



Additional Assessment Materials
Summer 2021

Pearson Edexcel GCE in Chemistry 9CH0

Resource Set 1 – Topic Group 4

Topics included:

Topic 6: Organic Chemistry I

Topic 7: Modern Analytical Techniques I

Topic 17: Organic Chemistry II

Topic 18A: Arenes – benzene,

Topic 18B: Amines, amides, amino acids
and proteins

(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- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.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.

1 This is a question about alkanes.

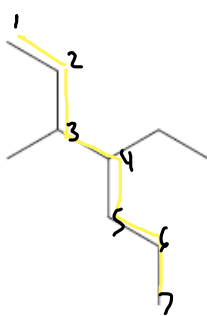
(a) What is the reaction mechanism when ethane and chlorine react in UV light?

(1)

- A electrophilic addition
- B electrophilic substitution
- C free radical addition
- D free radical substitution

(b) What is the name of this alkane?

(1)



longest part of chain = 7C

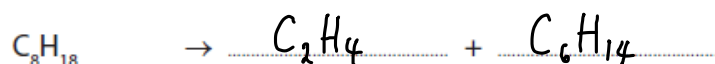
- A 2-ethyl-3-propylpentane
- B 4-ethyl-3-methylheptane
- C 3-methyl-4-propylhexane
- D 4-methyl-3-propylhexane

(c) Alkanes are obtained by processing crude oil.

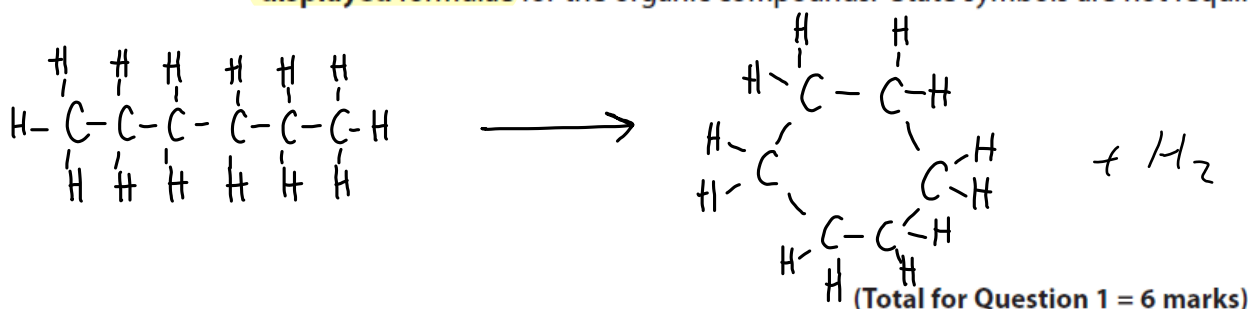
(i) Explain why different alkanes in crude oil can be separated by fractional distillation. (2)

The different alkanes have different lengths. This means they have different boiling points, so will condense at different temperatures in the fractionating column.

(ii) Complete the equation for the cracking of octane to produce ethene and only one other organic compound. State symbols are not required. (1)



(iii) Write the equation for the reforming of hexane into cyclohexane, using displayed formulae for the organic compounds. State symbols are not required. (1)



2 This question is about alkenes.

(a) Which of these has the molecular formula C_6H_{10} ?

(1)

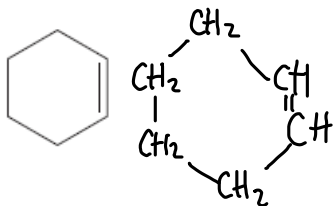
A



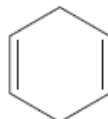
B



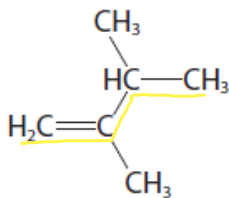
C



D



(b) What is the systematic name of this alkene?



longest chain = 4C

(1)

