AQA A-Level Chemistry

Alkenes mark scheme · goes with “Alkenes” · whiteboardchemistry.com/revision/aqa-a-level-chemistry/exam-questions

Mark schemes

Alkenes · 11 questions

Q1 · November 2021 · AS Paper 2 · Q5 · [8 marks]

(a) Step 1

M1 fractional distillation

[1 mark]

M2 separated into mixtures of compounds with similar boiling points / similar sized molecules

M2 to separate naphtha from other compounds; to separate compounds by chain length / size / boiling point

[1 mark]

Step 2

M3 (thermal) cracking

M3 not catalytic cracking

[1 mark]

M4 to make alkenes / propene / shorter molecules

[1 mark]

Step 3

M5 (addition) polymerisation

M5 not condensation polymerisation

[1 mark]

M6 molecules joined together or to produce long chain molecule

For each step the two marks are independent

[1 mark]

(b) no polar bonds (in chain) / non-polar

Do not allow if only C-H bonds mentioned as non polar

[1 mark]

(c) to prevent build-up of waste (in landfill) OR they can be broken down by natural processes

[1 mark]

Q2 · November 2021 · AS Paper 2 · Q18 · [1 mark]

Answer: **D**

$(CH_3)_2CHCH=CH_2$

Q3 · June 2022 · AS Paper 2 · Q11 · [1 mark]

Answer: **A**

The monomer is propanenitrile

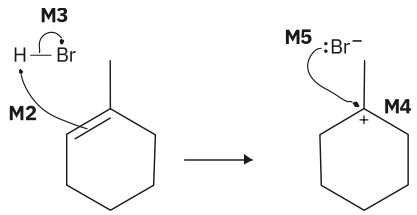
Q4 · June 2022 · AS Paper 2 · Q10 · [1 mark]

Answer: **C**

It has a higher melting point than ethene

Q5 · June 2023 · AS Paper 2 · Q4 · [10 marks]

(a) M1 electrophilic addition



M2 must show an arrow from the double bond towards the H atom of the HBr molecule

M3 must show the breaking of the H-Br bond

M4 is for the structure of the correct carbocation (the added H does not need to be shown)

M5 must show an arrow from the lone pair of electrons on the negatively charged Br towards the positively charged atom of their carbocation drawn

All arrows are double-headed. Penalise one mark from the total if half headed arrows are used

Do not penalise the "correct" use of "sticks"

Penalise only once in mechanism for a line and two dots to show a bond

Mechanism can involve skeletal or structural formulae. If skeletal, do not penalise presence of hydrogen atoms (and bonds)

Max 3 of 4 marks (M2-5) for wrong organic reactant or wrong carbocation (ignore structure of product)

Ignore partial negative charges on the double bond in M2

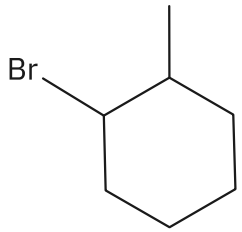
Penalise incorrect partial charges on the H–Br bond or formal charges in M3

Penalise M4 if there is a bond drawn to the positive charge

For M5, credit attack on a partially positively charged carbocation structure, but penalise M4 for the structure of the carbocation.

[5 marks]

(b) M1



M1 Penalise inclusion of —H bonds

(allow carbonium ion in place of carbocation)

M2 idea that 1-bromo-1-methylcyclohexane is formed from/via or has more stable carbocation

M2 and M3 must refer to stability of carbocations (ignore reference to stability of products)

M3 idea that major product from tertiary carbocation rather than secondary carbocation

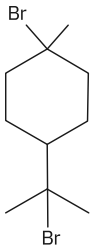
M3 allow descriptions in terms of number of alkyl groups attached to positive C atom

M4 idea of stability from greater (positive) inductive effect (from more alkyl/C groups) or more electron-releasing alkyl/C groups

M4 must be a comparison

[4 marks]

(c)



Any correct form of the structure

[1 mark]

Q6 · June 2023 · AS Paper 2 · Q9 · [1 mark]

Answer: **D**

methylpropene

Q7 · June 2024 · AS Paper 2 · Q4 · [14 marks]

(a)

This question is marked using levels of response.

Level 3 5-6	**All stages are covered and each stage is generally correct and virtually complete. (6 v 5) Answer is well structured, with no repetition or irrelevant points, and covers all aspects of the question. Accurate and clear expression of ideas with no errors in use of technical terms.**
Level 2 3-4	**All stages are covered but stage(s) may be incomplete or may contain inaccuracies OR two stages are covered and are generally correct and virtually complete**. (4 v 3) Answer has some structure and covers most aspects of the question. Ideas are expressed with reasonable clarity with, perhaps, some repetition or some irrelevant points. If any, only minor errors in use of technical terms.
Level 1 1-2	**Two stages are covered but stage(s) may be incomplete or may contain inaccuracies OR only one stage is covered but is generally correct and virtually complete**. (2 v 1) Answer includes statements which are presented in a logical order and / or linked.
Level 0 0	Insufficient correct chemistry to gain a mark.

