

M1.B

[1]

M2. (a) Pentan-2-one

ONLY but ignore absence of hyphens

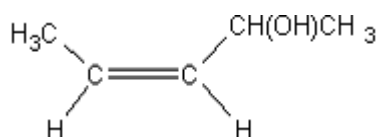
1

(b) Functional group (isomerism)

Both words needed

1

(c) (i)



Award credit provided it is obvious that the candidate is drawing the Z / cis isomer

The group needs to be CHOHCH₃ but do not penalise poor C–C bonds or absence of brackets around OH

Trigonal planar structure not essential

1

(ii) Restricted rotation (about the C=C)

OR

No (free) rotation (about the C=C)

1

(d)

<p>M1 Tollens' (reagent)</p> <p><i>(Credit ammoniacal silver nitrate OR a description of making Tollens')</i></p> <p><i>(Do not credit Ag⁺, AgNO₃ or [Ag(NH₃)₂]⁺ or "the silver mirror test")</i></p>	<p>M1 Fehling's (solution) / Benedict's</p> <p><i>(Penalise Cu²⁺(aq) or CuSO₄ but mark M2 and M3)</i></p>
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<i>on their own, but mark M2 and M3)</i>	
M2 <u>silver mirror</u> OR <u>black solid or black precipitate</u>	M2 <u>Red solid/precipitate</u> (Credit <u>orange</u> or <u>brown solid</u>)
M3 (stays) colourless OR no (observed) change / no reaction	M3 (stays) blue OR no (observed) change / no reaction

If M1 is blank CE = 0, for the clip

Check the partial reagents listed and if M1 has a totally incorrect reagent, CE = 0 for the clip

Allow the following alternatives

M1 (acidified) potassium dichromate(VI) (solution); mark on from incomplete formulae or incorrect oxidation state

M2 (turns) green

M3 (stays) orange / no (observed) change / no reaction

OR

M1 (acidified) potassium manganate(VII) (solution); mark on from incomplete formulae or incorrect oxidation state

M2 (turns) colourless

M3 (stays) purple / no (observed) change / no reaction

In all cases for M3

Ignore “nothing (happens)”

Ignore “no observation”

3

(e) (i) **Spectrum is for Isomer 1**

or named or correctly identified

The explanation marks in (e)(ii) depend on correctly identifying Isomer 1.

The identification should be unambiguous but candidates should not be penalised for an imperfect or incomplete name. They may say “the alcohol” or the “alkene” or the “E isomer”

1

(ii) **If Isomer 1 is correctly identified, award any two from**

- (Strong / broad) absorption / peak in the range

3230 to 3550 cm⁻¹ or specified value in this range

or **marked correctly** on spectrum

and

(characteristic absorption / peak for) OH group / **alcohol** group

- No absorption / peak in range **1680 to 1750** cm⁻¹ or absence **marked correctly** on spectrum
and
(No absorption / peak for a) **C=O** group / **carbonyl** group / **carbon-oxygen double bond**

- Absorption / peak in the range **1620 to 1680** cm⁻¹ or specified value in this range or marked correctly on spectrum
and

(characteristic absorption / peak for) **C=C** group
/ **alkene** / **carbon-carbon double bond**

If 6(e)(i) is incorrect or blank, CE=0

Allow the words “dip” OR “spike” OR “trough” OR “low transmittance” as alternatives for absorption.

