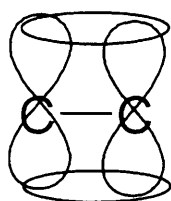


1 (a)

(i) *unsaturated* contains a double/multiple/ π bond ✓ [1]*hydrocarbon* contains hydrogen and carbon **only**. ✓ [1](ii) angle **a** $109 - 110^\circ$ ✓ [1]angle **b** $117 - 120^\circ$ ✓ [1]

(iii)

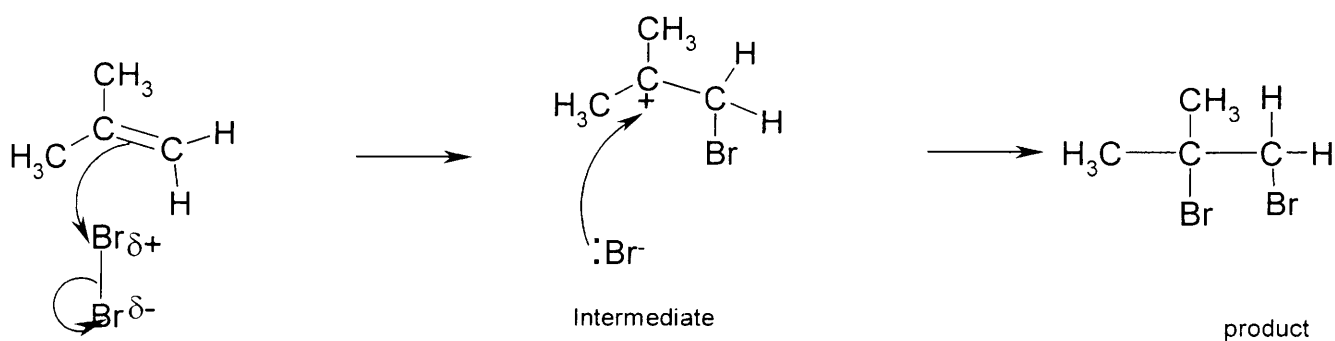
Diagram to show a minimum of 2 carbons, each with a σ -bond and p-orbitals ✓

Overlap of adjacent p-orbitals (in words or in diagram) ✓ [2]

(b)

(i) *electrophile*: lone pair (of electrons) acceptor. ✓ [1]

(ii)



essential mark intermediate carbocation/carbonium ion, accept primary/"triangular"/ ✓

essential mark product ✓

curly arrow from double bond to Br_2 ✓curly arrow showing movement of electrons in the Br-Br bond **or** the dipole in the Br-Br ✓curly arrow from lone pair of electrons in Br^- to intermediate ✓*mark any errors first*

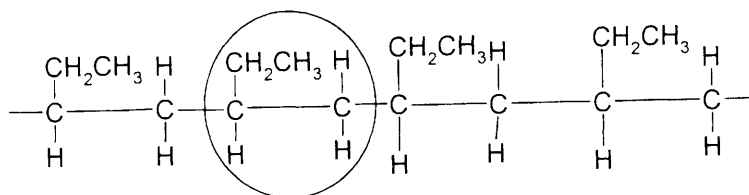
5 max = [4]

(c)

(i) Addition (not additional)

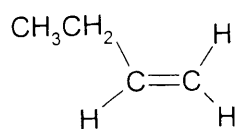
✓

(ii)



✓

(iii)



or but-1-ene

✓

(iv) Poly(but-1-ene)

✓

[Tc

2

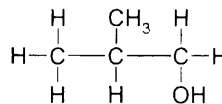
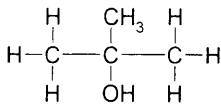
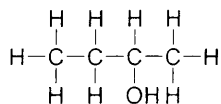
(a)

(i) bubbles/ effervescence ✓ [1]

(ii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{O}^-\text{Na}^+/\text{C}_4\text{H}_9\text{O}^-\text{Na}^+$ need **not** be shown as ionic ✓ [1]

Must clearly show that the Na is bonded to the O, penalise if the Na—O is a covalent bond

(iii)



✓✓✓ [3]

(b)

(i) orange to green/dark green/brown/black ✓ [1](ii) $\text{C}_4\text{H}_9\text{OH}/\text{C}_4\text{H}_{10}\text{O} + 2[\text{O}] \rightarrow \text{C}_3\text{H}_7\text{COOH} + \text{H}_2\text{O}$ ✓✓ [2]
1 mark available for correct formula of the carboxylic acid