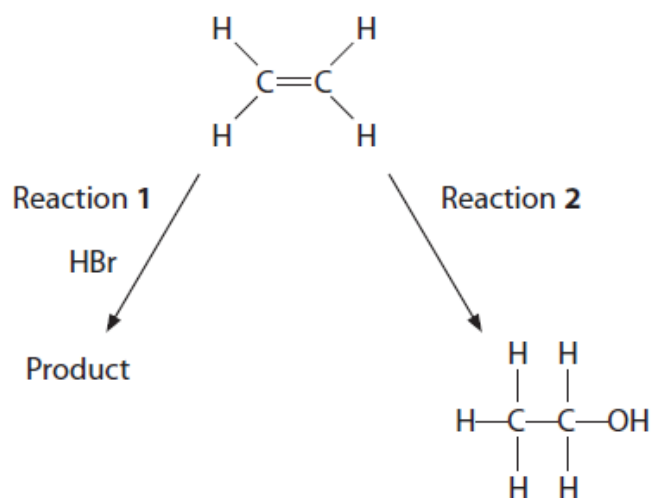
A 2-methylpent-1-ene

B 3-methylpent-1-ene

C 2,3-dimethylbut-1-ene

D 2,3-dimethylbut-3-ene

(c) Two reactions of ethene are shown.

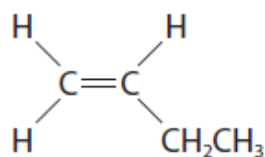


Complete the table.

(3)

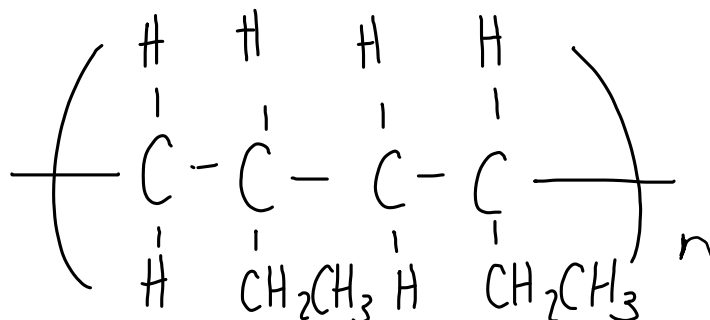
Reaction	Reagent and condition	Product
1	HBr at room temperature	$ \begin{array}{cc} \text{H} & \text{H} \\ & \\ \text{H}-\text{C} & -\text{C}-\text{H} \\ & \\ \text{H} & \text{Br} \end{array} $
2	phosphoric(v) acid 300 °C 60 atm	$ \begin{array}{cc} \text{H} & \text{H} \\ & \\ \text{H}-\text{C} & -\text{C}-\text{OH} \\ & \\ \text{H} & \text{H} \end{array} $

(d) But-1-ene has the structure



(i) Draw the structure of the polymer formed when but-1-ene polymerises.
Include two repeat units.

(1)



(ii) Calculate the number of molecules in 70.0g of but-1-ene.
[Avogadro constant = $6.02 \times 10^{23} \text{ mol}^{-1}$]

(2)

