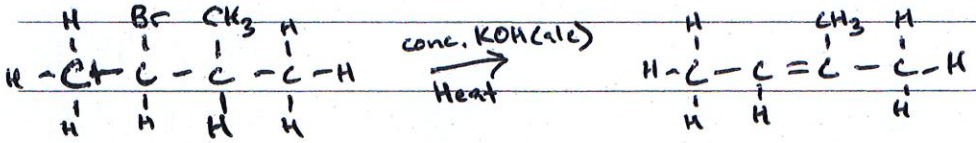
(iii) 2-bromo-3-methylbutane also reacts with conc. KOH(alc). However, in this reaction TWO organic products are formed, a major and a minor product.

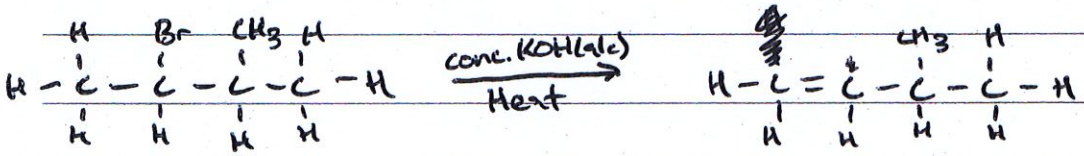
Give an account of the chemical processes that occur in this reaction.

In your answer you should:

- write an equation for this reaction showing the organic compounds
- name the type of reaction occurring
- explain how the products form
- explain which product you would expect to be the minor product.



This is the major product of the reaction. This is an elimination reaction, two bonds are broken and the C=C double bond is formed. This is the



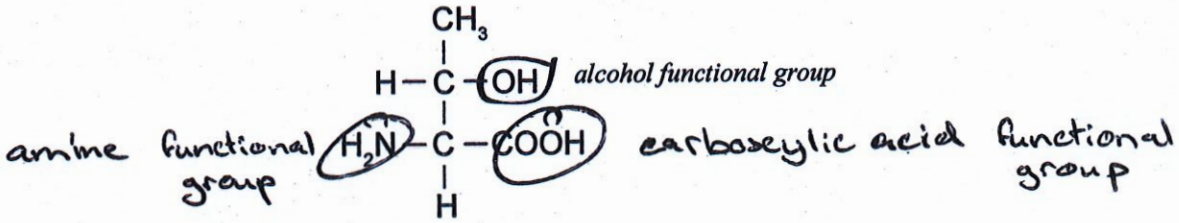
This is the ~~major~~ minor product of the reaction. We can tell this because, to get the minor product, the double bond will form between the C atom that loses the Br and whichever C atom it is bonded to, is bonded with the most H atoms.

1

M5

QUESTION TWO

(a) The structure of a molecule of an organic compound, threonine, is shown below.



An alcohol functional group has been identified in the threonine molecule above.

(i) Circle and name **two other** functional groups on the threonine molecule above.

(ii) Classify the alcohol functional group as primary, secondary, or tertiary.

Secondary

(iii) Explain how you classified the alcohol group.

The c atom that the alcohol functional group is bonded to is also bonded with two other c atoms, making it a secondary alcohol.

(b) Name the organic compounds in the table below.

Compound	IUPAC (systematic) name
$CH_3-CH_2-CH_2-C\equiv CH$	~~pentamyne~~ pent-1-yne
$CH_3-\underset{\underset{Br}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_2-CH_3$	2-bromo-3-methylhexane
$CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$	2,2-dimethylpentan-3-ol

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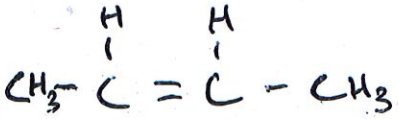
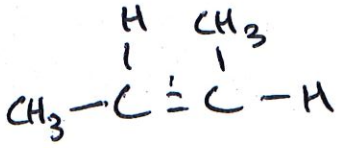
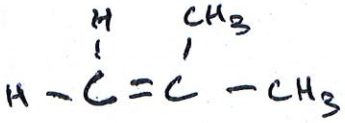
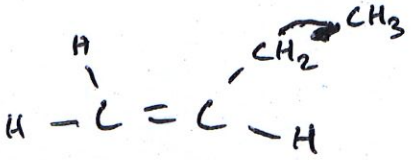
(c) (i) Draw four alkene isomers for the organic compound C_4H_8 in the table below.

