OCR A-Level Chemistry A

Alkenes and addition polymers mark scheme · goes with “Alkenes and addition polymers” · whiteboardchemistry.com/revision/exam-questions/ocr-a-level-chemistry/

Mark schemes

Alkenes and addition polymers · 10 questions

Q1 · June 2022 · AS Paper 1 (Breadth in chemistry) · Q17 · [1 mark]

Answer: **D**

Q2 · June 2023 · AS Paper 2 (Depth in chemistry) · Q5 · [9 marks]

OCR MARK SCHEME

5(a)(i)

3-methylpentan-2-ol ✓

[1 mark]

EXAMINER GUIDANCE

IGNORE lack of hyphens or addition of commas

ALLOW *3-methylpentane-2-ol*

DO NOT ALLOW

2-methylpentan-3-ol

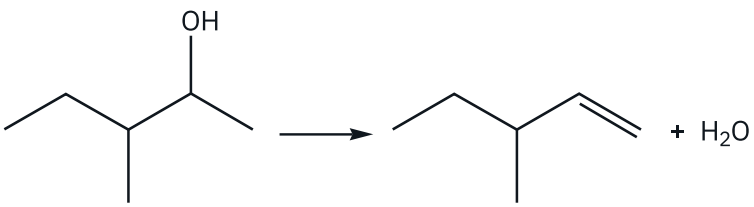
3-methylpent-2-ol

3-methpentan-2-ol

3-methypentan-2-ol

3-methlypentan-2-ol

5(a)(ii)



Correct structure of organic product ✓

Balanced equation ✓

[2 marks]

ALLOW *any combination of skeletal OR structural OR displayed formula as long as unambiguous*

DO NOT ALLOW *additional reactants such as H^+ or [O] in the equation.*

ALLOW *incorrect isomer 3-methylpent-2-ene for balancing mark.*

5(a)(iii)

Priority groups on same side ✓

High(est) priority groups are CH_3CH_2 and CH_3

OR

Low(est) priority groups are CH_3 and H ✓

ALLOW *suitable alternatives to ‘priority’ e.g. Groups with highest atomic number or more important groups etc.*

ALLOW *priority groups are both on the top*

[2 marks]

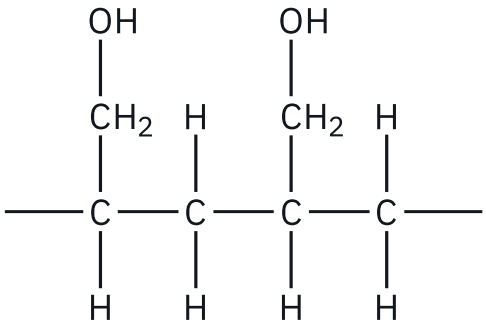
IGNORE references to relative mass of groups, Ar, M_r,

ALLOW *identification by name e.g. ethyl and methyl, or by circling on the structure.*

IF *'priority' is not mentioned* ***ALLOW*** *1 mark for CH_3CH_2 and CH_3 are on same side OR H and CH_3 are on same side*

5(b)(i)

Section of polymer



✓

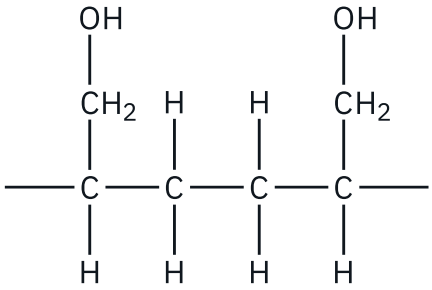
- -

Reason for solubility in water

OH/alcohol groups form hydrogen bonds with water ✓

ALLOW *correct structural OR displayed OR skeletal formula.*

ALLOW *alternating side chains i.e.*



IGNORE brackets and use of 'n'

IGNORE incorrect connectivity for -CH_2OH

DO NOT ALLOW *-HO*

End bonds MUST be shown (solid or dotted)

DO NOT ALLOW *one repeat unit*

Question asks for 2 repeat units.