$$M_r = (12 \times 4) + (1 \times 8) = 56$$

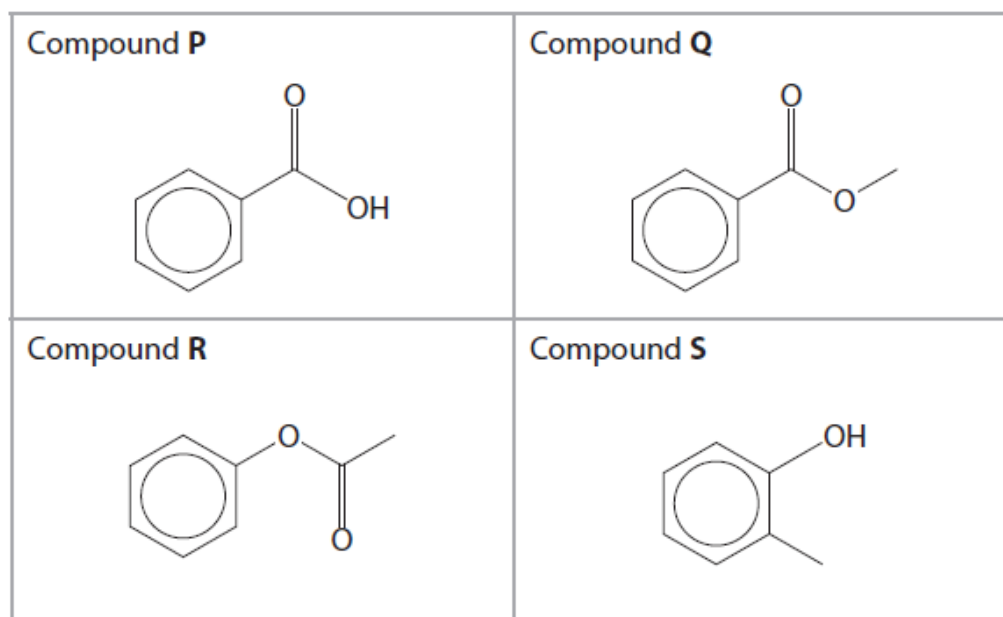
$$\text{mass} = M_r \times \text{mol} \therefore \text{mol} = \frac{\text{mass}}{M_r}, \quad \text{mol} = \frac{70}{56} = 1.25$$

$$\begin{array}{l} \times 1.25 \\ \downarrow \\ 1 \text{ mol} = 6.02 \times 10^{23} \text{ molecules} \\ \times 1.25 \\ \downarrow \\ 1.25 \text{ mol} = \underline{\underline{7.525 \times 10^{23}}} \end{array}$$

(Total for Question 2 = 8 marks)

4 This question is about the identification of some organic compounds.

(a) The skeletal formulae of four organic compounds are shown.



(i) Which of these compounds can be hydrolysed to form methanol as one of the products?

(1)

- A Compound P
- B Compound Q
- C Compound R
- D Compound S

(ii) Which of these compounds produces carbon dioxide when it reacts with aqueous sodium hydrogencarbonate?

(1)

- A Compound P \rightarrow *carboxylic acid*
- B Compound Q
- C Compound R
- D Compound S

(b) Compound **T**, $C_4H_{10}O$, is oxidised by acidified potassium dichromate(VI) to form compound **U**, C_4H_8O .

→ a ketone/aldehyde

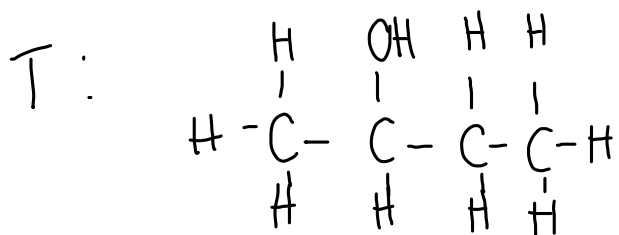
U gives an orange precipitate with 2,4-dinitrophenylhydrazine (Brady's reagent) but does **not** give a red precipitate when heated with Fehling's solution.

T reacts with ethanoyl chloride to form compound **V**, $C_6H_{12}O_2$.

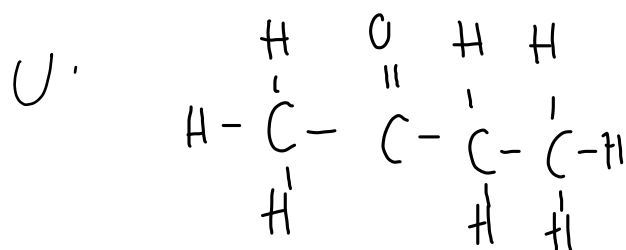
↓ not an aldehyde

Deduce the structures of compounds **T**, **U** and **V**. Justify your answers.