Stage 1 - What stereoisomers are (1 'covered' or 'virtually complete')

1a same structure/structural formula

1b different arrangement of atoms/bonds in space

Stage 2 - E-Z isomerism occurs (1 'covered ', 2 'virtually complete')

2a lack of rotation around C=C

2b each C atom of C=C has (two) different groups attached

2c this is E

Stage 3 - Justify E/Z (2 'covered", 3 'virtually complete')

3a indicates in some way that CH_3CH_2 is higher priority than H on RHS C

3b as atomic number of C is higher than H or C = 6 v H = 1

3c indicates in some way that $(CH_3)_2CH$ is higher priority than CH_3CH_2 on LHS C

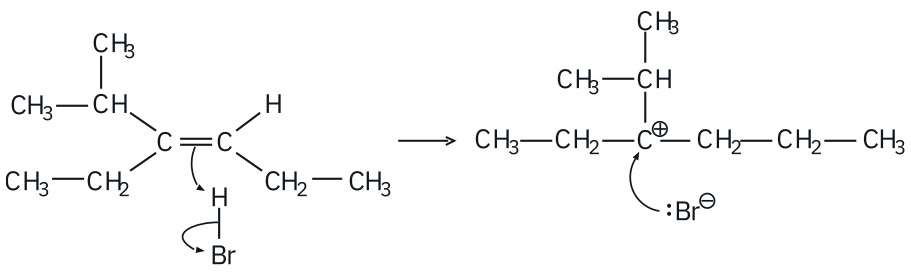
3d as atomic numbers of atoms joined to C (joined to C=C) are higher for $(CH_3)_2CH$ than CH_3CH_2 or 6,6,1 v 6,1,1

3e highest priority groups on opposite sides (of C=C)

[6 marks]

(b) M1 Electrophilic addition

M2-5



M2 Arrow from C=C bond towards H of HBr

M3 Breaking of H-Br bond

M4 Correct carbocation

M5 Arrow from lone pair of Br^- to positively charged C of their carbocation

All arrows are double-headed. Penalise one mark from the total for 2-5 if half headed arrows are used. Do not penalise the "correct" use of "sticks"

Penalise only once in any part of the mechanism for a line and two dots to show a bond

M2 Ignore partial negative charges on the double bond

M3 Penalise incorrect partial charges on the H–Br bond and penalise formal charges

Penalise M4 if there is a bond drawn to the positive charge

***Max 3 of 4 marks (M2-5)** for wrong organic reactant or wrong carbocation (ignore structure of product); for example, correct mechanism for compound L would score 3/4 for M2-5)*

For M5, credit attack on a partially positively charged carbocation structure, but penalise M4 for the structure of the carbocation

[5 marks]

(c) M1 Idea that K is formed from/via/has/by the more stable carbocation (intermediate)

M1 and M2 must refer to stability of carbocations (ignore reference to stability of products). M1 and M2 are penalised if answer suggests that the products are carbocation.

M2 Idea that major product from tertiary carbocation rather than secondary carbocation

M2 Allow descriptions in terms of number of alkyl groups attached to positive C atom

M3 Idea of stability from greater (positive) inductive effect (from more alkyl/C groups) or more electron-releasing alkyl/C groups

M3 Must be a comparison; could refer to 3 v 2 electron-releasing alkyl/R/C groups (but allow ECF from M2 for number of alkyl groups)

[3 marks]

Q8 · June 2024 · AS Paper 2 · Q15 · [1 mark]

Answer: **A**

Q9 · June 2025 · Paper 2 · Q2 · [7 marks]

02.1

M1 Z-3-methylpent-2-ene

M2 cannot rotate about C=C / double bond

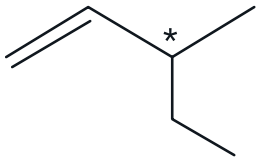
M3 (Two) different groups attached to each C in C=C / double bond

M2 allow restricted/limited rotation

[3 marks]

02.2

M1 CH_2=CHCH(CH_3)CH_2CH_3 OR other valid structural representation eg



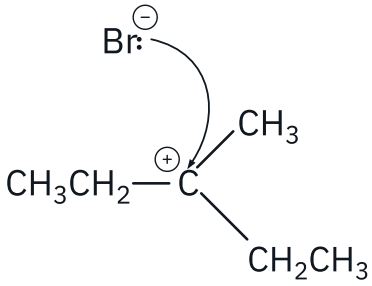
M2 It has a chiral centre or asymmetric carbon or a C with four different groups attached (need not be shown in structure)

M2 allow: can form two non-superimposable

mirror images

[2 marks]

02.3



M1 Structure of tertiary carbocation

M2 Curly arrow from lone pair on $Br:^-$ to C^+

[2 marks]

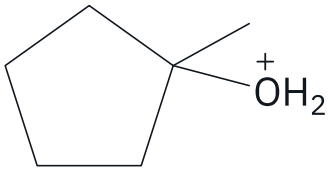
Q10 · June 2025 · Paper 3 · Q13 · [1 mark]

Answer: **D**

Propene

Q11 · June 2025 · Paper 3 · Q36 · [1 mark]

Answer: **A**



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