- -

DO NOT ALLOW *'it forms hydrogen bonds'*

[2 marks]

5(b)(ii)

Any two ✓✓

- Recycled (to make other plastic materials)
- Combustion to generate energy / electricity
- As (organic) feedstock

IGNORE Reused

ALLOW *Used as a fuel to generate energy / electricity*

[2 marks]

Q3 · June 2024 · AS Paper 1 (Breadth in chemistry) · Q17 · [1 mark]

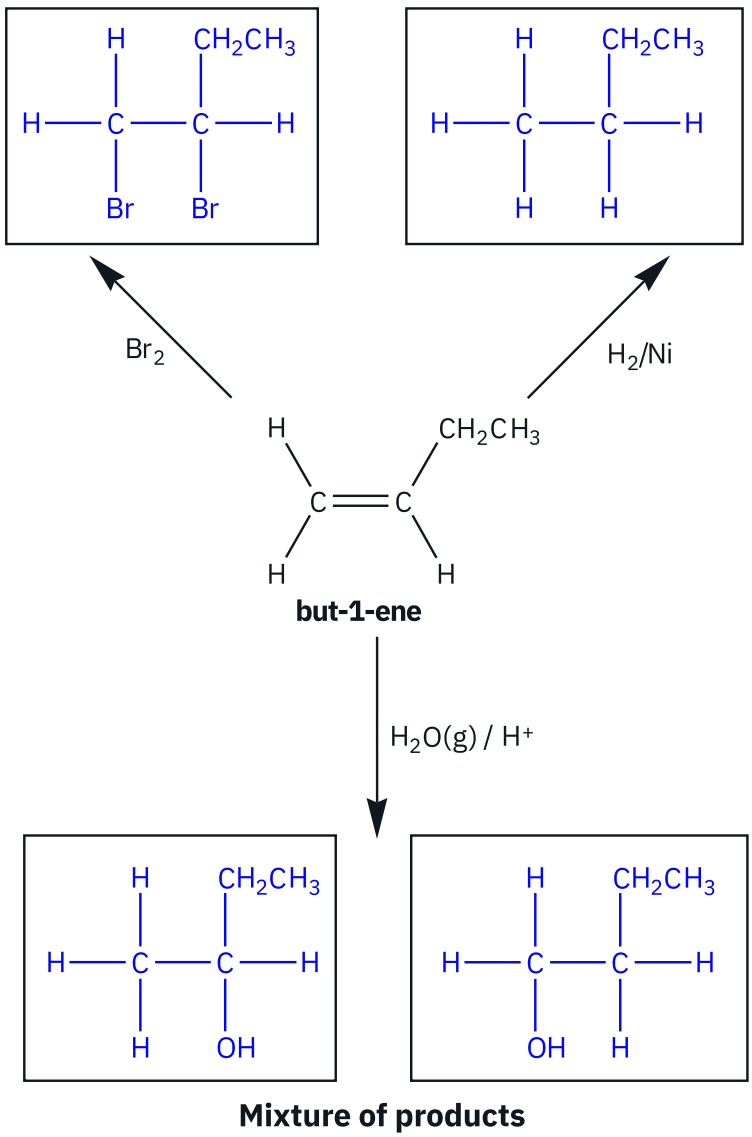
Answer: **C**

The monomer is $H_3CCH=CHCl$.

Q4 · June 2024 · AS Paper 2 (Depth in chemistry) · Q5 · [10 marks]

OCR MARK SCHEME

5(a)



one mark for each correct structure ✓✓✓✓

[4 marks]

EXAMINER GUIDANCE

ALLOW *any combination of skeletal OR structural OR displayed formula as long as unambiguous*

DO NOT ALLOW *structure if H(s) are missing from ONE structural formula*

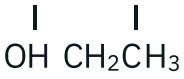
..... BUT **ALLOW** any further omissions as **ECF**

Take care with numbers of carbons

IGNORE *connectivity,*

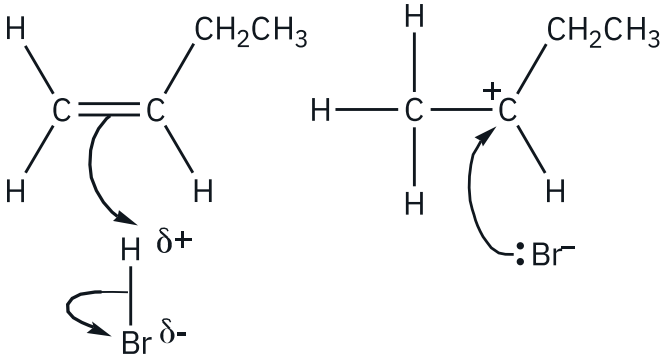
e.g.

