

1. How many stereoisomers are there of $\text{CH}_3\text{CH}=\text{CHCH}(\text{OH})\text{CH}_2\text{CH}=\text{CH}_2$?

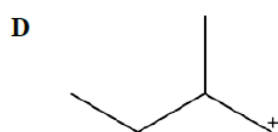
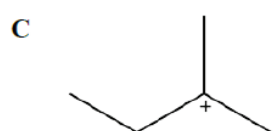
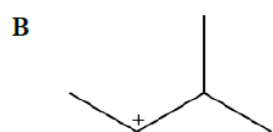
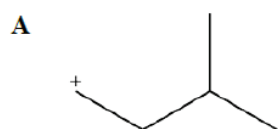
- A 2
- B 4
- C 6
- D 8

Your answer

[1]

2. Hydrogen bromide reacts with 3-methylbut-1-ene.

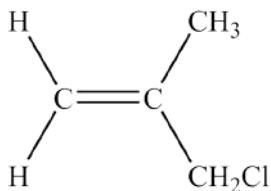
What is the structure of the major intermediate formed in the mechanism?



Your answer

[1]

3. Methyl allyl chloride, MAC, is a chemical used in the production of insecticides. The structure of MAC is shown below.



MAC

- (a) (i) Give the **molecular** formula of MAC.

..... [1]

- (ii) Draw the **skeletal** formula of MAC.

[1]

- (iii) MAC has several structural isomers.

State what is meant by *structural isomers*.

.....

..... [1]

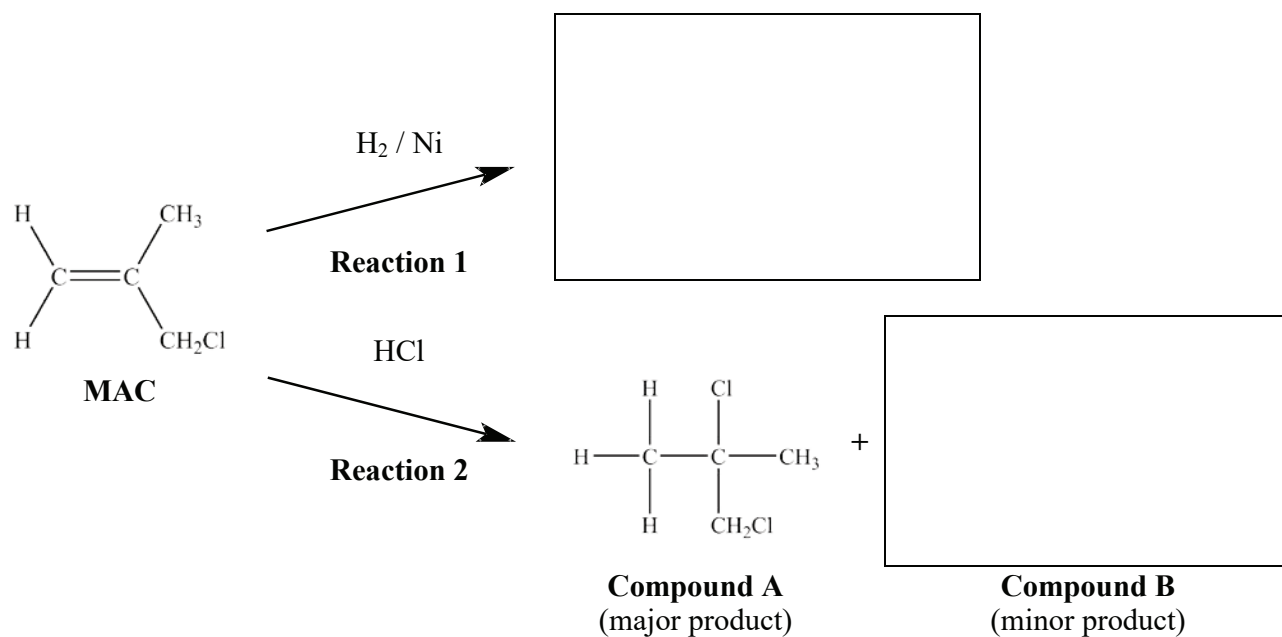
- (b) MAC is highly flammable. When MAC burns, one of the products formed is a toxic gas.