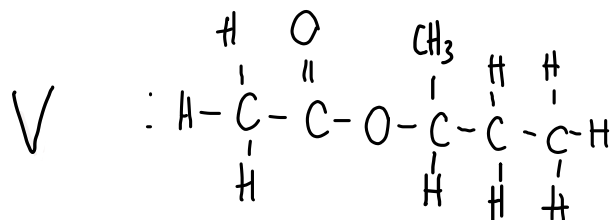
(6)



We know **T** must be a secondary alcohol as it is oxidised to a ketone.



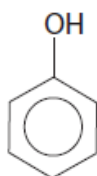
The test with Brady's reagent shows **U** is a ketone/aldehyde. The test with Fehling's solution shows it is not an aldehyde, hence it is a ketone.



T and ethanoyl chloride undergo acylation to produce $C_6H_{12}O_2$.

(Total for Question 4 = 8 marks)

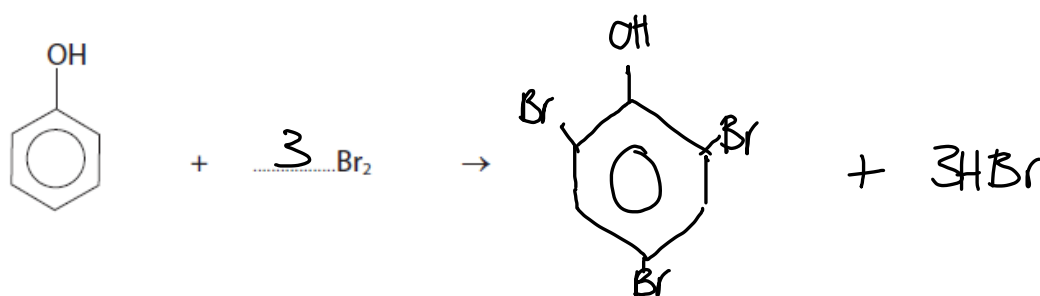
8 Phenol is a feedstock in the production of many organic molecules.



(a) Phenol reacts with bromine water.

(i) Complete the equation for the reaction of phenol with excess bromine water, using the **skeletal** formula of the organic product.

(2)

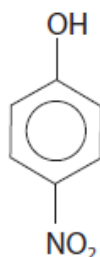


(ii) Compare and contrast the bromination of phenol with the bromination of benzene.

(3)

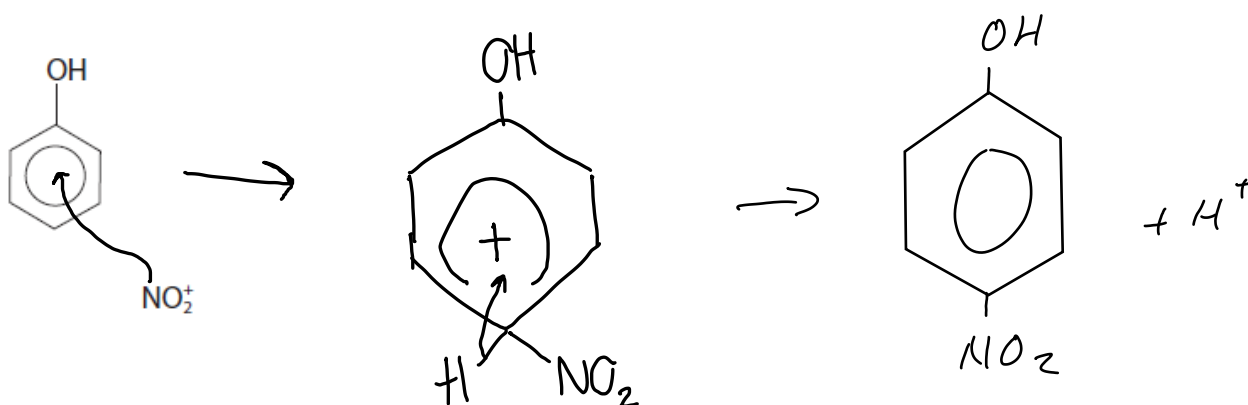
- Bromination of phenol can happen directly with Br_2 , whereas benzene requires the Br^+ ion.
- Benzene bromination requires a catalyst, like FeBr_3 to act as a halogen carrier and enable the reaction to happen, phenol does not.
- Both can produce up to three different products, the single, di- or tri-bromide forms. This depends on the quantity of bromine present.