ALLOW



But **DO NOT ALLOW** –HO

5(b)(i)



Throughout,

ALLOW *any combination of skeletal OR structural OR displayed formula as long as unambiguous*

For curly arrows,

ALLOW *straight or snake-like arrows and small gaps (see examples)*

DO NOT ALLOW *half headed or double headed arrows but allow* ***ECF*** *if seen more than once*

1st curly arrow (from ANY alkene)

Curly arrow from double bond to H of H–Br ✓

DO NOT ALLOW *partial charge on C=C*

2nd curly arrow

Correct dipole on H–Br

AND curly arrow for breaking of H–Br bond ✓

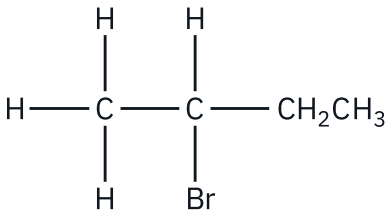
3rd curly arrow

Correct carbocation with + charge on C

AND curly arrow from Br^- to C+ of carbocation ✓

DO NOT ALLOW *δ+ on C of carbocation*

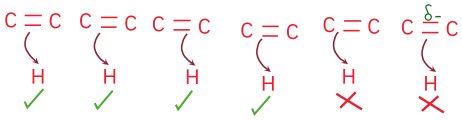
Correct product (independent mark) ✓



[4 marks]

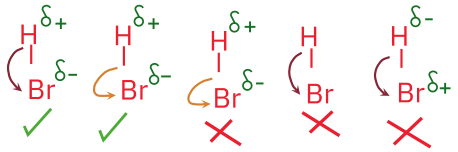
1st curly arrow must

- go to a H atom of H–Br
- **AND**
- start from, OR be traced back to any point across width of C=C



2nd curly arrow must

- start from, OR be traced back to, any part of $^{\delta+}H–Br^{\delta-}$ bond
- **AND** go to $Br^{\delta-}$



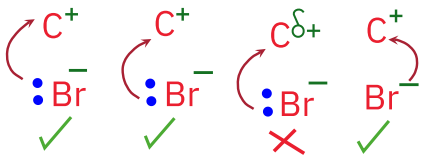
ALLOW ECF for 2nd and 3rd curly arrow marking points if used Br_2 instead of HBr

3rd curly arrow must

- go to the C^+ of carbocation

AND

- start from, OR be traced back to any point across width of lone pair on $:Br^-$
- OR start from – charge on Br^- ion



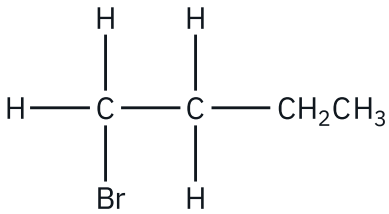
(Lone pair **NOT** needed if curly arrow shown from – charge on Br^-)

IGNORE *connectivity of alkyl groups in carbocation and product*

IF *drawn both intermediates and products with no labelling*

ALLOW *3rd curly arrow mark BUT* ***NOT*** *product mark, unless clearly labelled as'2-bromobutane' or 'major' product*

ALLOW ECF for product from incorrect carbocation. e.g. 1-bromobutane:



5(b)(ii)

(major product forms from) most/more stable intermediate/carbocation ✓

(major product forms from a) secondary carbocation OR carbocation bonded to more C atoms / more alkyl groups OR carbocation bonded to fewer H atoms ✓

[2 marks]

ALLOW *carbonium ion for carbocation*

IGNORE *descriptions of the major/minor product in terms of Markownikoff's rule*

e.g. H atom joins to C with most H

IGNORE *references to stability of the product*

ALLOW ORA

Q5 · June 2024 · Paper 2 (Synthesis and analytical techniques) · Q19 · [6 marks]

OCR MARK SCHEME

EXAMINER GUIDANCE

19

Level 3 (5–6 marks)

Describes addition reactions including the mechanisms of one alkene AND one carbonyl compound AND some additional details

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Level 2 (3–4 marks)

Describes an addition reaction including the mechanism of one alkene OR one carbonyl compound AND some additional details

OR

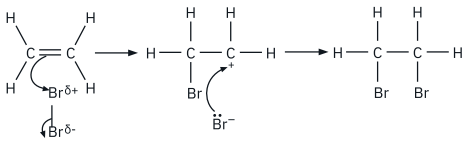
Indicative scientific points may include:

Reaction of alkene and mechanism

- Suitable reaction, e.g. alkene and Br_2 OR X_2 OR HX OR H_2O OR H_2 OR polymerisation

May be shown within mechanism

- Mechanism, e.g.



Describes addition reactions including an attempt to give the mechanisms of one alkene AND one carbonyl compound

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1–2 marks)

Selects suitable reagents for addition reactions of one alkene AND one carbonyl compound.

