



Additional Assessment Materials

Summer 2021

Pearson Edexcel GCE in Chemistry 8CH0

Resource Set 1 – Topic Group 3

Topics included:

Topic 6: Organic Chemistry I

Topic 7: Modern Analytical Techniques I

(Public release version)

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Additional Assessment Materials, Summer 2021

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General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

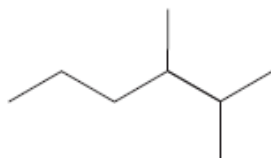
Purpose

- The purpose of this resource is to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

Some questions must be answered with a cross .
 If you change your mind about an answer, put a line through the box
 and then mark your new answer with a cross .

1 Alkanes are a homologous series of hydrocarbons.

(a) What is the name of this compound?



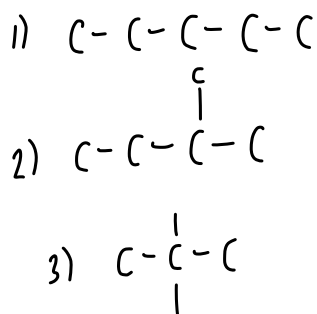
(1)

- A 1,1,2-trimethylpentane
 B 2,3-dimethylhexane
 C 4,5-dimethylhexane
 D 4,5,5-trimethylpentane

(b) The number of structural isomers with the molecular formula C_5H_{12} is

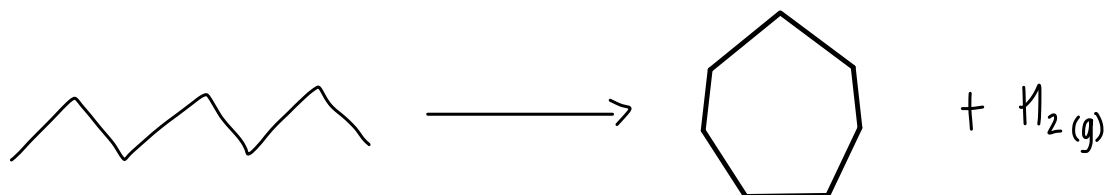
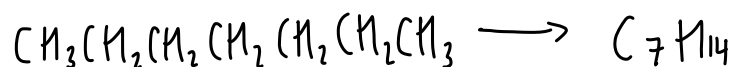
(1)

- A 3
 B 4
 C 5
 D 6



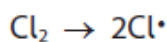
(c) Write the equation for reforming heptane into cycloheptane, showing the skeletal formulae of the organic molecules.

(2)



(d) Ethane reacts with chlorine in the presence of ultraviolet light to form a mixture of products.

(i) In the initiation step, chlorine molecules are converted into radicals.



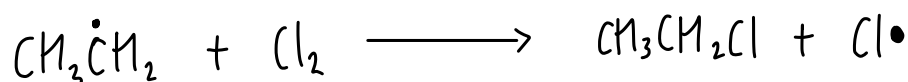
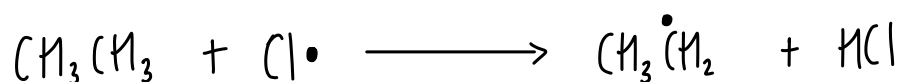
Identify the type of bond broken and the type of bond fission occurring in this step.

(1)

	Bond broken	Bond fission
<input type="checkbox"/> A	π	heterolytic
<input type="checkbox"/> B	σ	heterolytic
<input type="checkbox"/> C	π	homolytic
<input checked="" type="checkbox"/> D	σ	homolytic

(ii) Write the propagation steps to show the formation of $\text{C}_2\text{H}_5\text{Cl}$.

(2)



(iii) State how some butane, C_4H_{10} , is formed in the reaction.

(1)

two ethyl free radicals ($\text{CH}_3\dot{\text{C}}\text{H}_2$) react together to form a stable compound (C_4H_{10})

(Total for Question 1 = 8 marks)

2 This question is about organic compounds.

(a) Organic compounds can be grouped together in homologous series.

(i) Describe **two** characteristics of a homologous series.

(2)

- same chemical properties
- same general formula

(ii) Name the homologous series to which propene belongs.

(1)

alkenes

(b) Propene can be converted into a mixture of 1-chloropropane and 2-chloropropane, in which 2-chloropropane is the major product.

(i) Give the reagent required for this reaction.

(1)

HCl

(ii) What is the type and mechanism of the reaction in (b)(i)?

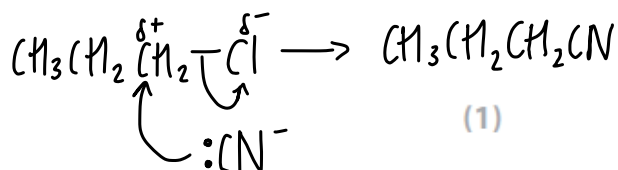
(1)

- A electrophilic addition
- B nucleophilic addition
- C electrophilic substitution
- D nucleophilic substitution

(c) 1-chloropropane and 2-chloropropane can be converted into compounds containing the nitrile functional group.

