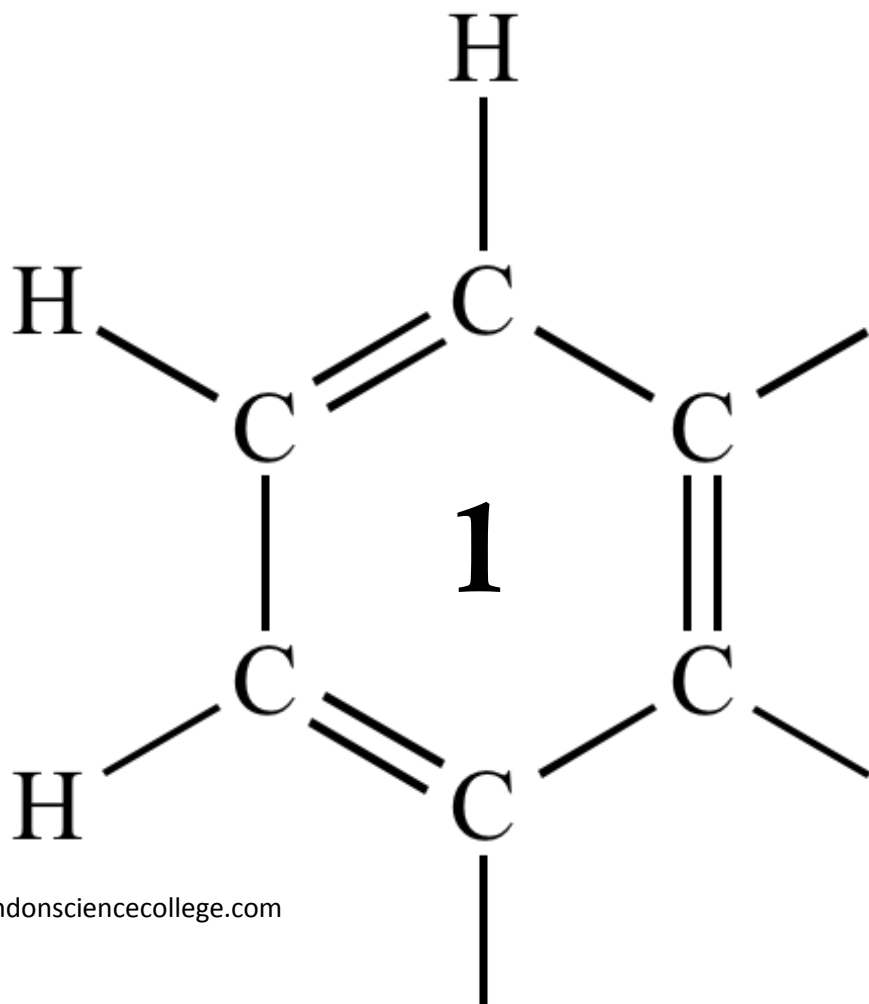


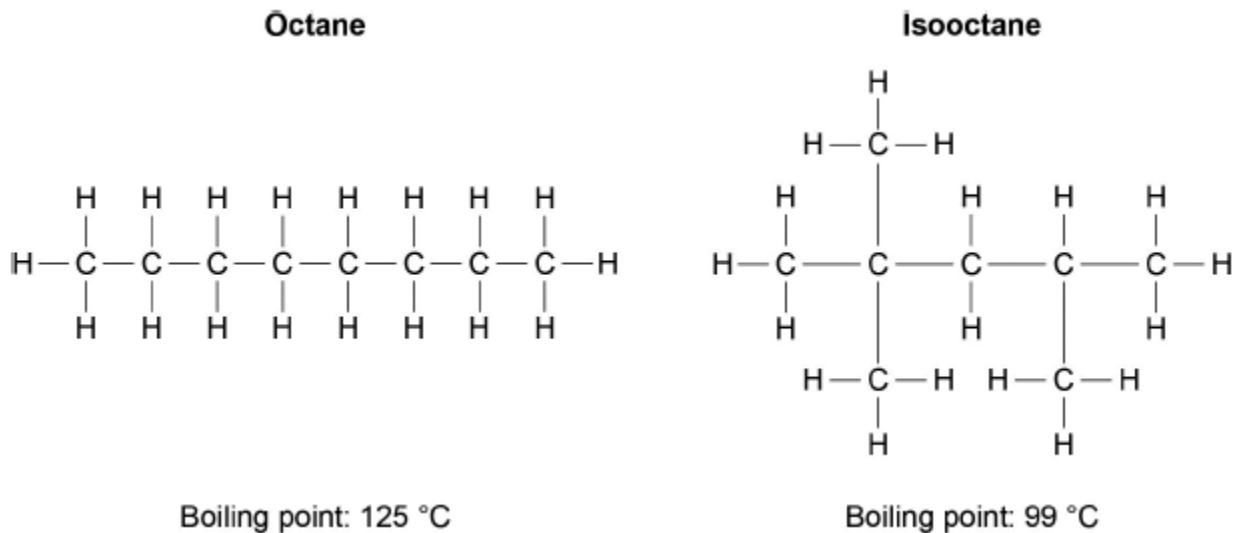
AQA AS CHEMISTRY
INTRO TO ORGANIC



1

Octane and isooctane are structural isomers with the molecular formula C_8H_{18} . The displayed formulas and boiling points of octane and isooctane are shown in **Figure 1**.

Figure 1



(a) Give the IUPAC name for isooctane.

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(1)

(b) Octane and isooctane can be separated in the laboratory.

Name a laboratory technique that could be used to separate isooctane from a mixture of octane and isooctane.

Outline how this technique separates isooctane from octane.

Name

Outline

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(3)

(c) Isooctane is added to petrol to increase its octane rating. Some high-performance engines require fuel with a higher octane rating.

Write an equation for the complete combustion of isooctane. Use the molecular formula (C_8H_{18}) of isooctane in your equation.

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(1)

(d) Explain, in general terms, how a catalyst works.

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(2)

(e) Carbon monoxide is produced when incomplete combustion takes place in engines. Nitrogen monoxide is another pollutant produced in car engines.

Write an equation to show how these pollutants react together in a catalytic converter.