OR

Attempts to describe an addition reaction including an attempt to give the mechanism of one alkene OR one carbonyl compound.

There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.

0 marks No response or no response worthy of credit.

[6 marks]

ALLOW *mechanism for H_2 AND H_2O to be shown as electrophilic addition even though incorrect - consider impact on communication statement.*

ALLOW *suitable non-specification alternative e.g. HCN*

Additional details (**NOT** INCLUSIVE)

- Electrophilic addition
- Systematic names of reactants and/or products
- Details of functional group interconversion e.g. alkene to dibromo
- Details on reagents required e.g.

- H_2 with Ni Catalyst

- $H_2O(g)$ with H_3PO_4 catalyst

- Explanation of major and minor product from electrophilic addition of HX with unsymmetrical alkene
- Explanation of carbocation intermediate stability
- Heterolytic fission

Reaction of carbonyl compound and mechanism

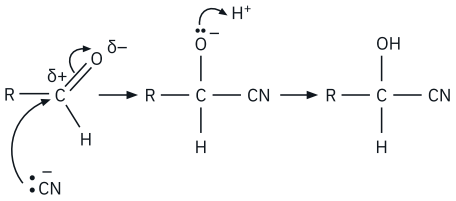
Suitable reactions, e.g.

- Aldehyde or ketone and HCN OR H^-

e.g. RCHO + HCN → RCH(OH)CN

May be shown within mechanism

- Mechanisms, e.g.



OR H_2O instead of H^+ for 2nd stage

ALLOW *suitable non-specification alternative e.g. H_2O, NH_3, 1° amine*

IGNORE *reactions with carboxylic acids (or derivatives) i.e. addition-elimination mechanism (condensation reaction)*

Additional details (**NOT** INCLUSIVE)

- Nucleophilic addition
- Systematic names of reactants and/or products
- Details of functional group interconversion e.g. aldehyde to hydroxynitrile
- In reduction, aldehydes form 1° alcohols and ketones form 2° alcohols
- Details on reagents required e.g.

- formation of hydroxynitriles with $NaCN/H^+(aq)$

- formation of alcohols with $NaBH_4$

- Heterolytic fission

Aspects of the communication statement being met might typically include:

- Curly arrows starting from lone pairs / negative charges / bonds.
- All reactants and intermediates have relevant charges and dipoles.
- Mechanisms given are chemically feasible for the reactions.
- No additional incorrect reactants have been included.

Q6 · June 2024 · Paper 2 (Synthesis and analytical techniques) · Q2 · [1 mark]

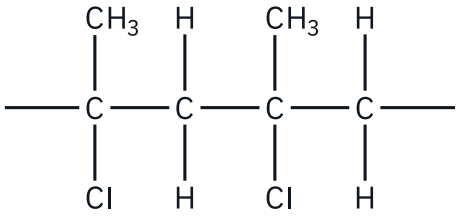
Answer: **C**

The bond enthalpy of C–C σ bonds is **higher** than that of π bonds.

Q7 · June 2025 · AS Paper 1 (Breadth in chemistry) · Q24 · [9 marks]

OCR MARK SCHEME

24(a)(i)



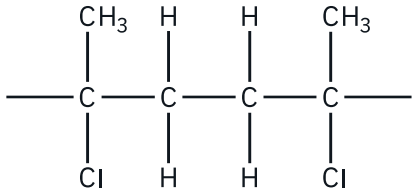
Two correct repeat units for 2-chloropropene (*n* and brackets not required) ✓

[1 mark]

EXAMINER GUIDANCE

ALLOW *structural* ***OR*** *displayed* ***OR*** *skeletal formula* ***OR*** *mixture of the above (as long as unambiguous)*

ALLOW:



.....but CH_3 and Cl must be on same C atom

CH_3 and Cl can be shown either side of the structure

NOTE*: 'side bonds' ARE required on either side of repeat unit from C atoms*

IGNORE *connectivity of methyl group*

IGNORE *brackets*

IGNORE *n or subscript numbers*

24(a)(ii)

Formation of HCl/hydrochloric acid/ **OR** chlorine

[1 mark]

ALLOW *Cl or* Cl_2 *for chlorine*

ALLOW *produces CO (from incomplete combustion)*

IGNORE *toxic waste products*

Response must reflect chlorine or carbon monoxide in some way

24(b)

$C_5H_{10} + 7½\ O_2 \rightarrow 5CO_2 + 5H_2O$ ✓

[1 mark]