Ignore reference to other absorptions e.g. C-H, C-O

2

[10]

M3. (a) Ca(OH)₂ OR Mg(OH)₂

Ignore name

Could be ionic

1

(b) NaF or sodium fluoride

OR

NaCl or sodium chloride

Either formula or name can score

Do not penalise the spelling “fluoride”

When both formula and name are written,

- *penalise contradictions*
- *if the attempt at the correct **formula** is incorrect, ignore it and credit **correct name** for the mark unless contradictory*

- if the attempt at the correct name is incorrect, ignore it and credit **correct formula** for the mark unless contradictory

1

(c) NaClO OR NaOCl

Ignore name (even when incorrect)

The correct formula must be clearly identified if an equation is written

1

(d) Br₂ (ONLY)

Only the correct formula scores;

penalise lower case "b", penalise upper case "R", penalise superscript

Ignore name

The correct formula must be clearly identified if an equation is written

1

(e) M1 S OR S₈ OR S₂

M2 I₂ (ONLY)

Ignore names

penalise lower case "i" for iodine,

penalise superscripted numbers

Mark independently

The correct formula must be clearly identified in each case if an equation is written

2

(f) (i) CH₃CH₂CH=CH₂

Structure of but-1-ene. Ignore name

Credit "sticks" for C-H bonds

1

(ii) CH₃CH₂CH₂CH₂OH

Structure of butan-1-ol. Ignore name

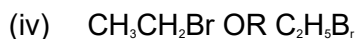
Credit "sticks" for C-H bonds

1



Structure of propane. Ignore name
Ignore calculations and molecular formula
Credit "sticks" for C-H bonds
Ignore the molecular ion

1



Structure of bromoethane.
Ignore name and structure of nitrile
Credit "sticks" for C-H bonds

1

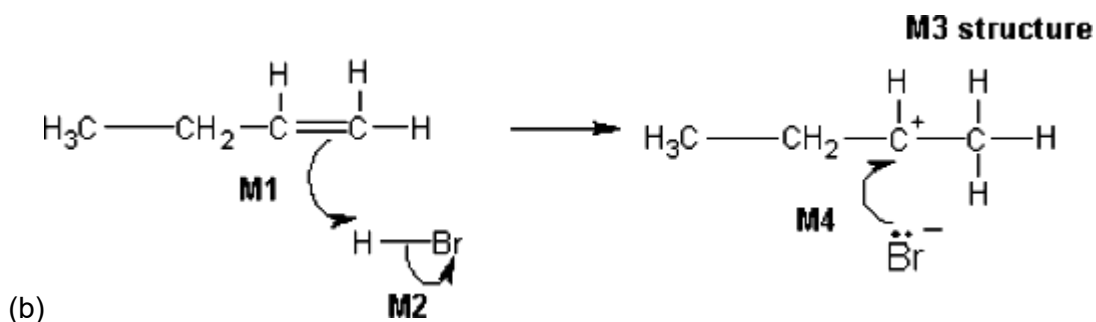
[10]

M4.C

[1]

M5.(a) Position(al) (isomerism)

1



Penalise one mark from their total if half-headed arrows are used

M1 must show an arrow from the double bond towards the H atom of the H-Br molecule

M1 Ignore partial negative charge on the double bond.

M2 must show the breaking of the H–Br bond.

M2 Penalise partial charges on H–Br bond if wrong way and penalise formal charges

M3 is for the structure of the secondary carbocation.

Penalise M3 if there is a bond drawn to the positive charge

M4 must show an arrow from the lone pair of electrons on the negatively charged bromide ion towards the positively charged carbon atom of either a primary or secondary carbocation.

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

Maximum any 3 of 4 marks for wrong reactant or primary carbocation.

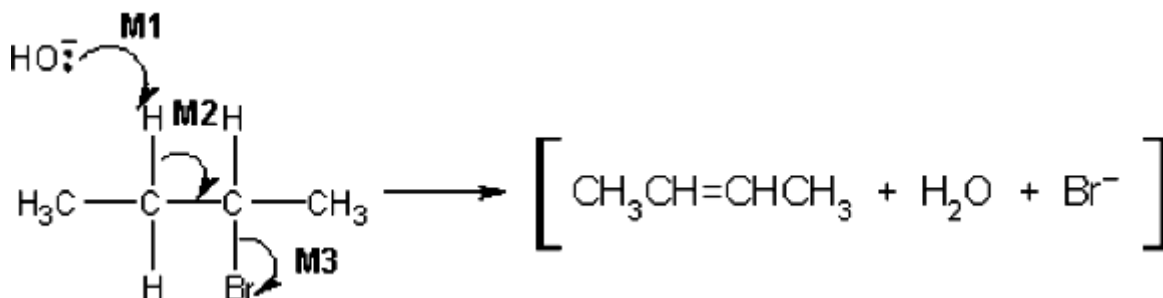
If Br₂ is used, maximum 2 marks for their mechanism

