

Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Mark Schemes

Q1.

- (a) (i) **M1** (Compounds / molecules with) the same structural formula
*Penalise **M1** if 'same structure' or 'different structural / displayed formula'.*

M2 with atoms / bonds / groups arranged differently in space

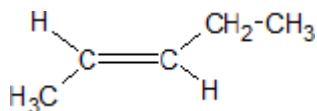
OR atoms / bonds / groups with different spatial arrangements / different orientation

Ignore references to 'same molecular formula' or 'same empirical formula'.

Mark independently.

2

(ii)



Credit C-H₃C

Credit C₂H₅

Penalise C-CH₃CH₂

1

- (b) **M1** Br₂ OR bromine (water) OR bromine (in CCl₄ / organic solvent)
*If **M1**, has no reagent or an incorrect reagent, **CE=0**.*
Ignore 'acidified'.

M2 Isomer 1: decolourised / goes colourless / loses its colour

*For **M1** penalise Br (or incorrect formula of other correct reagent), but mark on.*

M3 Isomer 2: remains orange / red / yellow / brown / the same **OR** no reaction / no (observable) change **OR** reference to colour going to the cyclopentane layer

*For **M1**, it must be a whole reagent and / or correct formula.*

*If oxidation state given in name, it must be correct. If 'manganate' OR 'manganate(IV)' or incorrect formula, penalise **M1**, but mark on.*

Alternatives : potassium manganate(VII)

M1 KMnO₄ in acid **M2** colourless **M3** purple

M1 KMnO₄ in alkali / neutral **M2** brown solid **M3** purple

Credit for the use of **iodine**

M1 iodine (solution / in KI) **M2** colourless **M3** (brown) to purple (credit no change)

Credit for the use of **concentrated** H_2SO_4

M1 concentrated H_2SO_4 **M2** brown **M3** no change / colourless

Ignore 'goes clear'.

Ignore 'nothing (happens)'.

Ignore 'no observation'.

No credit for combustion observations.

3

- (c) (i) (Both infrared spectra show an absorption in range) **1620 to 1680** (cm^{-1})

Ignore reference to other ranges (eg for C–H or C–C).

1

- (ii) The fingerprint (region) / below 1500 cm^{-1} will be different **or** its fingerprinting will be different

OR

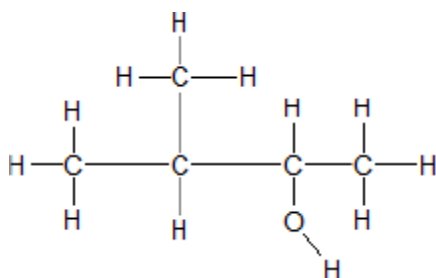
different absorptions / peaks are seen (in the region) below 1500 cm^{-1} (or a specified region within the fingerprint range)

*Allow the words 'dip' **OR** 'spike' **OR** 'low transmittance' as alternatives for absorption.*

QoL

1

- (d)



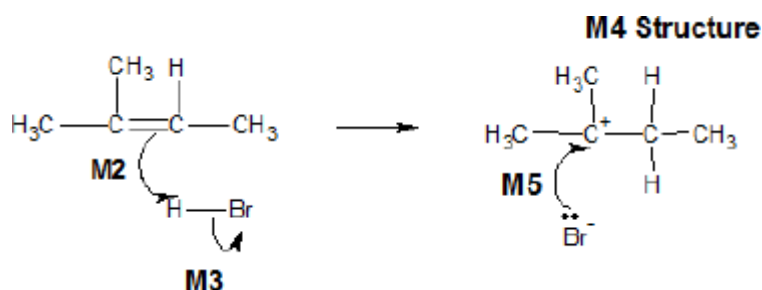
All bonds must be drawn.

Ignore bond angles.

1

- (e) (i) **M1 Electrophilic addition**

M1 both words needed.



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

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

M2 Ignore partial negative charge on the double bond.

M3 must show the breaking of the H–Br bond

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

M4 is for the structure of the tertiary carbocation

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

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

M5 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 secondary or a tertiary carbocation

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

Max 3 of any 4 marks in the mechanism for wrong organic reactant or wrong organic product (if shown) or secondary carbocation.

Max 2 of any 4 marks in the mechanism for use of bromine.

Do not penalise the correct use of 'sticks'.

NB The arrows here are double-headed

5

(ii) **M1** Reaction goes via intermediate carbocations / carbonium ions

M1 is a lower demand mark for knowledge that carbocations are involved.

M2 (scores both marks and depends on M1)

Tertiary carbocation / carbonium ion is more stable (than the secondary carbocation / carbonium ion)

OR

Secondary carbocation / carbonium ion is less stable (than the tertiary carbocation / carbonium ion)

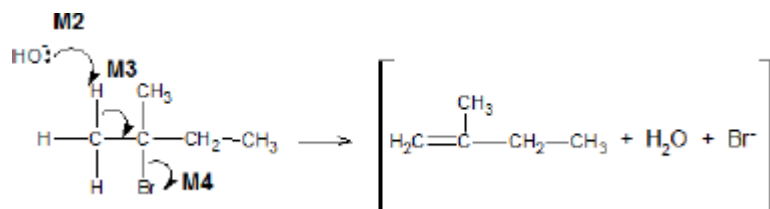
M2 is of higher demand and requires the idea that the secondary carbocation is less stable or the tertiary carbocation is more stable. Reference to incorrect chemistry is penalised.

A carbocation may be defined in terms of alkyl groups / number of carbon atoms, rather than formally stated.

2

(f) **M1 Elimination**

M1 credit 'base elimination' but no other qualifying prefix.



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

M2 must show an arrow from the lone pair on oxygen of a negatively charged hydroxide ion to a correct H atom

Penalise **M2** if covalent KOH

M3 must show an arrow from a correct C–H bond adjacent to the C–Br bond to a correct C–C bond. Only award if an arrow is shown attacking the H atom of a correct adjacent C–H bond (in **M2**)

M4 is independent provided it is from their original molecule **BUT** penalise **M2**, **M3** and **M4** if nucleophilic substitution shown

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

NB The arrows here are double-headed

*Penalise **M4** for formal charge on C or Br of the C–Br bond or incorrect partial charges on C–Br.*

*Penalise **M4** if an additional 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.*

***Max 2 of any 3 marks in the mechanism** for wrong reactant or wrong organic product (if shown) or a correct mechanism that leads to the alkene 2-methylbut-2-ene.*

Credit the correct use of “sticks” for the molecule except for the C–H being attacked.

M5 hydroxide ion behaves as a base / proton acceptor / electron pair donor / lone pair donor

*Penalise **M5** if ‘nucleophile’.*