

M4 must show an arrow from the lone pair of electrons on the oxygen atom of the negatively charged hydroxide ion to the C atom.

Penalise M4 if covalent NaOH / KOH is used

Penalise one mark from M4 or M5 if half-headed arrows are used

M5 must show the movement of a pair of electrons from the

C— Br bond to the Br atom. Mark M5 independently provided it is from their original molecule.

Penalise M5 for formal charge on C of the C—Br or incorrect partial charges on C—Br

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

For M4 and M5, award full marks for an S_N1 mechanism

For M4 and M5, maximum 1 of 2 marks if wrong reactant is used.

Penalise M5 if an extra arrow is drawn from the Br of the C—Br bond to, for example, K⁺

Do not penalise the use of “sticks”

M6 One statement from

- The yield is (very) low / not a high yield OR elimination occurs / ethene formed
- The rate of reaction slow
- Bromoethane has to be manufactured / made first
- Bromoethane is expensive

For M6 ignore references to other costs and expenses

6

(c) **M1** concentrated phosphoric acid / conc. H₃PO₄ **OR** concentrated sulfuric acid / conc. H₂SO₄

Answers in any order

Ignore reference to support medium in M1

M2 hydration or (electrophilic) addition

For M3 and M4 any two from

Do not apply the list principle to these three chosen criteria in M3 and M4

- Excess ethene

OR Excess steam / water / H₂O

OR remove the ethanol as it forms

OR recycle the ethene

- Specified Pressure

50 atm ≤ P ≤ 100 atm

OR 5000 kPa ≤ P ≤ 10000 kPa

OR 5 MPa ≤ P ≤ 10 MPa

- High Temperature unless they give a value that is not in the ranges given here;

OR $300\text{ }^{\circ}\text{C} \leq T \leq 600\text{ }^{\circ}\text{C}$

OR $570\text{ K} \leq T \leq 870\text{ K}$

Accept a reference to “low temperature” if they specify a correct temperature range or a correct temperature in the range

4

[15]

Q2.

(a) Pentan-2-one

ONLY but ignore absence of hyphens

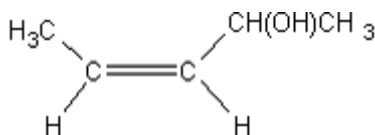
1

(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 CHOHCH_3 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)

M1 Tollens' (reagent) (Credit ammoniacal silver nitrate OR a description of making Tollens') (Do not credit Ag^+, AgNO_3 or [$\text{Ag}(\text{NH}_3)_2^+$] or "the silver mirror test" on their own, but mark M2 and M3)	M1 Fehling's (solution) / Benedict's (Penalise $\text{Cu}^{2+}(\text{aq})$ or CuSO_4 but mark M2 and M3)
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”

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(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”

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(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]