Do not penalise the use of “sticks”

NB The arrows here are double-headed

4

(c)



Penalise one mark from their total if half-headed arrows are used

M1 must show an arrow from the lone pair on oxygen of a negatively charged hydroxide ion to a correct H atom

Penalise M1 if covalent KOH

M2 must show an arrow from a C–H bond adjacent to the C–Br bond towards the appropriate C–C bond. Only award if an arrow is shown attacking the H atom of an adjacent C–H (in M1)

M3 is independent provided it is from their original molecule.

Penalise M3 for formal charge on C of the C–Br or incorrect partial charges on C–Br

Penalise M3 if an extra arrow is drawn from the Br of the C–Br bond to, for example, K⁺

Ignore other partial charges

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

Maximum any 2 of 3 marks for wrong reactant or wrong product(if shown) or a mechanism that leads to but-1-ene

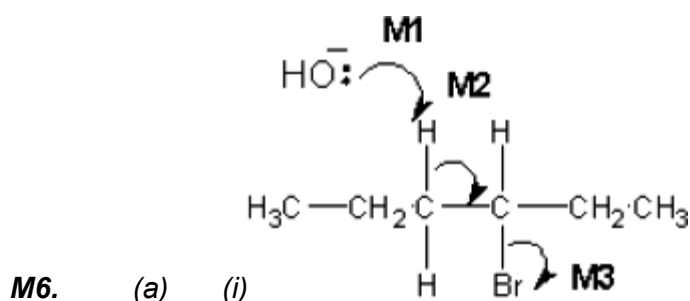
Accept the correct use of "sticks" for the molecule except for the C–H being attacked

Award full marks for an E1 mechanism in which M2 is on the correct carbocation.

NB The arrows here are double-headed

3

[8]



Penalise one mark from their total if half-headed arrows are used

Penalise **M3** for formal charge on C of the C-Br or incorrect partial charges on C-Br

Ignore other partial charges

M1 must show an arrow from the lone pair on oxygen of a negatively charged hydroxide ion to the correct H atom

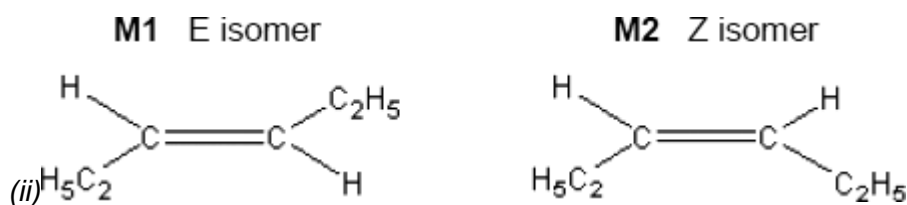
Penalise once only in any part of the mechanism for a line and two dots to show a bond.

M2 must show an arrow from the correct C–H bond to the correct C–C bond. Only award if an arrow is shown attacking the H atom of the correct C–H bond in **M1**

M3 is independent but **CE=0** if nucleophilic substitution

N.B these are double-headed arrows

3



Award 1 mark if both correct stereoisomers but in the wrong places

Accept no other alkenes.