1. 	**2.** 
3. 	**4.** 

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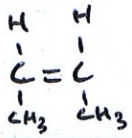
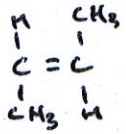
(ii) Identify the compounds that are *cis* and *trans* (geometric) isomers from the table above.

	cis	**trans**
Number		

Justify your choices, and explain why only these two compounds are *cis* and *trans* (geometric) isomers.

To be able to exist as geometric isomers, there must be a C=C double bond that cannot rotate and each of the c atoms in the C=C double bond must have two different ~~functional~~ functional groups bonded to them as well. The other two structural isomers do not meet these requirements and, therefore, cannot be geometrical isomers. The cis isomer has two of the same functional groups on the same side but trans has one on either side.

1

(d) Alkanes and alkenes can be identified by their reactions with a solution of bromine water, $Br_2(aq)$.

Contrast the types of reactions an alkane and an alkene will undergo with an orange solution of bromine water.

usually UV light

Alkanes require a catalyst, to undergo a reaction with bromine water. This is because it is a substitution reaction and requires energy to break a bond and form another with a Br atom. This reaction will take a couple minutes to take place and the bromine water will eventually lose it's orange colour and go colourless. Whereas, Alkenes will react with bromine water immediately and the bromine water will lose it's orange colour and go colourless immediately. This reaction is just an addition reaction.

C-

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M6

QUESTION THREE

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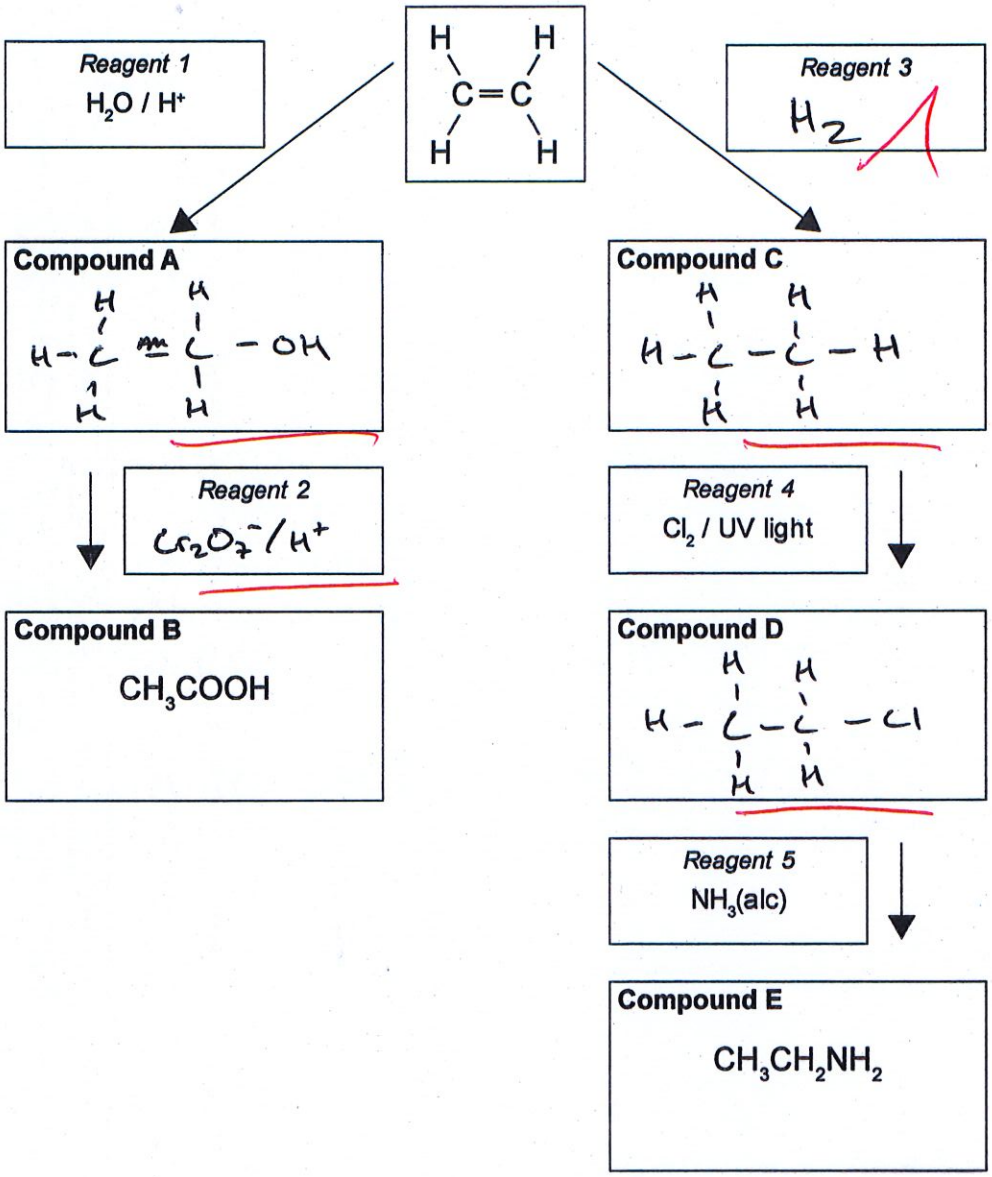
(a) (i) Complete the following reaction scheme by drawing the structural formulae for the organic compounds **A**, **C**, and **D**, and identifying *reagents 2 and 3*.



