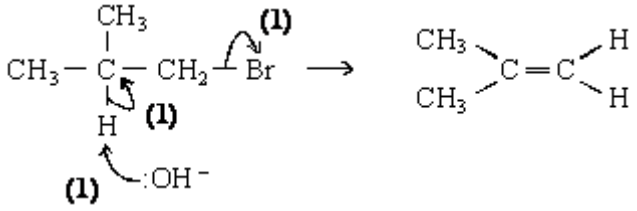
M1. (a) Identity of **X**; 2-methylpropene **(1)**
Absorption at 1650 cm^{-1} indicates an alkene present **(1)**
OR a chemical answer e.g. Br_2 (aq) brown to colourless

2

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

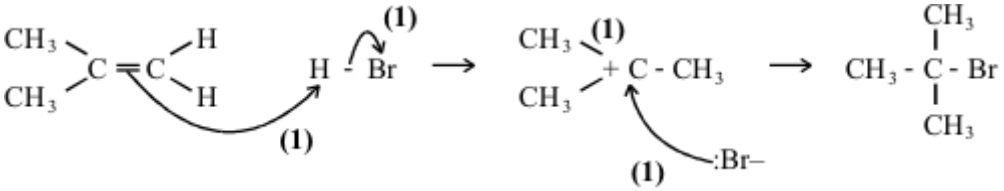
Step 2 HBr **(1)**

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]

M2. D

[1]

M3. (a) ***R***: O - H (alcohols) **(1)**
S: C=O or carbonyl **(1)**

2

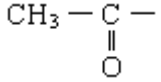
(b) aldehyde **(1)** - CHO or RCHO **(1)**

1

(c) (i) *Reason 1*: TMS inert or non-toxic or volatile / easily removed
Reason 2: single (intense) peak
peak of 12 protons
has 12 equivalent protons
all protons in same environment
OR
peak / signal upfield of others
highly shielded
more shielded
peak away from others or $\delta = 0$ or low
not solvent, not cheap
any 2 reasons × (1)

(ii) *Solvent*: $CDCl_3$ or CCl_4 **(NOT D_2O)**
Reason: proton free **(1)**
allow no hydrogens (atoms)
NOT H^+ / hydrogen ions

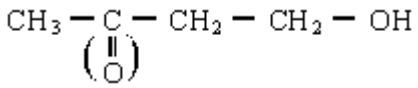
4

(d) (i)  **(1)**

(ii) –OH **(1)**

(iii) $–CH_2–CH_2–$ **(1)**

3

(e)  **(1)**

1

[11]