(i) Under appropriate conditions, 1-chloropropane can be converted into butanenitrile, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CN}$.

Which is the reagent for this conversion?



- A ammonia
 B nitric acid
 C potassium cyanide
 D silver nitrate

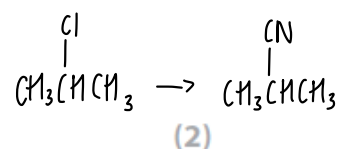
(ii) Under appropriate conditions, 2-chloropropane can be converted into a structural isomer of butanenitrile.

State what is meant by the term 'structural isomer'.

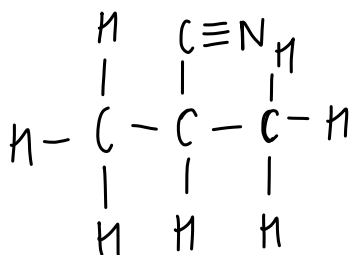
(2)

..... molecules with the same molecular formula but
..... different structural formula
.....
.....

(iii) Give the displayed formula **and** systematic name of the isomer of butanenitrile formed in (c)(ii). You must show **all** the bonds.



Displayed formula



Name

..... 2-methylpropanenitrile


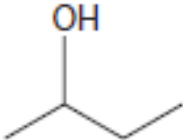
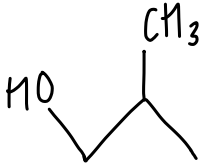
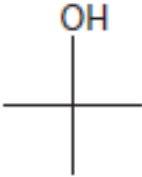
(Total for Question 2 = 10 marks)

2 This question is about alcohols and their reactions.

The table gives some of the names and skeletal formulae of isomers having the formula C_4H_9OH .

(a) Complete the table.

(2)

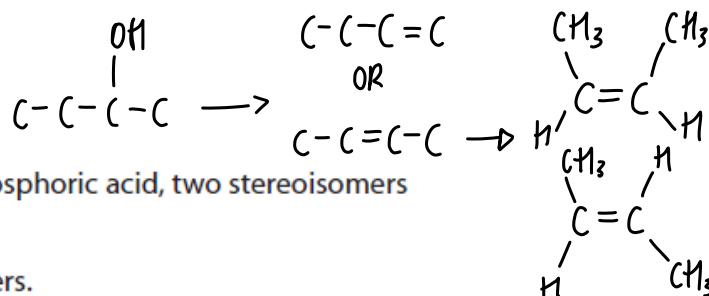
Name	Skeletal formula
butan-1-ol	
butan-2-ol	
2-methylpropan-1-ol	
2-methylpropan-2-ol	

(b) (i) Some alcohols react with concentrated phosphoric acid to form alkenes.

What is the type of this reaction?

(1)

- A addition
- B elimination
- C oxidation
- D substitution



(ii) When butan-2-ol reacts with concentrated phosphoric acid, two stereoisomers are formed.

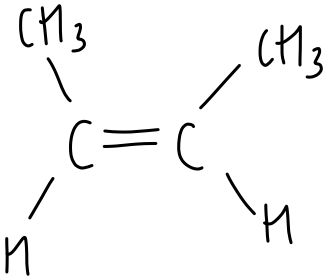
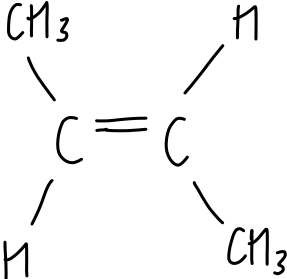
Explain what is meant by the term stereoisomers.

(2)

molecules with the same structural formula but
different spatial arrangement of atoms

(iii) Draw the structures and give the names of the two stereoisomers.

(2)

Stereoisomer 1	Stereoisomer 2
	
Name: Z-but-2-ene	Name: E-but-2-ene

(iv) Name this type of stereoisomerism.

(1)

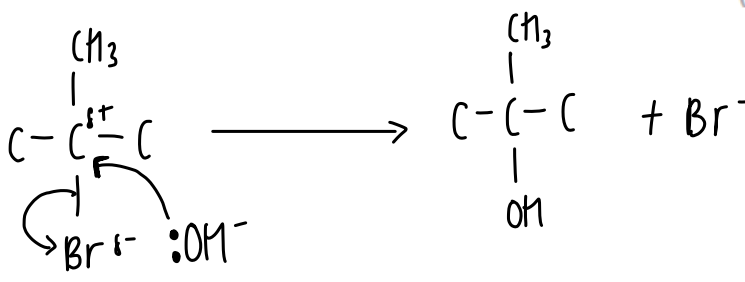
E-Z isomerism

(c) 2-methylpropan-2-ol may be formed by the reaction between 2-bromo-2-methylpropane and aqueous potassium hydroxide.

