New Specification

Rewarding Learning

ADVANCED

General Certificate of Education

2018

Centre Number

Candidate Number

Life and Health Sciences

Assessment Unit A2 2

assessing

Organic Chemistry

AZ021

[AZ021]

THURSDAY 24 MAY, AFTERNOON

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Answer **all six** questions.
Write your answers in the spaces provided in this question paper.

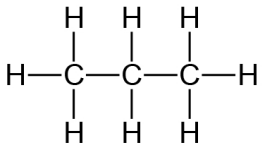
INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Your attention is drawn to the Data leaflet which is used with the question paper.
You may use an electronic calculator.
Quality of written communication will be assessed in Question **4(c)**.

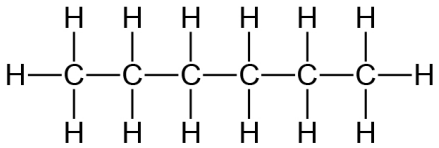
For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
Total Marks	

1 The structures of six hydrocarbons are shown below. They are labelled **A** to **F**.

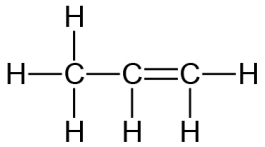
A



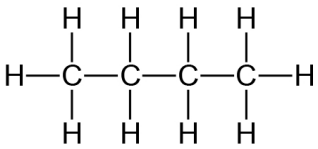
B



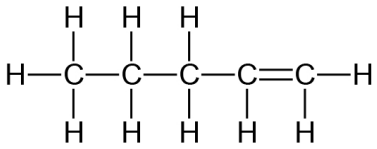
C



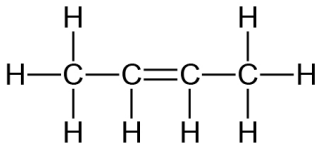
D



E



F



Examiner Only	
Marks	Remark

(a) (i) What is meant by the term hydrocarbon?

_____

_____ [1]

(ii) Write the molecular formula for **A**.

_____ [1]

(iii) Write the IUPAC name for **B**.

_____ [1]

(iv) To which homologous series does **C** belong?

_____ [1]

(v) Which hydrocarbon (**A**, **B**, **C**, **D**, **E** or **F**) would be able to exist as cis-trans isomers?

_____ [1]

(vi) Which hydrocarbon (**A**, **B**, **C**, **D**, **E** or **F**) has the empirical formula C_2H_5?

_____ [1]

(vii) Draw the skeletal formula for hydrocarbon **E**.

[1]

(viii) **D** has one branched isomer. Draw the structural formula of the branched isomer and write its IUPAC name.

[2]

(ix) Name the reactant which is used to convert **F** into **D** and the catalyst used in the reaction.

Reactant: _____

Catalyst: _____ [2]

(b) Hydrocarbons undergo combustion in a limited or plentiful supply of air.

(i) Write a balanced symbol equation for the combustion of **A** in a plentiful supply of air.

[2]

(ii) Name **all** the possible products of the combustion of **B** in a limited supply of air.

[3]

(iii) Describe **one** problem associated with any one of the products named in your answer to **(b)(ii)**.

[1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

2 Methane is a hydrocarbon and a member of the alkane homologous series.

(a) What is meant by the term homologous series?

_____

_____

_____

_____ [3]

(b) Methane reacts with chlorine forming a mixture of products including chloromethane, which reacts with more chlorine to form dichloromethane.

(i) Name the type of reaction which occurs between methane and chlorine.

_____ [1]

(ii) Write an equation for the reaction of chloromethane with chlorine to form dichloromethane.