1.321 g of this gas occupies 1.053 dm³ at 100 kPa and 350 K.

Use the information provided to suggest the identity of the gas.

gas = [4]

(c) The flowchart below shows some reactions of MAC.



(i) Complete the flowchart above.

- Draw the structure of the product of **Reaction 1**.
- Draw the structure of the minor organic product of **Reaction 2** (Compound B).

[2]

(ii) **Reaction 2** creates a mixture of compounds. Compound A is the major product.

Draw the mechanism for the formation of compound A.

Use curly arrows and show relevant dipoles.

[3]

(iii) Explain why compound **B** is the minor product of **Reaction 2**.

.....
..... [1]

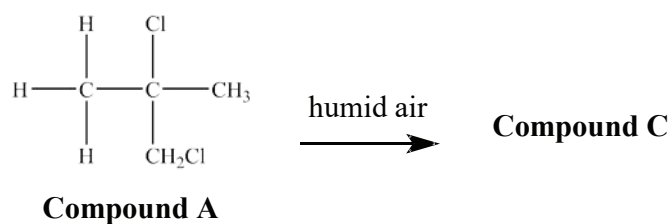
(iv) **MAC** reacts with water in the presence of $\text{AgNO}_3(\text{aq})$ and ethanol.

Draw the structure of the organic product of this reaction.

State what you would **observe** in this reaction and identify the compound responsible for the observation.

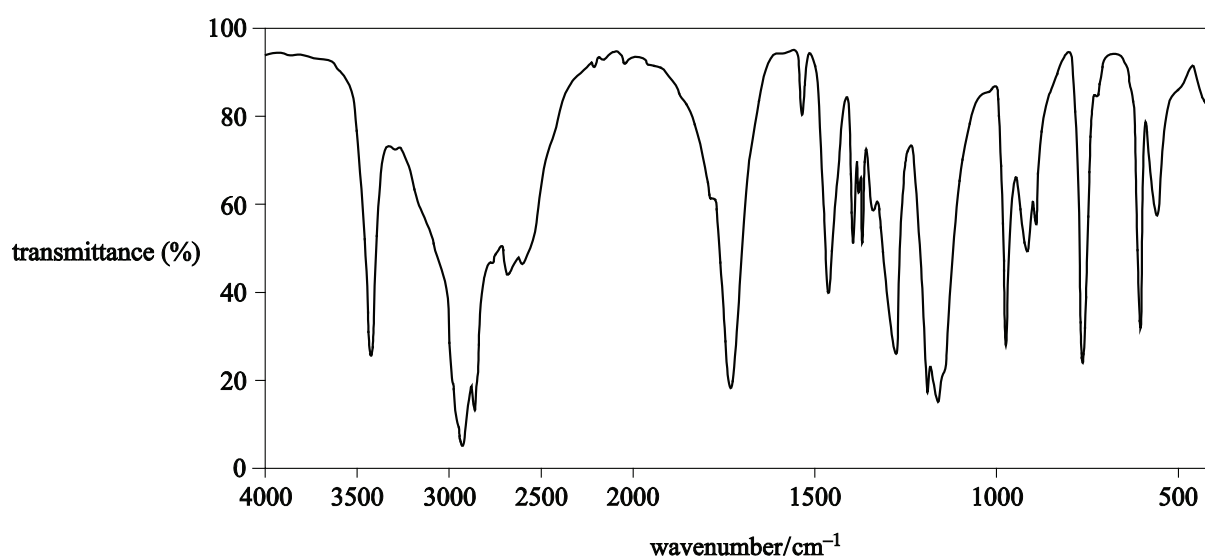
.....
..... [2]

(d) Compound A reacts slowly in humid conditions to form compound C.



