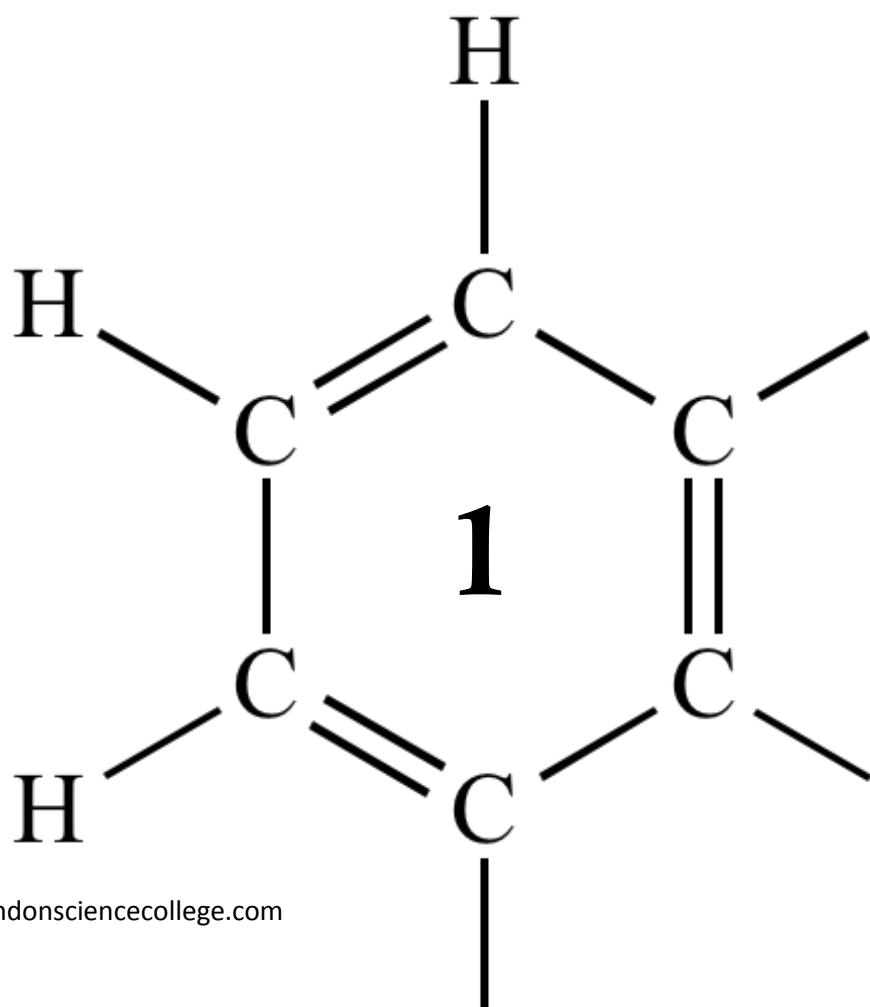


AQA AS CHEMISTRY

ALKENES



1

The alkene 3-methylpent-2-ene ($\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$) 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 ($\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$) 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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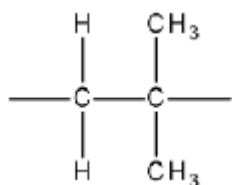
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(7)
(Total 8 marks)

2

The repeating unit of a polymer is



Which of the following molecules would form a polymer containing this repeating unit?

- A** But-1-ene
- B** *E*-but-2-ene
- C** *Z*-but-2-ene
- D** Methylpropene

(Total 1 mark)

3

Alcohols can be prepared from alkenes in various ways.

- (a) On a laboratory scale, a mixture of propan-1-ol and propan-2-ol can be prepared from propene in two steps.

In step 1, propene reacts with cold, concentrated sulfuric acid to form intermediate compounds.

In step 2, the intermediate compounds react with water to form the mixture of alcohols.

Name and outline the mechanism for the reaction between propene and concentrated sulfuric acid to form the intermediate compound which gives propan-2-ol in step 2.

Explain why propan-2-ol is the major product of this preparation.

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(7)

- (b) On an industrial scale ethanol can be produced from ethene by direct hydration or from glucose by fermentation.

State the conditions for the direct hydration reaction.

State two advantages and two disadvantages of the fermentation method compared with the direct hydration method.

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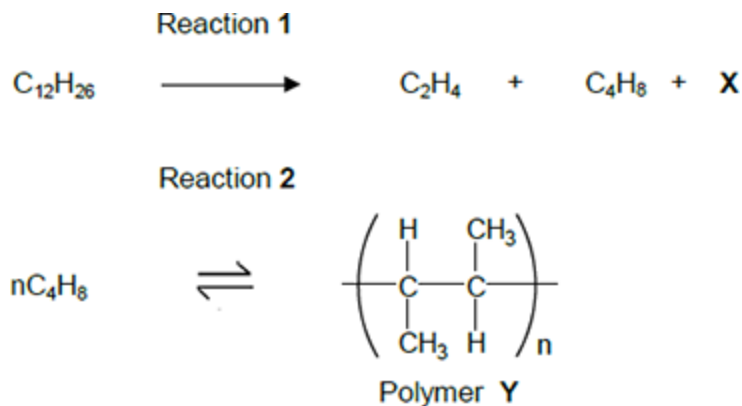
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(6)
(Total 13 marks)

4

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**.