(iii) Identify isomer 2-methylpropan-1-ol by appropriate number/name/formula ✓ [1]

(c)

(i) CH_2 has mass = 14, $14 \times 4 = 56$ ✓ [1] $\therefore \text{C}_4\text{H}_8$ ✓ [1](ii) $\text{C}_4\text{H}_9\text{OH} \rightarrow \text{C}_4\text{H}_8 + \text{H}_2\text{O}$ ✓ [1]

(iii) Identify butan-2-ol by appropriate number/name/formula ✓ [1]

(d)

(i) H_2SO_4 ✓ [1]

(ii) 0.06 ✓ [1]

(iii) 60% ✓ [1]

[Total : 16]

3

(a)

(i) alkene

✓ [1]

alcohol/hydroxy/hydroxyl

✓ [1]

(b)

(i) I = alkene & II = alcohol... both are needed

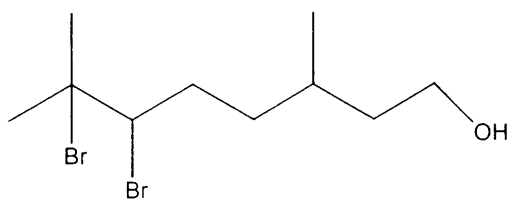
✓ [1]

(ii) decolourised / colourless

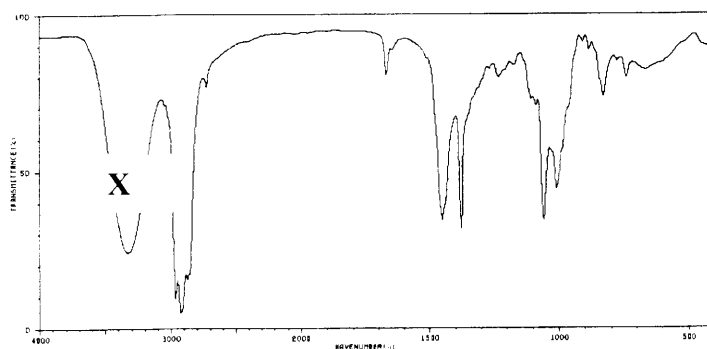
✓ [1]

(iii)

✓ [1]

(iv) **X** as shown below

✓ [1]



(c)

(i) Ni/Pt/Rh/Pd

✓ [1]

(ii) compound **B** is C₁₀H₂₂O

✓ [1]

(iii) C₁₀H₂₀O + H₂ → C₁₀H₂₂O

✓ [1]

[Total : 9]

4.

(i) sodium hydroxide/potassium hydroxide/NaOH/KOH ✓ [1]

(ii) heat to reflux ✓ [1]

(iii) water/aqueous accept NaOH(aq) ✓ [1]

(iv) ethanol/ethanolic/alcohol accept NaOH(alc) ✓ [1]

(v) (nucleophilic) substitution/hydrolysis ✓ [1]

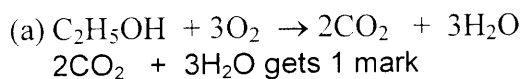
(vi) elimination ✓ [1]

(b)
$$\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{NH}_2 \\ | \quad | \\ \text{H} \quad \text{H} \end{array}$$
 ✓ [1]

(c) $\text{H}-\text{C}\equiv\text{C}-\text{H}$ ✓ [1]

[Total :8]

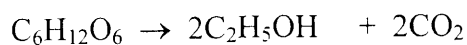
5



✓✓

(b) **Fermentation**

✓



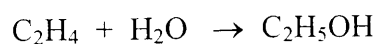
✓

Yeast /enzyme / temperature about 30 °C/ batch process

✓

Hydration of ethene.

✓



✓

Temp > 100 °C/ Press 370 –100 atm
continuous process

/ 6 –20 MPa/phosphoric acid catalyst/

✓

Glucose is obtained from plants

✓

Ethene is obtained from crude oil/cracking/fossil fuel

✓

glucose is renewable/ethene isn't

✓

1 mark available for *Quality of written communication*..... base the award of the mark on the ability to communicate the essential chemistry by correct use of at least two from:
 fermentation/hydration/catalyst/renewable/sustainable/biofuel/enzymes/finite/cracking ✓

[Total