Compound C contained the following percentage composition by mass:
 C, 46.1%; H, 7.7%; O, 46.2%

The infrared spectrum of compound C is shown below.



Using the information on the previous page, deduce the structure of compound C.

Give your reasoning.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

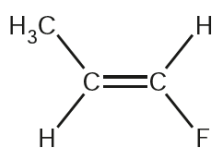
.....

structure =

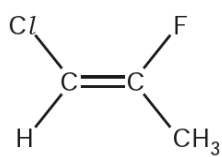


[5]

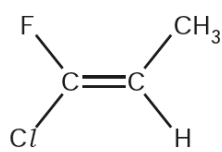
4 Which molecule is a Z-isomer?



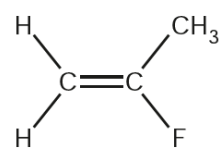
A



B



C



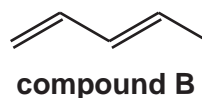
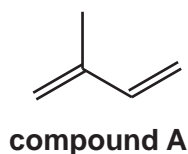
D

Your answer

[1]

5. This question is about unsaturated hydrocarbons.

(a) Compound **A** and compound **B** are isomers.



Compound **A** has a lower melting point than compound **B**.

Suggest why.

.....

.....

.....

.....

..... [2]

(b) Compound **C**, $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}_2\text{OH}$, exists as *cis* and *trans* stereoisomers.

(i) Name compound **C**.

..... [1]

(ii) Define the term *stereoisomers*.

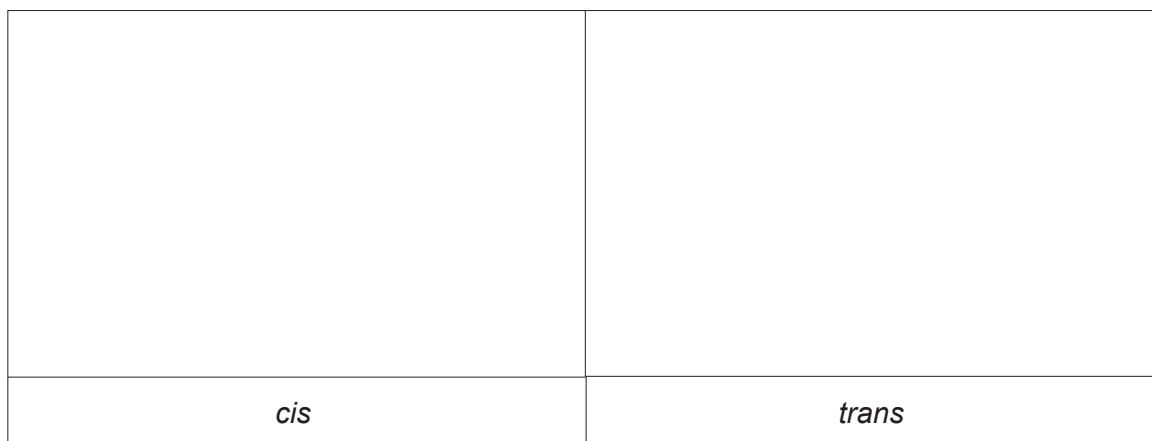
.....

.....

.....

..... [1]

(iii) Draw the structures of the *cis* and *trans* stereoisomers of compound C.



[2]

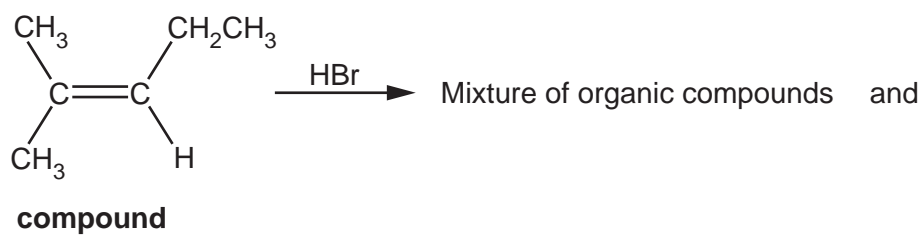
(c) The C=C group in an alkene contains a π -bond.