Be reasonably lenient on the bonds to ethyl (or to CH_2CH_3) since the question is about E and Z positions but penalise once only if connection is clearly to the CH_3 of CH_2CH_3

Accept linear structures

2

(iii) **M1** (Compounds / molecules with) the same structural formula
Penalise **M1** if “same structure”

M2 with atoms/bonds/groups arranged differently in space
Ignore references to “same molecular formula” or “same empirical formula” or any reference to “displayed formula”

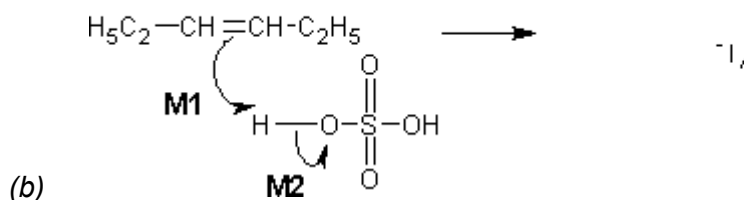
OR

atoms/bonds/groups that have different spatial arrangements / different orientation.

Mark independently

2

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M1 must show an arrow from the double bond towards the H atom of the H – O bond
OR HO on a compound with molecular formula for H_2SO_4

M1 could be to an H^+ ion and **M2** an independent O – H bond break on a compound with molecular formula for H_2SO_4

M1 Ignore partial negative charge on the double bond.

M2 must show the breaking of the O – H bond.

M2 Penalise partial charges on O – H bond if wrong way and penalise formal charges

In **M2** do not penalise incorrect structures for H_2SO_4

M3 is for the structure of the carbocation.

M4 must show an arrow from the lone pair of electrons on the correct oxygen of the negatively charged ion towards a correct (positively charged) carbon atom.

M4 NOT HSO_4^-

For **M4**, credit as shown or $^-\text{OSO}_3\text{H}$ ONLY with the negative

charge anywhere on this ion

OR correctly drawn out with the negative charge placed correctly on oxygen

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

NB The arrows here are double-headed

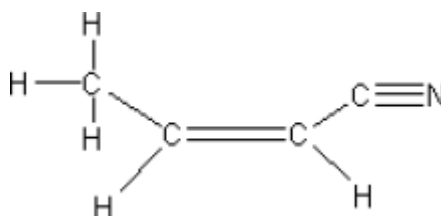
Max 3 of any 4 marks for wrong organic reactant or wrong organic product (if shown)

Accept the correct use of "sticks"

4

[11]

- M7.(a)** (i) Structure of (Z)-but-2-enitrile with or without either or both of the CH₃ and the CN groups displayed



Penalise C-NC

Do not penalise C-H₃C

Ignore bond angles.

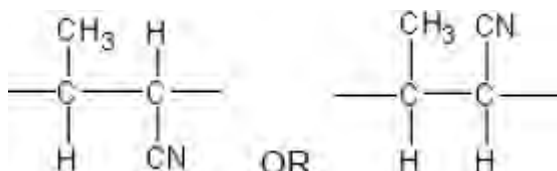
1

- (ii) Restricted rotation / no (free) rotation about the double bond / about the C=C **OR** does not rotate (about the double bond)

Must use the word rotate / rotation.

1

- (b) Repeating unit of polyalkene



All the bonds relevant to the unit must be drawn out including those on either side of the unit. There is no need to expand either the CH₃ or the CN

Penalise C–NC
Penalise “sticks”.
Ignore brackets.
Penalise “n”

1

(c) **Feature 1**

Absorption / peak in the range **2220 to 2260** cm^{-1} or specified value in this range or marked correctly on spectrum

and

(characteristic absorption / peak for) **C≡N** / **CN** group / **nitrile** / **cyanide** group

Allow the words “dip” **OR** “spike” **OR** “trough” **OR** “low transmittance” as alternatives for absorption.

Allow a peak at 2200 cm^{-1} to 2220 cm^{-1} **in this case**.

Feature 2

Absorption / peak in the range **1620 to 1680** cm^{-1} or specified value in this range or marked correctly on spectrum

and

(characteristic absorption / peak for) **C=C** group / **alkene** / **carbon-carbon double bond**

Ignore reference to other absorptions eg C-H

Either order.

2

[5]