

# Alkenes

1. Cyclohexene can be converted into cyclohexane.



**cyclohexene**

**cyclohexane**

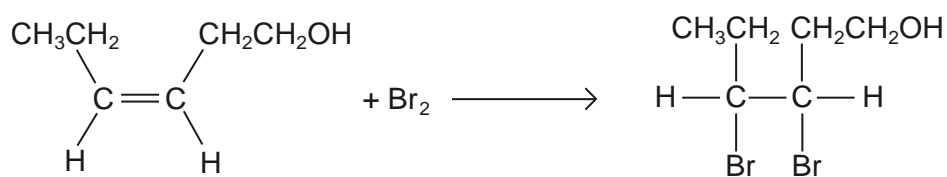
Suggest suitable reagents and conditions for this reaction.

reagents .....

conditions .....

[Total 2 marks]

2. Leaf alcohol reacts with bromine as shown in the equation below.



- (i) State what you would **see** when bromine reacts with leaf alcohol.

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[1]

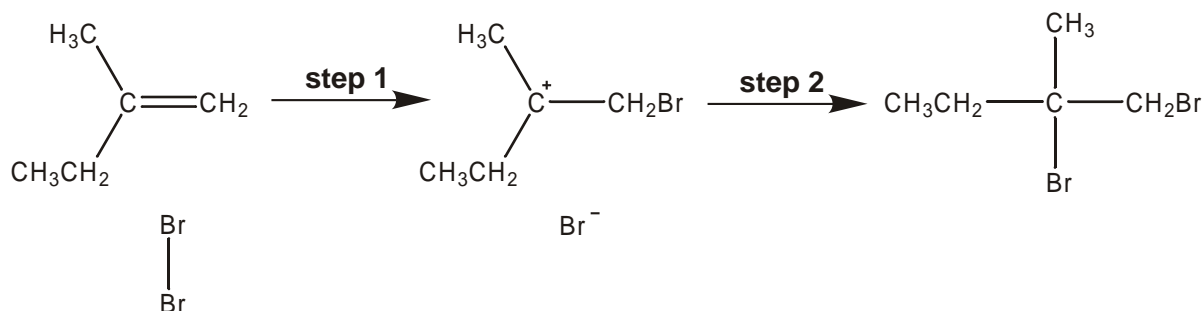
- (ii) Complete, with the aid of curly arrows, the mechanism involved in the reaction between leaf alcohol and bromine. Show any relevant dipoles, charges and lone pairs of electrons.

[4]

[Total 5 marks]

3. 2-Methylbut-1-ene can be formed by the partial hydrogenation of isoprene.

2-Methylbut-1-ene reacts with Br<sub>2</sub> to produce 1,2-dibromo-2-methylbutane by an electrophilic addition mechanism. The mechanism for the reaction is shown below.



- (i) In **step 1**, Br<sub>2</sub> behaves as an electrophile. Explain what is meant by the term *electrophile*.

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[1]

- (ii) Label any relevant dipoles and add 'curly arrows' to the mechanism to show the movement of electron pairs in **step 1** and in **step 2**.

[3]

[Total 4 marks]

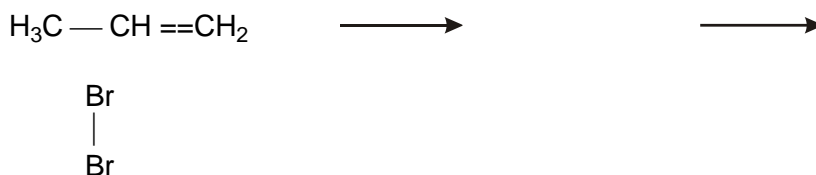
4. Propene, CH<sub>3</sub>CH=CH<sub>2</sub>, is an alkene and undergoes an addition reaction with bromine.

- (i) State what you would **see** when propene reacts with bromine.

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[1]

- (ii) Complete, with the aid of curly arrows, the mechanism involved in the reaction between propene and bromine. Show any relevant dipoles and charges.



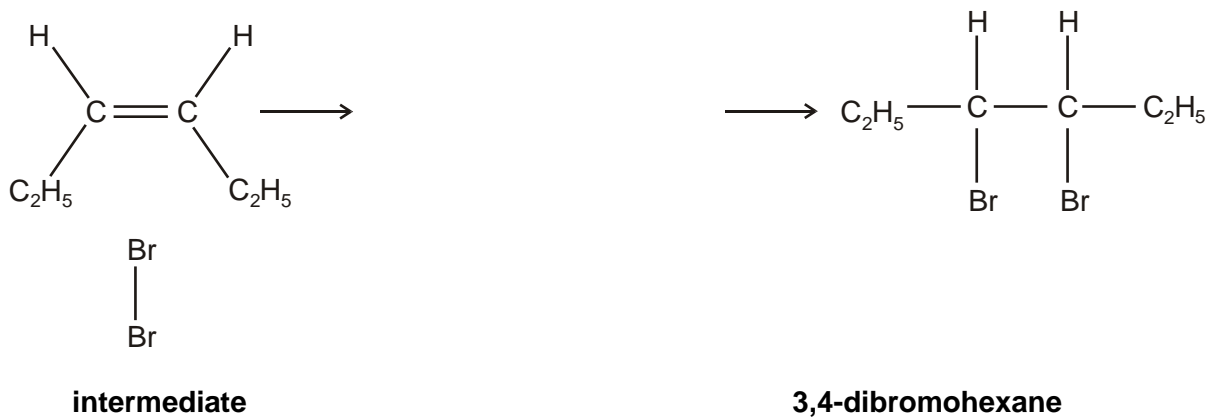
[4]