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(1)

(f) Platinum, palladium and rhodium are metals used inside catalytic converters. A very thin layer of the metals is used on a honeycomb ceramic support.

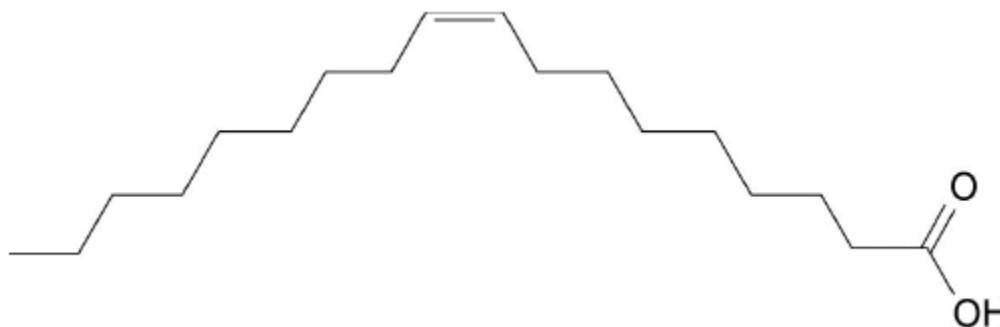
Explain why a thin layer is used in this way.

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(2)

- (g) Oleic acid ($C_{18}H_{34}O_2$) is a straight-chain fatty acid obtained from plant oils. Isooctane can be made from oleic acid. The skeletal formula of oleic acid is shown in **Figure 2**.

Figure 2



Identify a reagent that could be used in a chemical test to show that oleic acid is unsaturated.

State what would be observed in this test.

Reagent

Observation.....

.....

(2)
(Total 12 marks)

2 The alkene 3-methylpent-2-ene ($CH_3CH=C(CH_3)CH_2CH_3$) reacts with hydrogen bromide to form a mixture of 3-bromo-3-methylpentane and 2-bromo-3-methylpentane.

- (a) The alkene 3-methylpent-2-ene ($CH_3CH=C(CH_3)CH_2CH_3$) exists as *E* and *Z* stereoisomers.

Draw the structure of *Z*-3-methylpent-2-ene.

(1)

- (b) Name and outline the mechanism for the formation of 3-bromo-3-methylpentane from this reaction of 3-methylpent-2-ene with hydrogen bromide.

Explain why more 3-bromo-3-methylpentane is formed in this reaction than 2-bromo-3-methylpentane.

