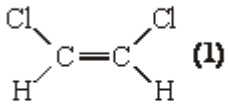
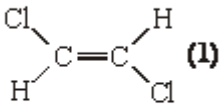
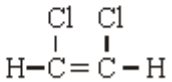
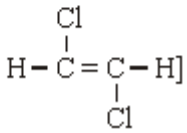
M1. (a) (i)

Isomer 1 either order *Isomer 2*


(1)

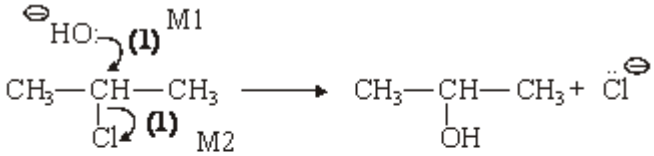

(1)

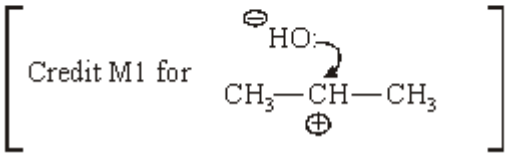
[credit  and ]

(ii) restricted <u>rotation</u> OR no <u>rotation</u> OR cannot <u>rotate</u> **(1)**

3

(b) (i) *Mechanism*:



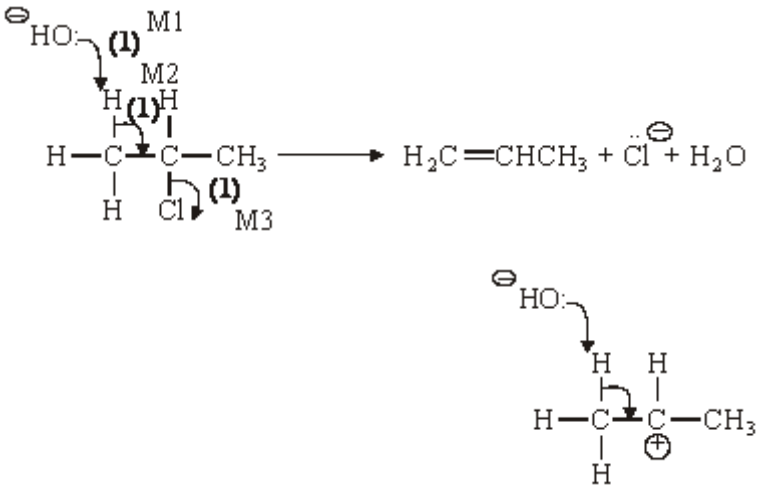


M1 and M2 independent
Curly arrows <u>must</u> be from a bond or a lone pair
Do not penalise sticks
Penalise M1 if  *precedes (penalise this once)*
Penalise incorrect δ+ δ– for M2
Penalise + on C atom for M2
Only allow M1 for incorrect haloalkane

Role of the hydroxide ion: nucleophile **(1)**
electron pair donor
lone pair donor

NOT nucleophilic substitution

(ii) *Mechanism*:



Only allow M1 and M2 for incorrect haloalkane unless RE on (i)

+ charge on H on molecule, penalise M1

M3 independent

M2 must be to correct C–C

M1 must be correct H atom

Credit M1 and M2 via carbocation mechanism

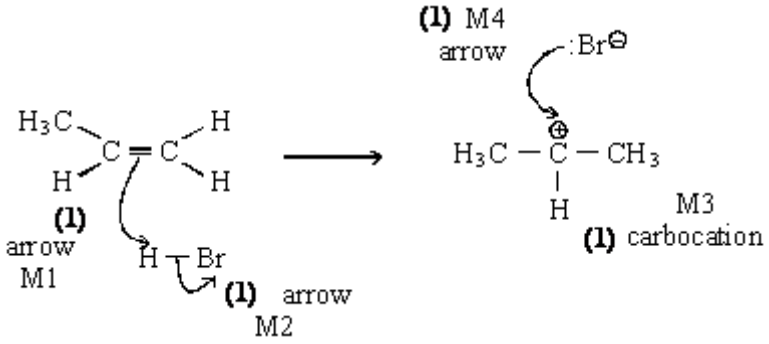
No marks after any attack of C ⊕ by OH⁻

Role of the hydroxide ion: base **(1)**
proton acceptor
accepts H^+

7

[10]