(b) Phenol can be nitrated to produce 4-nitrophenol.



(i) The mechanisms of the nitration of phenol and of benzene are similar. Complete the diagram, using curly arrows, to show a possible mechanism for the reaction between the electrophile, NO_2^+ , and phenol to produce 4-nitrophenol.

(3)



(ii) What is the mass, in grams, of 4-nitrophenol produced from 0.94 g of phenol if the yield of this isomer is 15%?

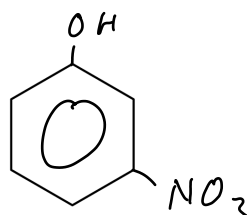
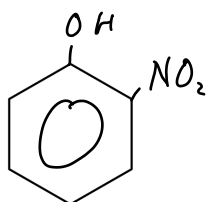
- A 0.14
 B 0.21
 C 0.68
 D 1.39

$$\begin{aligned}
 & \downarrow \\
 & M_r = 139 \\
 & \text{mass} = 139 \times 0.01 \\
 & = 1.39 \text{ g} \\
 & 1.39 \times 0.15 = 0.2085 \\
 & \approx 0.21
 \end{aligned}$$

$M_r = 94$
 $\text{mol} = 0.01 \text{ mol}$ (1)

(iii) Draw **two** structural isomers of 4-nitrophenol which have a benzene ring.

(1)

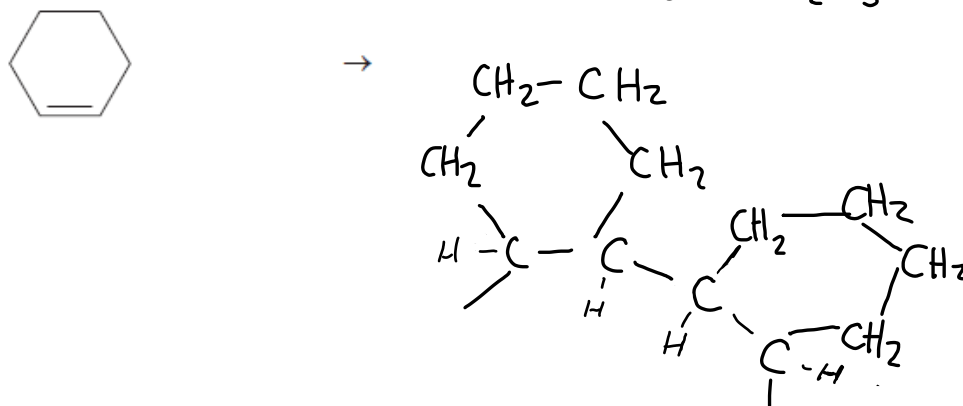
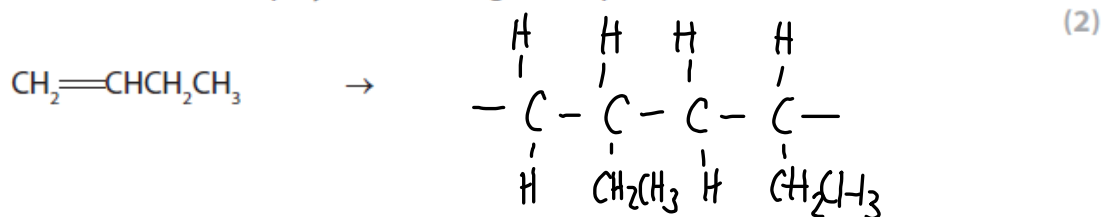


(Total for Question 8 = 10 marks)