_____ [2]

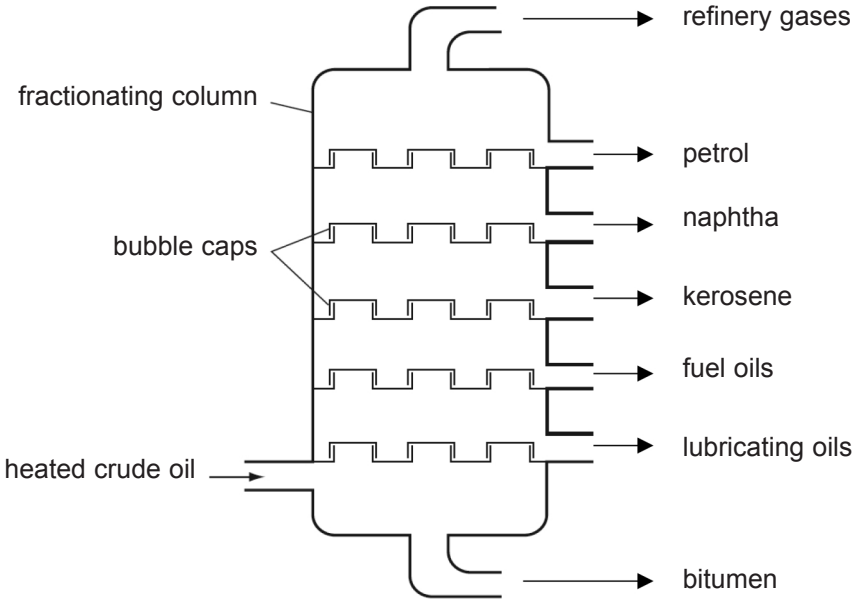
(iii) Explain why the reaction does not occur in the dark.

_____

_____ [1]

(c) The diagram below shows the fractional distillation of crude oil.

Examiner Only	
Marks	Remark



(i) Explain how the process of fractional distillation occurs.

_____

_____

_____

_____

_____

_____

_____ [3]

(ii) The petrol fraction contains nonane, C_9H_{20}. Nonane is cracked to form propene and one other hydrocarbon product. Write an equation for the cracking of nonane and name the other product.

Equation: _____

Product: _____ [2]

(iii) Nonane is reformed to form 2,3,3-trimethylhexane. Draw the structural formula for 2,3,3-trimethylhexane.

[1]

(d) Petrol is used as a fuel for motor vehicles. The exhaust emissions contain nitrogen dioxide (NO_2).

(i) State **one** environmental problem caused by nitrogen dioxide.

_____ [1]

(ii) How do car manufacturers reduce the amount of nitrogen dioxide in exhaust emissions?

_____ [1]

(iii) Write a balanced symbol equation for the conversion of nitrogen dioxide into nitrogen and oxygen.

_____ [2]

Examiner Only	
Marks	Remark

(e) Biofuels can be used as fuels in motor vehicles.

Examiner Only	
Marks	Remark

(i) Name **two** biofuels.

1. _____

2. _____ [2]

(ii) Give **two** reasons why the environmental impact of burning of biofuels is less than that of burning the petrol fraction from crude oil.

1. _____

_____

2. _____

_____ [2]

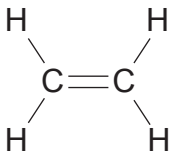
Examiner Only	
Marks	Remark

3 **(a)** Alkenes undergo addition reactions whereas alkanes do not.

(i) Explain, in terms of sigma and pi bonds, why an alkene undergoes addition reactions whereas an alkane does not.

[3]

(ii) Complete the mechanism for the reaction of hydrogen bromide with ethene.



[3]

(iii) Name the mechanism by which hydrogen bromide reacts with ethene.

[2]

(iv) Name the organic product formed when ethene reacts with hydrogen bromide.

[1]

(b) Hex-2-ene forms cis-trans isomers. Draw and label the structures of the cis and trans isomers of hex-2-ene.

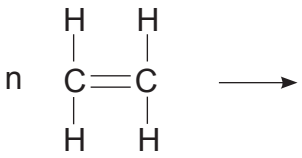
[3]

(c) Ethene can form a polymer. The polymer is inert and non-biodegradable.