M2. (a) (i)



If wrong carbocation, lose structure mark
If wrong alkene, lose structure mark
Can still score ¾ i.e. penalise M3
Penalise M2 if polarity included incorrectly
no bond between H and Br
bond is shown as *or*

(ii) $CH_3CH_2\overset{\oplus}{C}H_2$ **(1)**

credit secondary carbocation here if primary carbocation has been used in (i)

Ignore attack on this carbocation by $\ddot{B}r^{\ominus}$

5

(b) (i) *Structure*:

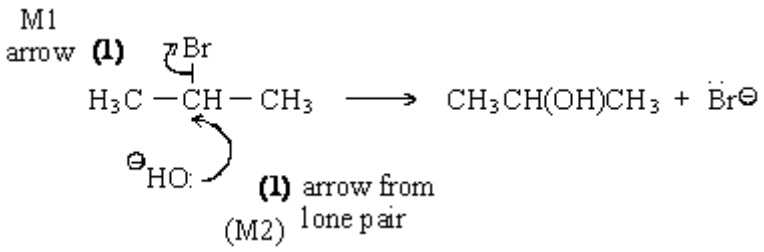
$H_3C-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$ **(1)** [insist on C — OH bond]

No credit for propan-1-ol even when named correctly
Credit propane-2-ol

Name: propan-2-ol **(1)**
Not 2-hydroxypropane

(ii) *Name of mechanism*: nucleophilic substitution **(1) (both words) (NOT S_N1 or S_N2)**

Mechanism:



penalise incorrect polarity on C - Br (M1)
Credit <u>the arrows</u> even if incorrect haloalkane
If S_N1, <u>both marks</u> possible

i.e. M1 C — Br M2 ⊖HO correct carbocation

5

(c) (i) elimination **(1)**
Ignore nucleophylic elimination
Penalise electrophilic elimination

(ii) base **(1)**
OR proton acceptor
NOT nucleophile (base)

2

[12]

M3. C

[1]

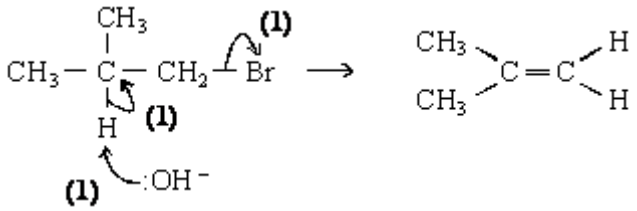
M4. (a) Identity of **X**; 2-methylpropene **(1)**
Absorption at 1650 cm^{-1} indicates an alkene present **(1)**
OR a chemical answer e.g. Br_2 (aq) brown to colourless

2

(b) Reagents
Step 1 KOH (allow NaOH) **(1)** alcoholic **(1)** warm **(1)**
Only allow solvent and warm if reagent correct

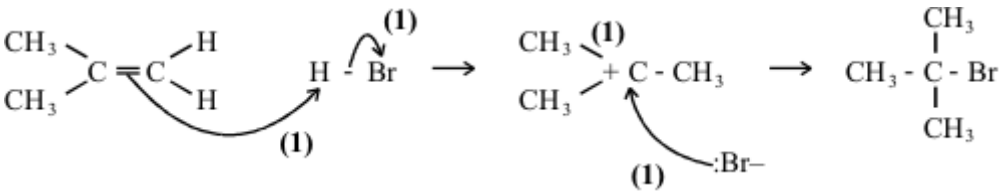
Step 2 HBr **(1)**

Mechanism: A → **X**



Or a carbocation mechanism

Mechanism **X** → B



11

(c) A gives three peaks **(1)**
B gives one peak **(1)**

Allow one for "A has more peaks than B" when no number of peaks is given

2

[15]