Complete the diagram below to show how p-orbitals are involved in the formation of a π -bond.



[1]

- (d) Compound **D**, shown below, reacts with hydrogen bromide by electrophilic addition. A mixture of two organic compounds, **E** and **F**, is formed.



- (i) Suggest how an HBr molecule can act as an electrophile.

.....

.....

..... [1]

- (ii) Draw the structures of the two organic compounds **E** and **F**.

E	F

[2]

- (iii) Outline the mechanism of the reaction between compound **D** and hydrogen bromide to form **either** compound **E** or compound **F**.

Include curly arrows and relevant dipoles.

[3]

- (iv) Which of **E** or **F** is the major organic product?

Explain your answer.

Major organic product

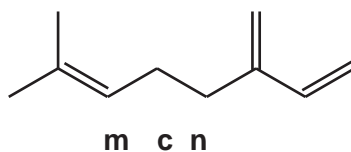
Explanation

.....

.....

..... [1]

- (e) Myrcene, $C_{10}H_{16}$, is a naturally occurring hydrocarbon containing more than one carbon-carbon double bond.



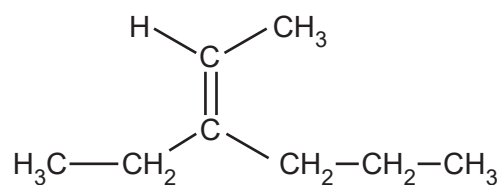
- (i) Reaction of 204 mg of myrcene with hydrogen gas produces a saturated alkane.
Calculate the volume of hydrogen gas, in cm^3 and measured at RTP, needed for this reaction.
Show your working.

volume = cm^3 [2]

- (ii) β -Carotene is a naturally occurring unsaturated hydrocarbon found in carrots.
A β -carotene molecule contains 40 carbon atoms, has two rings, and a branched chain.
0.0200 mol of β -carotene reacts with $5.28 dm^3$ of hydrogen gas to form a saturated hydrocarbon.
Using molecular formulae, construct a balanced equation for this reaction.
Include relevant calculations and reasoning.

Equation [4]

6. What is the name of the compound below?

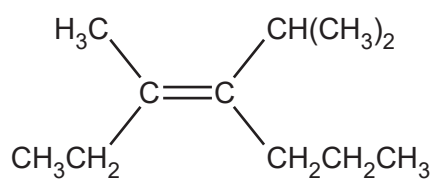


- A 3-Propylpent-2-ene
- B 3-Propylpent-3-ene
- C 3-Ethylhex-2-ene
- D 4-Ethylhex-4-ene

Your answer

[1]

7. The structure of a stereoisomer is shown below.



Which term correctly describes this stereoisomer?

- A *cis*-
- B *trans*-
- C *E*-
- D *Z*-

Your answer

[1]

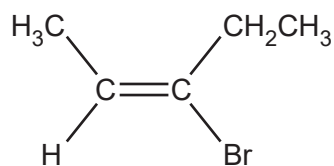
8. Which types of bonds are broken and formed in the reaction of ethene and bromine?

	Types of bond broken	Types of bond formed
A	σ	π
B	π	σ
C	σ and π	π
D	σ and π	σ

Your answer

[1]

9. What is the name of the compound below?

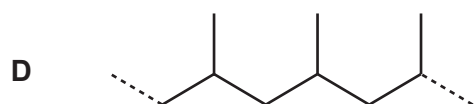
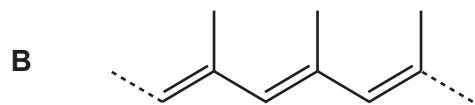
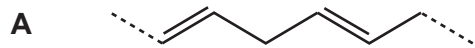


- A *E*-3-bromopent-2-ene
- B *E*-3-bromopent-3-ene
- C *Z*-3-bromopent-2-ene
- D *Z*-3-bromopent-3-ene

Your answer

[1]

10. Which structure shows a section of poly(propene)?



Your answer

[1]