What is the role of the hydroxide ions in this reaction?

(1)

- A alkali
- B catalyst
- C electrophile
- D nucleophile
(electron pair donor)



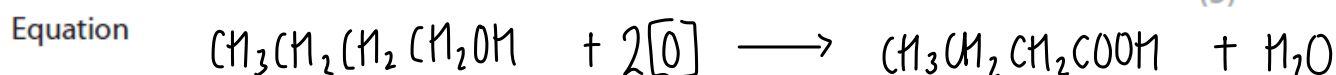
(d) (i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ reacts with the oxidising agent potassium dichromate(VI) in dilute sulfuric acid.

Two organic products can be formed, depending on the conditions.

Write a balanced equation for the formation of **one** of these products, giving its name and the condition required to achieve this product in high yield.

Use [O] in the equation to represent each oxygen atom from the oxidising agent.

(3)



Name butanoic acid

Condition heat under reflux

(ii) The colour of the solution at the end of the reaction in (d)(i) will be

(1)

- A brown
- B green
- C orange
- D yellow

(Total for Question 2 = 13 marks)

7 This question is about the identification of an alcohol, X.

(a) Alcohol X has the following percentage composition by mass:

carbon, C = 68.2%

hydrogen, H = 13.6%

oxygen, O = 18.2%

The molecular ion peak in the mass spectrum for alcohol X occurs at $m/z = 88$.

Use all of these data to show that the molecular formula for alcohol X is $C_5H_{12}O$.
Include your working.

(2)

Empirical Formula:

$$\begin{aligned} \text{C: } & 68.2 \div 12 = 5.6833 \div 1.1375 = 4.996 \dots \approx 5 \\ \text{H: } & 13.6 \div 1 = 13.6 \div 1.1375 = 11.956 \dots \approx 12 \\ \text{O: } & 18.2 \div 16 = 1.1375 \div 1.1375 = 1 \end{aligned}$$

Hence the empirical formula = $C_5H_{12}O$

hence molecular formula = $C_5H_{12}O$ because $88 \div 88 = 1$

M_r of $C_5H_{12}O = 88 = m/z$ of molecular ion peak

(b) (i) When alcohol X is oxidised, a carboxylic acid is formed.

State what information this gives about alcohol X.

(1)

it is a primary alcohol

$C_5H_{12}O$, 1° alcohol

(ii) Draw the **displayed** formulae of the four possible structural isomers that could be alcohol X.

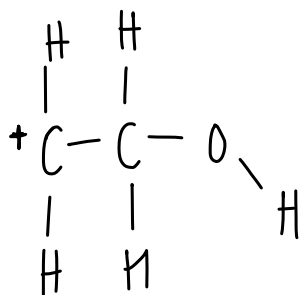
(3)

Alcohol 1	Alcohol 2
$ \begin{array}{cccccc} & H & H & H & H & H \\ & & & & & \\ H & -C & -C & -C & -C & -C-O-H \\ & & & & & \\ & H & H & H & H & H \end{array} $	$ \begin{array}{cccc} & & H & \\ & & & \\ & H & -C & -H \\ & & & \\ H & -C & -C & -C & -C-O-H \\ & & & & \\ & H & H & H & H \end{array} $
Alcohol 3	Alcohol 4
$ \begin{array}{cccc} & H & & \\ & & & \\ H & -C & -H & \\ & & & \\ H & -C & -C & -C-O-H \\ & & & \\ & H & H-C-H & H \\ & & & \\ & & H & \end{array} $	$ \begin{array}{cccc} & H & & \\ & & & \\ H & -C & -H & \\ & & & \\ H & -C & -C & -C & -C-O-H \\ & & & & \\ & H & H & H & H \end{array} $

(iii) The mass spectrum of alcohol X has a major peak at $m/z = 45$.

Draw the structure of the species that could give this peak.

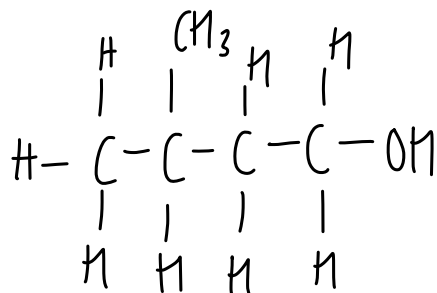
(1)



(iv) Alcohol X has a branched chain.

Identify alcohol X, explaining your reasoning.

(2)



because it is the only alcohol with a branched chain
that forms $\text{CH}_2\text{OHCH}_2^+$

(Total for Question 7 = 9 marks)

Total for Test = 40 marks