[Total 5 marks]

5. (a) Hex-3-ene reacts with Br<sub>2</sub> to produce 3,4-dibromohexane.

Describe, with the aid of curly arrows, the movement of the electrons in the mechanism.

Show the intermediate, any relevant dipoles and lone pairs of electrons.



[4]

- (b) The mechanism in (a) shows *cis*-hex-3-ene reacting with Br<sub>2</sub>. *Trans*-hex-3-ene also reacts with Br<sub>2</sub> to produce 3,4-dibromohexane.

- (i) How does the structure of *trans*-hex-3-ene differ from that of *cis*-hex-3-ene?

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[1]

- (ii) Explain why both *cis* and *trans* hex-3-ene react with Br<sub>2</sub> to produce the same structural isomer.

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[1]

[Total 6 marks]

6. (a) Propan-2-ol can be formed by the hydration of an alkene in the presence of a catalyst.

(i) Suggest a suitable catalyst for this reaction.

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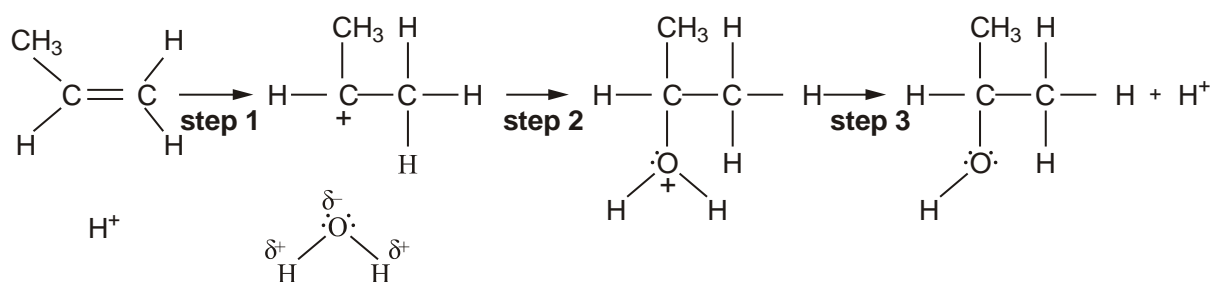
[1]

(ii) This is an electrophilic addition reaction. What is meant by the term *electrophile*?

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[1]

(b) A mechanism for the reaction in (a) is shown below.



(i) Add 'curly arrows' to the mechanism to show the movement of electron pairs in steps **1**, **2** and **3**.

[3]

(ii) Suggest, with a reason, the role of the  $\text{H}^+$ .

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[1]

[Total 6 marks]

7. (a) Compound **A** is a chloroalkene with the percentage composition by mass: C, 24.7%; H, 2.1%; Cl, 73.2%.

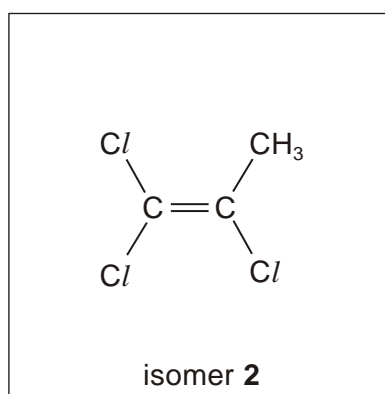
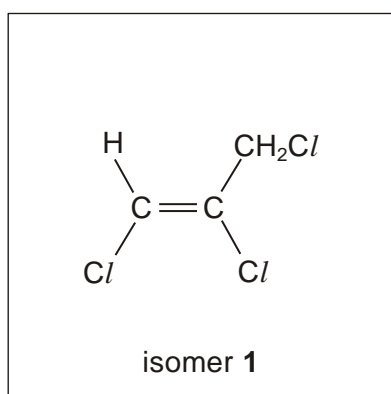
(i) Calculate the empirical formula of compound **A**. Show your working.