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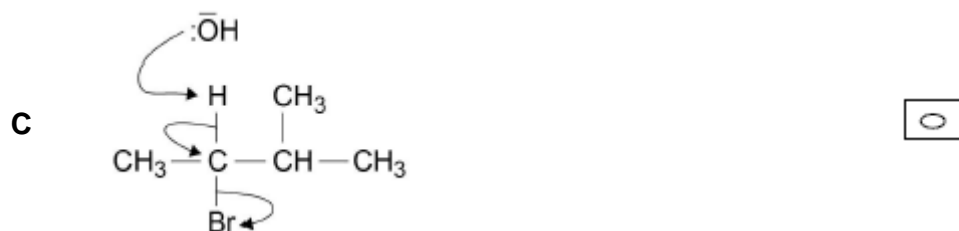
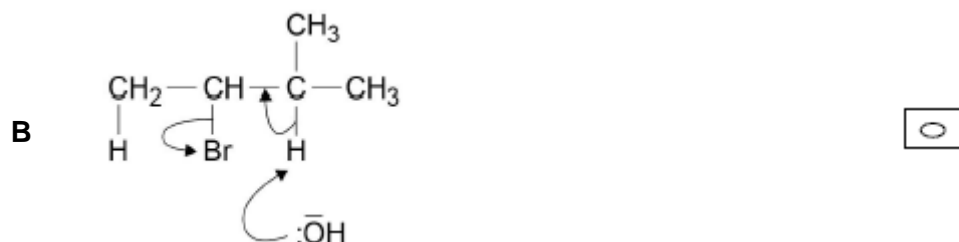
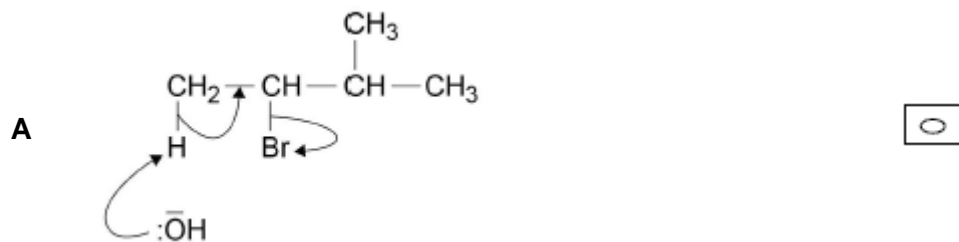
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(7)
(Total 8 marks)

3

Which of the following is a correct mechanism for the formation of 2-methylbut-2-ene from 2-bromo-3-methylbutane?



(Total 1 mark)

4

An organic compound is found to contain 40.0% carbon, 6.7% hydrogen and 53.3% oxygen.

Which of the following compounds could this be?

A Ethanol

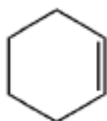
B Ethanoic acid

C Methanol

D Methanoic acid

(Total 1 mark)

5 The structure of cyclohexene is shown.



Which of the following is the general formula of cyclic alkenes such as cyclohexene?

A C_nH_{2n-4}

B C_nH_{2n-2}

C C_nH_{2n}

D C_nH_{2n+2}

(Total 1 mark)

6 (a) Octane (C_8H_{18}) is an important compound in petrol.

(i) Identify the homologous series to which octane belongs.

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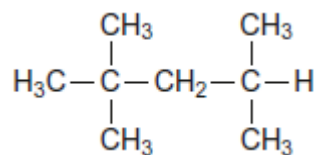
(1)

(ii) Write an equation to show the complete combustion of C_8H_{18}

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(1)

(iii) An isomer of octane used to improve the performance of car engines is shown.

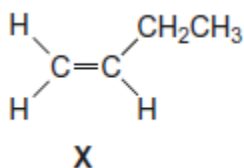


Give the IUPAC name of this isomer.

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(1)

(b) Compound **X** is produced when an alkane is cracked.



(i) Give the IUPAC name for compound **X**.

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(1)

(ii) One molecule of an alkane is cracked to produce one molecule of compound **X**, one molecule of octane and one molecule of ethene.

Deduce the molecular formula of this alkane.

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(1)

(iii) Name the type of cracking that produces a high yield of compound **X**.
Give **two** conditions required for this process.

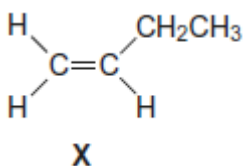
Type of cracking

Conditions

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(2)

(iv) Compound **X** has several isomers. The structure of **X** is repeated here.



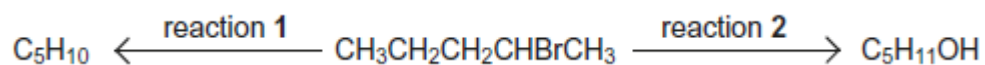
Draw the displayed formula of a chain isomer, a position isomer and a functional group isomer of compound X.

Type of isomer	Displayed formula of isomer of compound X
Chain	
Position	
Functional group	

(3)
(Total 10 marks)

7

Two reactions of 2-bromopentane, (CH₃CH₂CH₂CHBrCH₃) are shown.



The C₅H₁₀ formed in reaction 1 exists as a mixture of three isomers, one of which is pent-1-ene. Two of the isomers are a pair of stereoisomers. All three isomers decolourise bromine.

- (a) The same reagent is used in both reactions. The product is determined by the choice of conditions.

