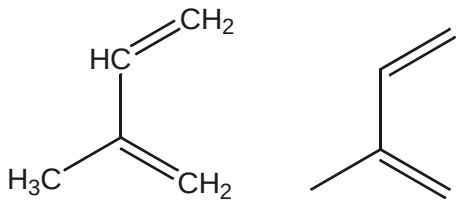
Alkenes

1. Isoprene is an alkene that can be tapped from some trees. It is the monomer in natural rubber.

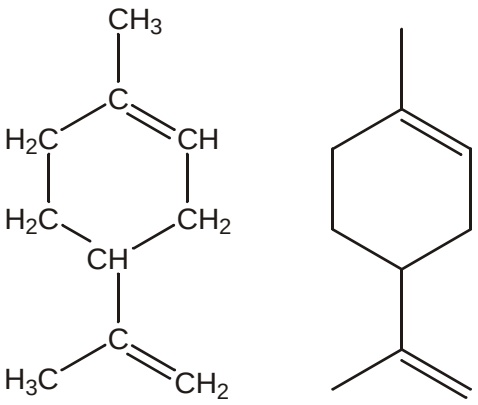
Limonene is a natural oil found in the rind of oranges and lemons.

Both isoprene and limonene contain two double bonds.

Their structural and skeletal formulae are shown below.



isoprene



limonene

(a) (i) What is the molecular formula of **isoprene**? .....

[1]

(ii) What is the empirical formula of **limonene**? .....

[1]

(b) In the presence of a suitable catalyst, isoprene and limonene both react with hydrogen.

(i) State a suitable catalyst for this reaction. .....

[1]

(ii) Write an equation for the reaction when **isoprene** reacts **completely** with hydrogen.

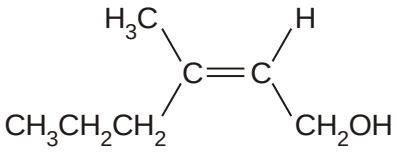
[2]

(iii) Draw the skeletal formula of a product formed when **limonene** reacts **partially** with hydrogen.

[1]

[Total 6 marks]

2. Body odour often begins with secretions from glands called apocrine glands, which are most numerous in the armpits. Bacteria, which live in the armpits, use these secretions to produce energy and many different waste products. Scientists have isolated one of these waste products, compound **E**, which is shown below.



compound **E**

Compound **E** contains two functional groups, one of which is a primary alcohol.

(i) **Name** the other functional group and state how you could test for it.

name of the other functional group .....

test .....

observation .....

[3]

(ii) Name compound **E** .....

[1]

[Total 4 marks]

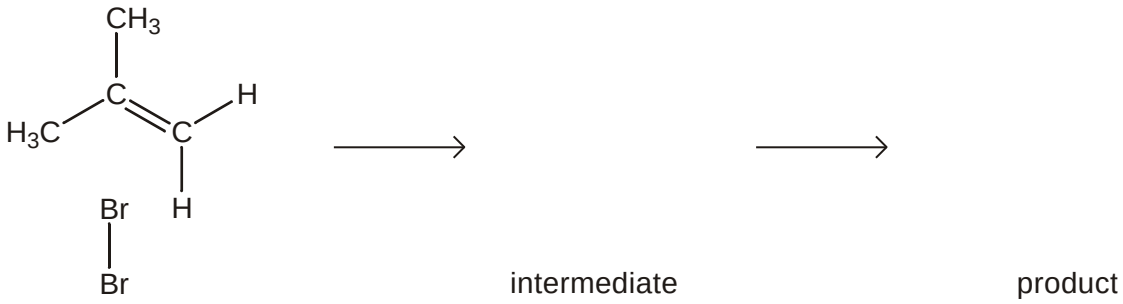
3. Alkenes undergo electrophilic addition reactions to form saturated compounds.

(i) Define the term *electrophile*.

.....

[1]

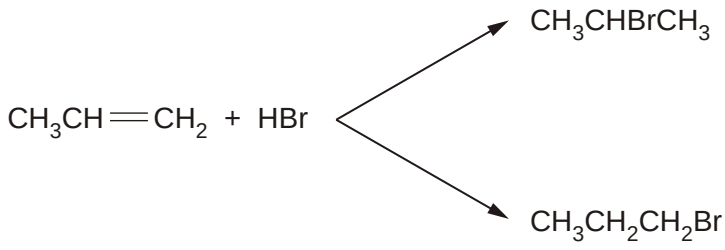
(ii) The reaction between bromine and methylpropene is an electrophilic addition.
Describe, with the aid of curly arrows, the mechanism for this reaction.
Show the intermediate and the product along with any relevant dipoles and lone pairs of electrons.



[4]

[Total 5 marks]

4. Propene, $CH_3CH{=}{=}CH_2$, reacts with HBr to produce two bromoalkanes that are structural isomers.



Propyne, $CH_3C{\equiv}CH$, reacts like propene. It reacts with HBr to give three isomers with molecular formula $C_3H_6Br_2$.

Draw the three isomers with molecular formula $C_3H_6Br_2$.

[Total 3 marks]

5. Long chain alkanes, such as nonane, can be cracked into shorter chain alkanes and alkenes.

(i) Write a balanced equation for the cracking of nonane into heptane and ethene.

.....

[1]

(ii) Much of the ethene is then converted into ethanol.

Write a balanced equation for the conversion of ethene into ethanol. State the essential conditions.

equation .....

[1]

conditions .....

.....

[2]

[Total 4 marks]

6. Chloroethene, CH_2CHCl, is polymerised to form poly(chloroethene) commonly known as *pvc*.

(i) Draw a section of *pvc* showing **three** repeat units. Put a bracket round one repeat unit.

[2]

(ii) Polymers such as *pvc* are difficult to dispose of because they are non-biodegradable. Increasingly, they are disposed of by combustion.

State the problem associated with the combustion of polymers such as *pvc.*

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[1]

(iii) State **two** ways in which chemists are trying to minimise the damage to the environment caused by the disposal of halogenated plastics such as *pvc*.

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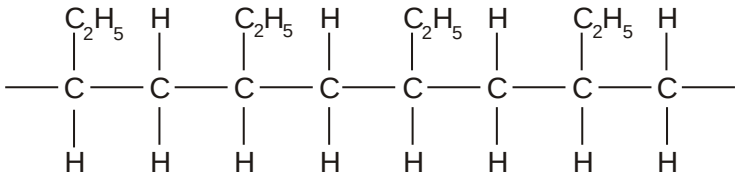
[2]

[Total 5 marks]

7. Polymer **A**, shown below, can be formed from an alkene.



A

polymer **A**

(i) State the type of polymerisation involved in the formation of polymer **A**.

.....

[1]

(ii) Draw a circle around the repeat unit of polymer **A**.

[1]

(iii) Identify the monomer that formed polymer **A**.

[1]

(iv) Name polymer **A**.

.....

[1]

[Total 4 marks]

8. But-1-ene is just one isomer with the molecular formula C_4H_8.

The chemical properties of but-1-ene are similar to those of ethene.

- Using this information, predict the organic products in, and the equations for, the reactions of but-1-ene with bromine, hydrogen bromide and steam.
- Draw a section of the polymer formed from but-1-ene by showing two repeat units.
- Discuss **two** ways in which chemists are trying to minimise the damage to the environment caused by the disposal of polymers.

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[Total 10 marks]