[2]

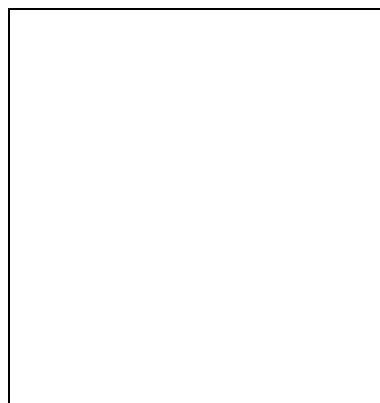
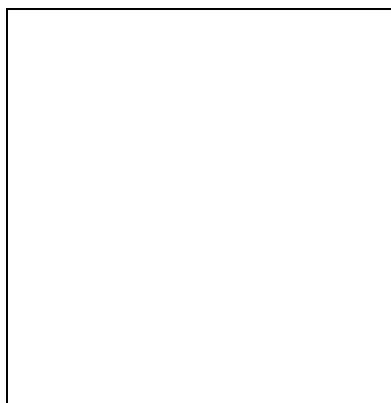
(ii) The relative molecular mass of compound **A** is 145.5. Show that the molecular formula is  $C_3H_3Cl_3$ .

[2]

- (b) Compound **A** is one of six possible structural isomers of  $C_3H_3Cl_3$  that are chloroalkenes. Two of these isomers are shown below as isomer **1** and isomer **2**.



(i) Draw two other structural isomers of  $C_3H_3Cl_3$  that are chloroalkenes.



[2]

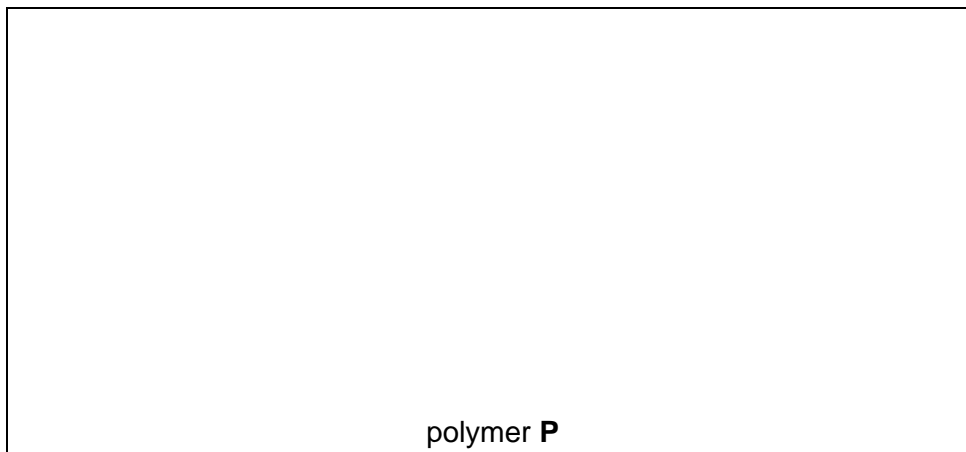
(ii) Name isomer **1**. .....

[2]

(c) All of the isomers in (b) readily polymerise.

- (i) Draw a section of the polymer **P** that could be formed when isomer **2** polymerises.

Show two repeat units.



[2]

- (ii) Addition polymers can be difficult to dispose of.

State **two** general problems in the disposal of polymers and identify an extra problem when disposing of polymer **P**.

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[3]

[Total 13 marks]

8. But-1-ene can undergo polymerisation. Draw a section of the polymer that can be formed from but-1-ene. Show **two** repeat units.

[Total 2 marks]

9. In this question, one mark is available for the quality of use and organisation of scientific terms.

Alkenes are used in the industrial production of many organic compounds.

Outline how alkenes are used in the manufacture of

- margarine,
- polymers such as poly(propene).

State any essential conditions.

Write a balanced equation for the manufacture of poly(propene) and draw a section of the polymer to show two repeat units.

State **two** difficulties in the disposal of polymers like poly(propene).

Suggest **two** ways in which waste polymers may be treated in the future.

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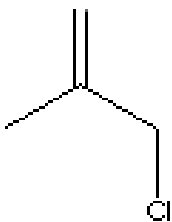
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[9]

Quality of Written Communication [1]

[Total 10 marks]

10. Methyl allyl chloride, MAC, is an important industrial chemical. It is used as an intermediate in the production of synthetic fibres, pharmaceuticals and epoxy resins. The structural formula of MAC is shown below.



- (a) Give the **systematic** chemical name of MAC.

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[1]

- (b) MAC contains the alkene group and can undergo polymerisation. Draw a section of the polymer, poly(MAC), showing **two** repeat units.

[2]

[Total 3 marks]

11. In this question, one mark is available for the quality of use and organisation of scientific terms.

- Describe, with the aid of a suitable diagram, the formation of the  $\pi$ -bond in propene.
- State the shape, and an approximate value for the bond angles, around each carbon atom in propene.
- Describe, with the aid of a suitable example, why some alkenes show *cis-trans* isomerism.

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[9]

Quality of Written Communication [1]

[Total 10 marks]