ALLOW $2C_5H_{10} + 15O_2 \rightarrow 10CO_2 + 10H_2O$

IGNORE *state symbols (even if incorrect)*

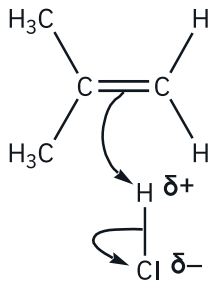
24(c)(i)

Curly arrows can be straight, snake-like, etc. but **NOT** double headed or half headed arrows

1st curly arrow must

- go to the H atom of H–Cl

1. Curly arrow from C=C to HCl and H–Cl 2 marks



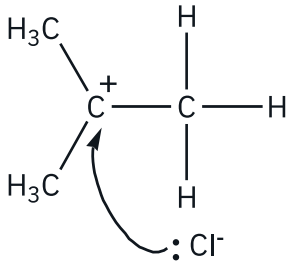
Curly arrow from C=C bond to H of H–Cl ✓

DO NOT ALLOW *partial charge on C=C*

Correct dipole shown on H–Cl

AND curly arrow that breaks H–Cl bond ✓

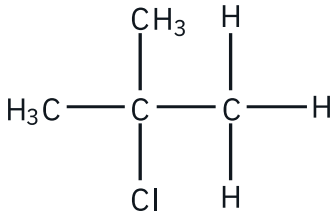
2. Curly arrow from Cl^- to carbocation 1 mark



Curly arrow from Cl^- to C^+ of carbocation (carbocation must follow structure from step 1 i.e. 2 methyl groups) ✓

DO NOT ALLOW *δ+ on C of carbocation*

3. Product 1 mark



✓

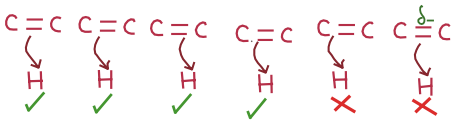
4. Name of mechanism 1 mark

Electrophilic addition ✓

[5 marks]

AND

- start from, **OR** be traced back to any point across width of C=C

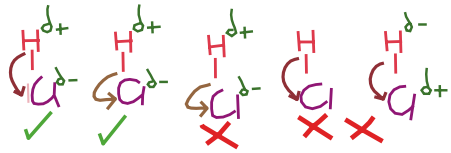


2nd curly arrow must

- start from, **OR** be traced back to any part of $^{\delta+}H–Cl^{\delta-}$ bond

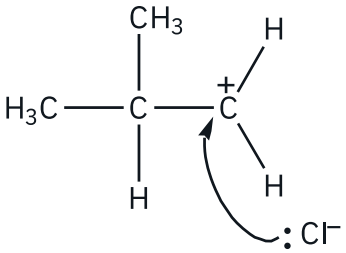
AND

- go to $Cl^{\delta-}$



Use of Cl-Cl or H-Br loses first marking point but gains **ECF** for second marking point

ALLOW formation of minor carbocation, i.e.



(formation of major product assessed below)

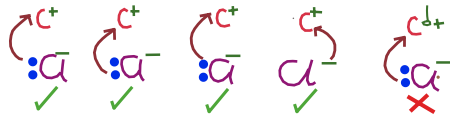
ALLOW ECF from use of Cl_2 OR HBr

3rd curly arrow must

- go to the C+ of carbocation

AND

- start from, **OR** be traced back to any point across width of lone pair on $:Cl^-$
- **OR** start from – charge of Cl^- ion



(Lone pair **NOT** needed if curly arrow shown from – charge of Cl^- ion)

ALLOW ECF *for correct tertiary product following use of HBr ONLY (i.e. Cl in structure shown replaced with Br)*

24(c)(ii)

More stable (tertiary) carbocation is formed as intermediate

OR

The minor product forms a less stable (primary) carbocation ✓

[1 mark]

NOTE must refer to stability of carbocation

IGNORE *references to Markownikoff's rule*

IGNORE *secondary*

Q8 · June 2025 · Paper 2 (Synthesis and analytical techniques) · Q10 · [1 mark]

Answer: **D**

OCR MARK SCHEME

8

EXAMINER GUIDANCE

ALLOW *8*

Q9 · June 2025 · Paper 2 (Synthesis and analytical techniques) · Q8 · [1 mark]

Answer: **C**

$H^{\delta+}$—$Br^{\delta-}$ acts as an electrophile.

Q10 · November 2021 · AS Paper 1 (Breadth in chemistry) · Q13 · [1 mark]

Answer: **B**

OCR MARK SCHEME

4

EXAMINER GUIDANCE

ALLOW *4*

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