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(1)

- (c) Name polymer **Y**.

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(1)

- (d) Reaction **1** is an example of thermal cracking and is carried out at a temperature of $750\text{ }^\circ\text{C}$.

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)

5

A student carried out an experiment to determine the number of C=C double bonds in a molecule of a cooking oil by measuring the volume of bromine water decolourised.

The student followed these instructions:

- Use a dropping pipette to add 5 drops of oil to 5.0 cm³ of inert organic solvent in a conical flask.
- Use a funnel to fill a burette with bromine water.
- Add bromine water from a burette to the solution in the conical flask and swirl the flask after each addition to measure the volume of bromine water that is decolourised.

The student's results are shown in the table below.

Experiment	Volume of bromine water / cm ³
1	39.40
2	43.50
3	41.20

- (a) In a trial experiment, the student failed to fill the burette correctly so that the gap between the tap and the tip of the burette still contained air.

Suggest what effect this would have on the measured volume of bromine water in this trial. Explain your answer.

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(2)

- (b) Other than incorrect use of the burette, suggest a reason for the inconsistency in the student's results.

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(1)

- (c) Outline how the student could improve this practical procedure to determine the number of C=C double bonds in a molecule of the oil so that more consistent results are obtained.

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(4)

- (d) The oil has a density of 0.92 g cm^{-3} and each of the 5 drops of oil has a volume of $5.0 \times 10^{-2} \text{ cm}^3$.
The approximate M_r of the oil is 885.
The concentration of bromine water used was $2.0 \times 10^{-2} \text{ mol dm}^{-3}$.

Use these data and the results from experiment 1 to deduce the number of C=C double bonds in a molecule of the oil.

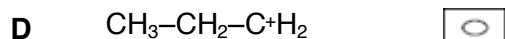
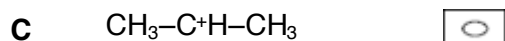
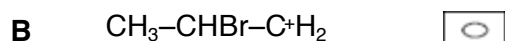
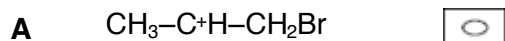
Show your working.

(5)
(Total 12 marks)

6

Consider the reaction between propene and hydrogen bromide to form the major product.

Which species is formed in the mechanism of this reaction?



(Total 1 mark)

7

Which statement about *E*-1,2-dichloroethene is correct?

A It has the same boiling point as *Z*-1,2-dichloroethene.

B It forms a polymer with the same repeating unit as *Z*-1,2-dichloroethene.

C It has the same IR spectrum as *Z*-1,2-dichloroethene in the range $400\text{--}1500\text{ cm}^{-1}$.

D It has a molecular ion peak different from that of *Z*-1,2-dichloroethene in its mass spectrum.

(Total 1 mark)

8

Which statement about ethene is correct?

A It has no geometric isomers because there is free rotation around the C=C bond.

B It reacts with HBr in a nucleophilic addition reaction.

C It burns in excess oxygen to produce carbon dioxide and water.

D The C=C bond is twice as strong as the C-C bond in ethane.

(Total 1 mark)

9

But-1-ene reacts with a reagent of the form HY to form a saturated compound.

(a) Suggest a reagent of the form HY which reacts with but-1-ene.

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(1)

(b) Name and draw a mechanism for the reaction in part (a).

Name of mechanism

Mechanism

(5)

(c) Explain how three isomeric products are formed when HY reacts with but-1-ene.

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(3)

(Total 9 marks)

10

What is the major product of the reaction between but-1-ene and DBr?
(D is deuterium and represents ^2H)

A $\text{CH}_2\text{DCH}_2\text{CH}_2\text{CH}_2\text{Br}$

B $\text{CH}_2\text{DCH}_2\text{CHBrCH}_3$

C $\text{CH}_3\text{CH}_2\text{CHBrCH}_2\text{D}$

C $\text{CH}_3\text{CH}_2\text{CHDCH}_2\text{Br}$

(Total 1 mark)

11

The following pairs of compounds can be distinguished by simple test-tube reactions.

For each pair of compounds, give a reagent (or combination of reagents) that, when added separately to each compound, could be used to distinguish between them.

State what is observed in each case.

(a) Butan-2-ol and 2-methylpropan-2-ol

Reagent

Observation with butan-2-ol

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Observation with 2-methylpropan-2-ol

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(3)

(b) Propane and propene

Reagent

Observation with propane

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Observation with propene

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(3)

(c) Aqueous silver nitrate and aqueous sodium nitrate

Reagent

Observation with aqueous silver nitrate

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Observation with aqueous sodium nitrate

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(3)

(d) Aqueous magnesium chloride and aqueous barium chloride

Reagent

Observation with aqueous magnesium chloride

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Observation with aqueous barium chloride

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(3)
(Total 12 marks)