(ii) Identify the types of reactions that occur to produce compounds **A, B, C, D,** and **E**:

A. Addition

B. Oxidation

C. Addition

D. Substitution

E. Substitution

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(b) Describe a simple test that will distinguish between solutions of the final organic compounds **B** and **E**.

Add Na_2CO_3 to both, the carboxylic acid will produce CO_2 bubbles and the amine won't react.

4

(c) Compounds **B** and **E** react together.

(i) Write a balanced equation for the reaction that occurs between compounds **B** and **E**.

$$CH_3COOH + CH_3CH_2NH_2 \rightarrow CH_3COO^- + CH_3CH_2NH_3^+$$

(ii) Identify the type of reaction that occurs between compounds **B** and **E**.

Justify your answer.

C

An acid-base reaction.
CH_3COOH is the acid and donates a proton to $CH_3CH_2NH_2$, the base, which accepts the proton.

(d) Explain how compound **A** from the reaction scheme could be directly converted into compound **D**.

Add PCl_3 to the A compound and it will turn into compound D.

4

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Merit exemplar for 91165 2017	Total score 16

Q	Grade score	Annotation
1	M5	The candidate was awarded M5 for the following reasons: in part (a), the correct structure of the monomer is given, but there is no link between the property and the use. In part (a)(iii), the candidate's explanation was good for addition reactions but there was a lack of evidence, especially from the equation for polymerisation. In part (b), the correct structure of propene and an explanation for identification is given, but the response failed to state the colour of bromine and in part (b)(iii), the major and minor isomers were drawn and stated correctly, however, only the minor formation was explained and the relative concentrations were not discussed.
2	M6	The candidate was awarded M5 for the following reasons: in part (a), both functional groups were correctly identified and named, and the correct classification was explained; in part (b), all compounds were named correctly; in part (c), all isomers were drawn correctly and the candidate was able to justify why but-2-ene formed geometric isomers but failed to elaborate on why the other isomers could not; in part (d), the candidate elaborated and contrasted both reactions with the correct observations, but did not discuss the number of Br atoms for the alkene.
3	M5	The candidate was awarded M5 for the following reasons: in part (a), the candidate correctly identified all formulae and reaction types, but omitted the catalyst from reagent 3; in part (b) the candidate described a correct simple test to distinguish between two different organic compounds; in part (c), the candidate gave the correct equation and justification of the reaction type; in part (d), the correct reagent was given, but lacked any detail within the explanation.