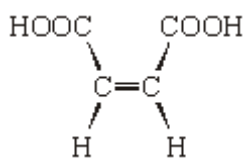
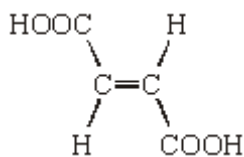


M1. (a)



1



1

NB The bonds shown in the structure must be correct

Isomerism: E-Z isomerism

If written answer is correct, ignore incorrect labelling of structures.

If no written answer, allow correctly labelled structures.

1

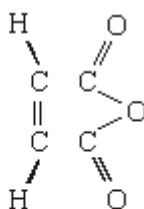
Both COOH groups must be on the same side/ close together/ cis

1

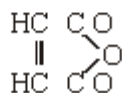
No rotation about C=C axis

1

Structure

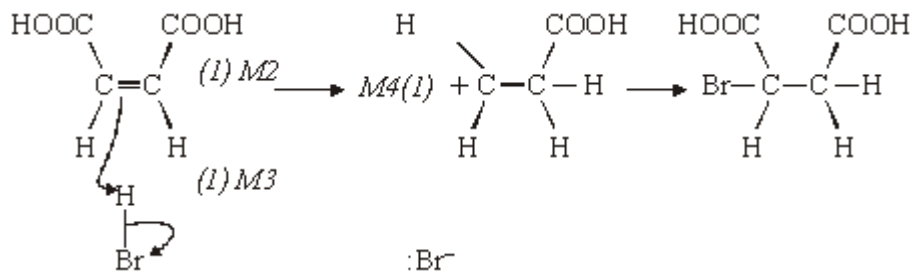


Allow



1

(b) Br<sub>2</sub> / HBr / H<sub>2</sub>SO<sub>4</sub> / H<sup>+</sup> / Br<sup>+</sup> / NO<sub>2</sub><sup>+</sup> (Mark M1)



*NB If electrophile  $\text{H}^+$  /  $\text{Br}^-$  /  $\text{NO}_2^+$  allow M1, M2 and M4  
 If the acid is incorrect, M2 and M3 can still be scored  
 Allow M4 consequentially if repeat error from part (a)*

4

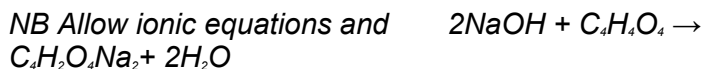


Both H replaced

1

Balanced for atoms and charges

1



*Allow one if structure incorrect but molecular formula correct*

*Allow one for a correct equation showing one H replaced*

(d) M1 Two peaks

1

M2 No splitting or singlets

1

M3 (Two) non-equivalent protons or two proton environments

1

M4 No adjacent protons

1

M5 Same area under the two peaks or same relative intensity

1

*NB Doublet could score M1 and M3 or M5 (Max 2)*

*More than two peaks CE = 0*

*Apply the "list principle" to incorrect answers if more than 3 given*

Max 3

[15]

M2.C

[1]

M3.B

[1]

M4.D

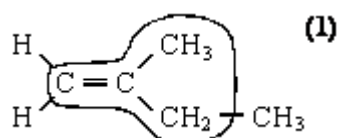
[1]

M5.D

[1]

M6.

(a)

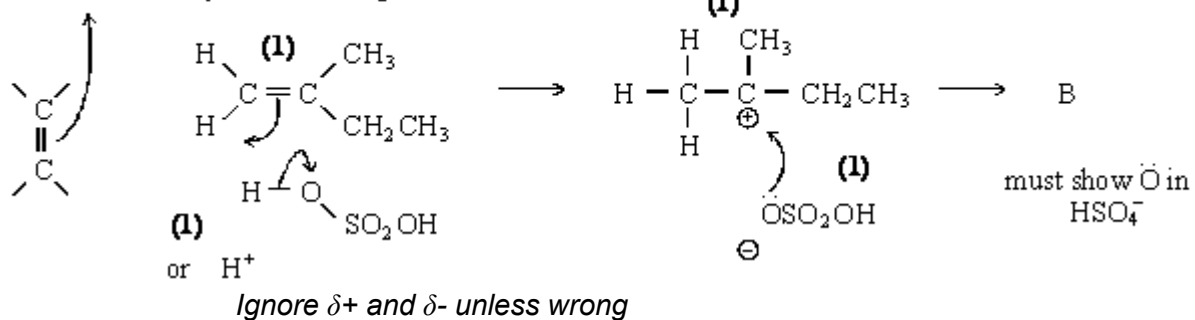


May circle 4 C's separately

1

(b)

H<sup>+</sup> can score M1 + M2  
H<sub>2</sub>SO<sub>4</sub> only M1 - see diagram not M2



(c) *Reagent:* H<sub>2</sub>O or water **OR steam, Or dilute sulphuric acid (1)**

*Condition:* heat, or warm, or boil or reflux [50-100°C] **(1)**

*Name of compound C:* 2-methylbutan-2-ol **(1)**

*Allow 2-methylbutane-2-ol*

*Penalise hydroxy-2-methylbutane and 2-methylbut-2-ol once only in the paper*

3

(d) *Identity of alcohol D:* 2-methylbutan-1-ol **(1)**,

*OR its structure, could describe structure*

*Explanation:* C formed via t-carbocation; D via p-carbocation, **(1)**  
tertiary more stable than primary **(1)**