State the reagent and the conditions for each of reaction 1 and reaction 2.

State the role of the reagent in each reaction.

Name and outline the mechanism of reaction 1 for the formation of pent-1-ene.

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(8)

(b) All three isomers of C_5H_{10} contain the same functional group.

Draw the displayed formula of pent-1-ene.

Draw the structures of the pair of stereoisomers and give their full IUPAC names.

Explain the origin of the stereoisomerism shown.

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(5)

- (c) The rates of hydrolysis of two chloroalkanes can be investigated by adding aqueous silver nitrate to the chloroalkanes. During the hydrolysis reactions, chloride ions are liberated slowly. Precipitates of silver chloride are formed.

Outline a method to compare the rate of hydrolysis of 1-chlorobutane with that of 2-chlorobutane. State how the method would ensure a fair test.

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(4)
(Total 17 marks)

8

Compound **J**, known as leaf alcohol, has the structural formula $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}_2\text{OH}$ and is produced in small quantities by many green plants. The *E* isomer of **J** is responsible for the smell of freshly cut grass.

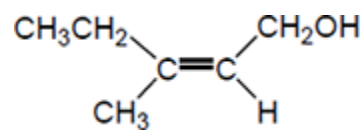
- (a) Give the structure of the *E* isomer of **J**.

(1)

- (b) Give the **skeletal formula** of the organic product formed when **J** is dehydrated using concentrated sulfuric acid.

(1)

(c) Another structural isomer of **J** is shown below.



Explain how the Cahn-Ingold-Prelog (CIP) priority rules can be used to deduce the full IUPAC name of this compound.

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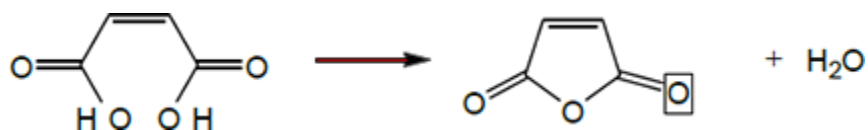
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(6)

(d) The effect of gentle heat on maleic acid is shown below.



A student predicted that the yield of this reaction would be greater than 80%.

In an experiment, 10.0 g of maleic acid were heated and 6.53 g of organic product were obtained.

Is the student correct? Justify your answer with a calculation using these data.

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(2)
(Total 10 marks)

9

2-bromo-2-methylpentane is heated with potassium hydroxide dissolved in ethanol. Two structural isomers are formed.

(a) State the meaning of the term **structural isomers**.

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(1)

(b) Name and draw the mechanism for the formation of **one** of the isomers.

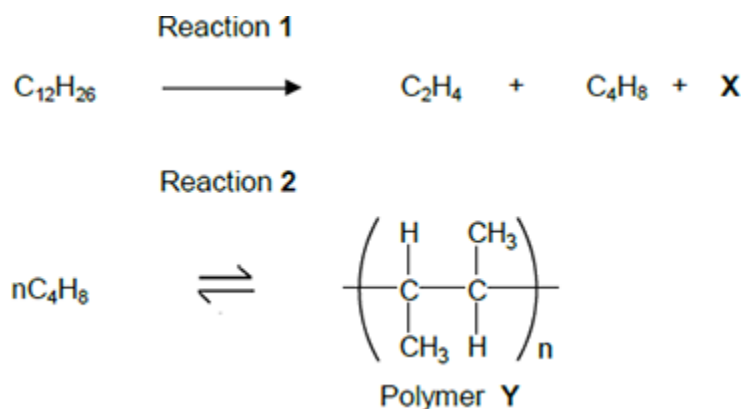
Name of mechanism

Mechanism

(5)
(Total 6 marks)

10

Dodecane ($C_{12}H_{26}$) is a hydrocarbon found in the naphtha fraction of crude oil. Dodecane can be used as a starting material to produce a wide variety of useful products. The scheme below shows how one such product, polymer **Y**, can be produced from dodecane.



(a) Name the homologous series that both C_2H_4 and C_4H_8 belong to.
Draw a functional group isomer of C_4H_8 that does **not** belong to this homologous series.

Name

Functional group isomer

(2)

(b) Identify compound **X**.

.....

(1)

(c) Name polymer **Y**.

.....

(1)

(d) Reaction **1** is an example of thermal cracking and is carried out at a temperature of 750 °C.

State **one other** reaction condition needed.

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(1)

(e) Reaction **2** is exothermic. A typical compromise temperature of 200 °C is used industrially for this reaction.

Explain the effect of a change of temperature on both the position of equilibrium and the rate of reaction, and justify why a compromise temperature is used industrially.

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(6)
(Total 11 marks)