6 This is a question about polymerisation.

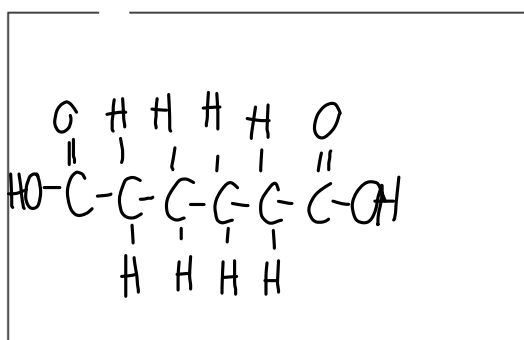
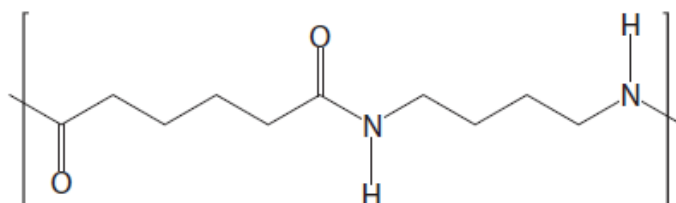
(a) But-1-ene and cyclohexene both form addition polymers.

Draw a section of each polymer, showing **two** repeat units.

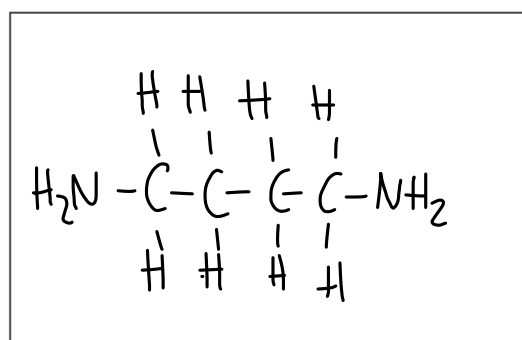


(b) Deduce the two monomers needed to produce the polyamide shown.

(2)

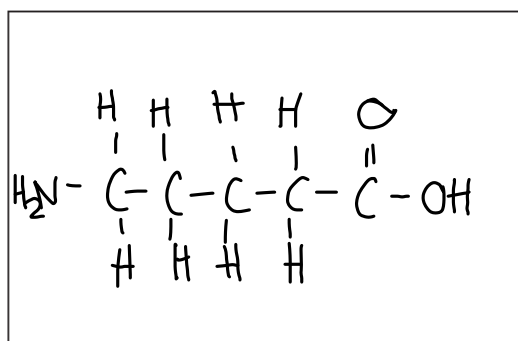
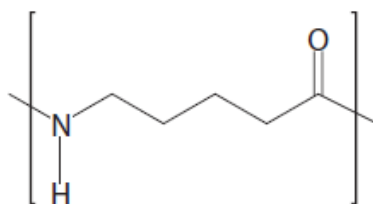


and



(c) Deduce the single monomer that could be used to produce the polyamide shown.

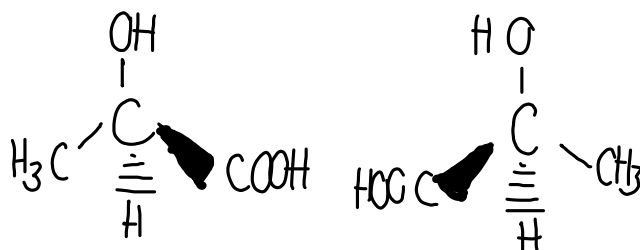
(1)



(d) PLA is a biodegradable polyester which is made from 2-hydroxypropanoic acid, $\text{CH}_3\text{CH}(\text{OH})\text{COOH}$.

(i) Draw the two enantiomers of 2-hydroxypropanoic acid.

(2)



(ii) State how separate samples of these two enantiomers could be distinguished in a laboratory.

(1)

see which direction they rotate plane polarised light. Each enantiomer will rotate it in opposite directions.

(Total for Question 6 = 8 marks)

Total for Test = 40 marks