*If have wrong carbocation can still score stability mark*

3

[11]

M7.B

[1]

**M8.** (a) *Identity of X;* 2-methylpropene **(1)**

*Absorption at 1650 cm<sup>-1</sup> indicates an alkene present (1)*

*OR a chemical answer e.g. Br<sub>2</sub> (aq) brown to colourless*

2

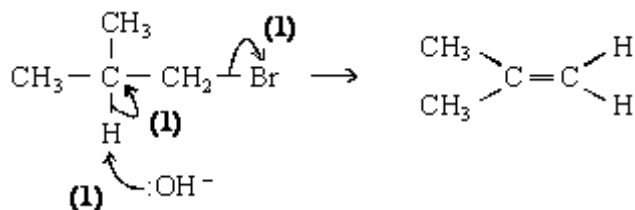
(b) *Reagents*

*Step 1 KOH (allow NaOH) (1) alcoholic (1) warm (1)*

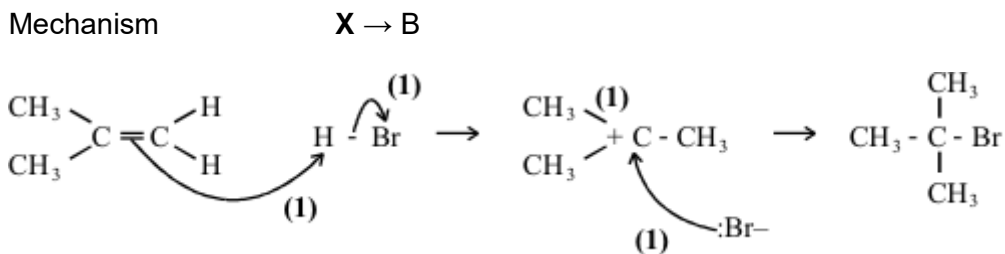
*Only allow solvent and warm if reagent correct*

*Step 2 HBr (1)*

*Mechanism: A → X*



Or a carbocation mechanism



11

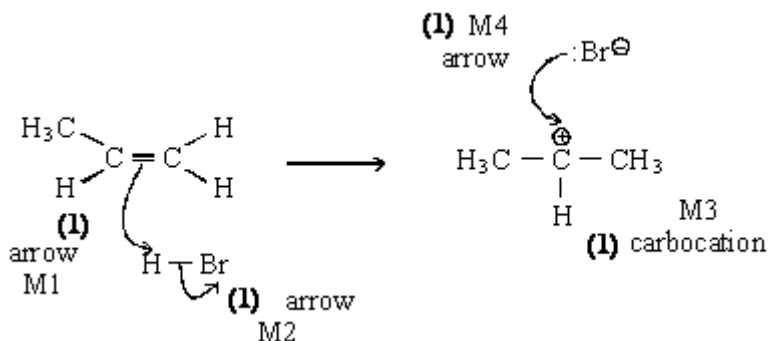
- (c) A gives three peaks (1)  
B gives one peak (1)

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

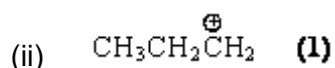
2

[15]

M9. (a) (i)



If wrong carbocation, lose structure mark  
If wrong alkene, lose structure mark  
Can still score  $\frac{3}{4}$  i.e. penalise M3  
Penalise M2 if polarity included incorrectly  
no bond between H and Br  
bond is shown as  $\overset{\ominus}{\text{Br}}-\text{H}$  or  $\text{H}-\overset{\oplus}{\text{Br}}$

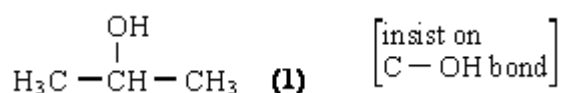


credit secondary carbocation here if primary carbocation has been used in (i)

Ignore attack on this carbocation by  $\ddot{\text{Br}}^-$

5

(b) (i) Structure:



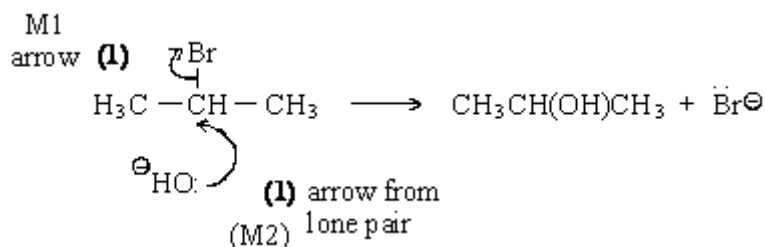
No credit for propan-1-ol even when named correctly  
Credit propane-2-ol

Name: propan-2-ol (1)

Not 2-hydroxypropane

(ii) Name of mechanism: nucleophilic substitution (1) (both words)  
(NOT  $\text{S}_{\text{N}}1$  or  $\text{S}_{\text{N}}2$ )

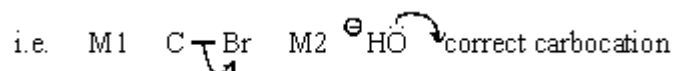
Mechanism:



penalise incorrect polarity on C-Br (M1)

Credit the arrows even if incorrect haloalkane

If  $\text{S}_{\text{N}}1$ , both marks possible



5

(c) (i) elimination (1)  
Ignore nucleophilic elimination

*Penalise electrophilic elimination*

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

2

[12]