(i) Name the polymer formed from ethene.

_____ [1]

(ii) Complete the balanced symbol equation for the polymerisation of ethene.



[2]

(iii) State **two** waste management strategies used for the polymer formed from ethene.

1. _____

_____

2. _____

_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

4 2-methylbutan-2-ol and pentan-2-ol are structural isomers. Both are used as solvents in the purification of pharmaceutical drugs.

(a) Define the term structural isomer.

_____

_____ [2]

(b) 2-methylbutan-2-ol can be converted to 2-methylbut-2-ene.

(i) Name the reagent which can be used to carry out this reaction.

_____ [2]

(ii) Name this type of reaction.

_____ [1]

(c) Acidified potassium dichromate(VI) solution may be used to distinguish between 2-methylbutan-2-ol and pentan-2-ol.
Describe how a practical experiment can be carried out to distinguish between 2-methylbutan-2-ol and pentan-2-ol.
Include conditions, observations and an explanation of the chemistry involved.

You will be assessed on your quality of written communication in this question.

[6]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(d) (i) Determine the empirical formula of an alcohol which has the following percentage composition by mass.

Element	% of element by mass
C	70.6
H	13.7
O	15.7

Empirical formula _____ [3]

(ii) The relative formula mass of the alcohol is 102. State its molecular formula.

Molecular formula _____ [1]

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(Questions continue overleaf)

5 The table below shows a selection of organic compounds.

Substance	IUPAC name	Structural formula
A	pentanal	$CH_3CH_2CH_2CH_2CHO$
B		$(CH_3)_2C=CHCH_3$
C	pentan-1-ol	
D		CH_3CH_2COOH

(a) Complete the table above. [4]

(b) Name the reagent used to test for the C=C functional group in **B** and state the colour change expected.

Reagent: _____

Colour change: _____ [3]

(c) Describe a chemical test for **A** (pentanal) and state the colour change expected.

Chemical test: _____

_____

Colour change: _____ [4]

Examiner Only

Marks	Remark

(d) Classify **C** (pentan-1-ol) as a primary, secondary or tertiary alcohol. Explain your answer.

_____

_____

_____ [2]

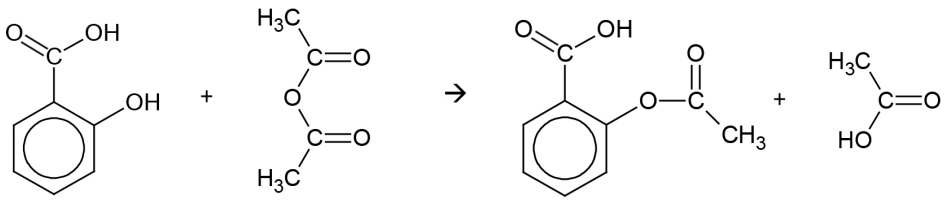
(e) State the IUPAC name of the alcohol that could be oxidised to form substance **D**.

_____ [1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

6 **(a)** The equation below shows the production of aspirin from salicylic acid and ethanoic anhydride.



salicylic acid ethanoic anhydride aspirin substance X

(i) State the IUPAC name of substance X.

_____ [1]

(ii) Describe the preparation and purification of a sample of aspirin from salicylic acid using ethanoic anhydride.

Preparation: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Examiner Only

Marks	Remark

Purification: _____

_____

_____

_____

_____

_____

_____

_____ [8]

(iii) Describe how you would determine the purity of laboratory synthesized aspirin.

_____

_____

_____

_____

_____ [3]

(b) 20.0 g of salicylic acid were reacted with an excess of ethanoic anhydride. Calculate the percentage yield given that 18.3 g of aspirin were obtained.

Relative formula mass of salicylic acid = 138
Relative formula mass of aspirin = 180
Give your answer to 3 significant figures.

Percentage yield = _____ [4]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER