1.

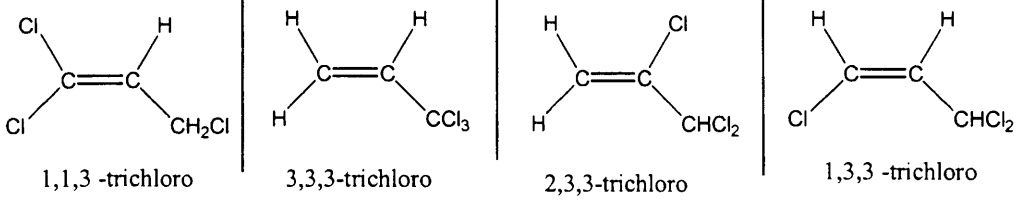
(a) (i) 24.7/12 : 2.1/1: 73.2/35.5
2.06 : 2.1 : 2.06 ✓

CHCl ✓

(ii) (CHCl = 12 + 1 + 35.5 =) 48.5 ✓

48.5 x 3 = 145.5 ✓

(b) (i) Any two from



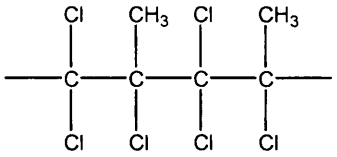
1,1,3 -trichloro 3,3,3-trichloro 2,3,3-trichloro 1,3,3 -trichloro ✓✓

(ii) 1,2,3-trichloropropene ✓✓
(trichloropropene scores 1 mark ✓)

3 marking points:
- *correct numbers 1,2,3*
- *trichloro*
- *propene/prop-1-ene*

any two gets 1 mark

(c) (i)



1 mark if backbone contains 4 carbons with 'end-bonds' and a reasonable attempt has been made e.g used the wrong isomer.... max = 1 mark ✓✓

(ii) non-biodegradable ✓

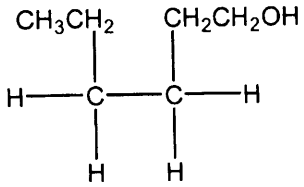
toxic fumes evolved <u>when burnt</u> ✓

HCl or Cl• or chlorinated organic compounds such as $COCl_2$ also evolved when burnt ✓

[Total: 13]

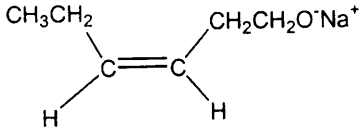
2.

(a) (i)



✓

(ii)

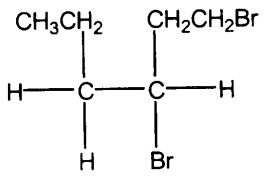


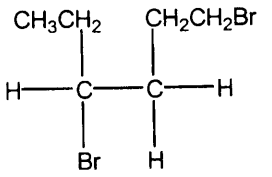
charges are not necessary

allow the alkoxide ion

✓

(iii)

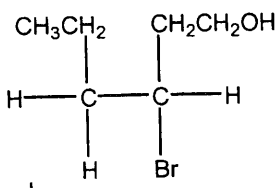


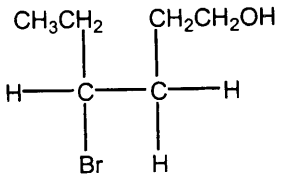


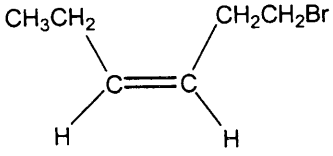
Both correct products gets 3 marks ✓✓✓

One correct product gets 2 marks

If neither of the above is correct then one mark can be awarded for any of:



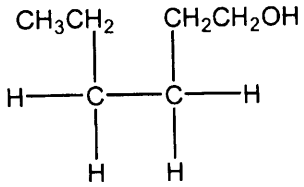




max of two marks

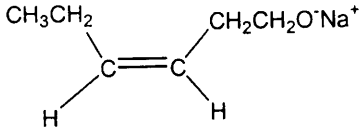
2.

(a) (i)



✓

(ii)

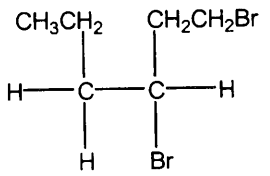


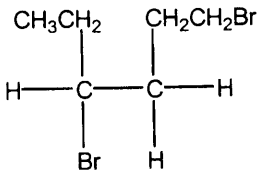
charges are not necessary

allow the alkoxide ion

✓

(iii)

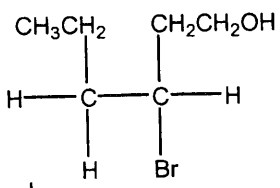


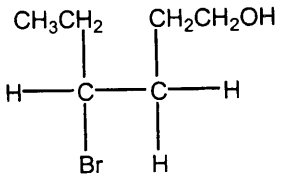


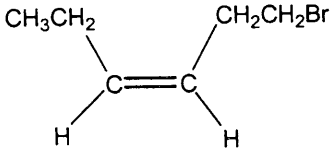
Both correct products gets 3 marks ✓✓✓

One correct product gets 2 marks

If neither of the above is correct then one mark can be awarded for any of:



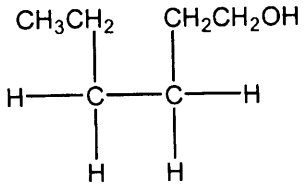




max of two marks

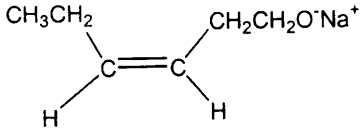
2.

(a) (i)



✓

(ii)

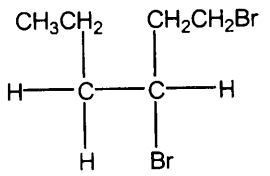


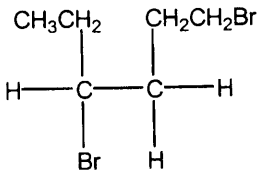
charges are not necessary

allow the alkoxide ion

✓

(iii)





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One correct product gets 2 marks

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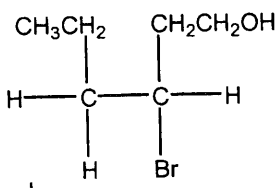
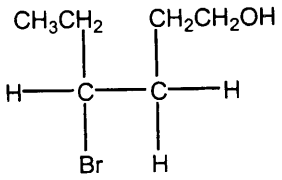
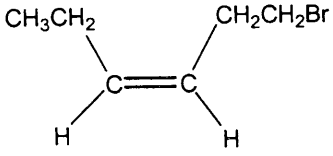


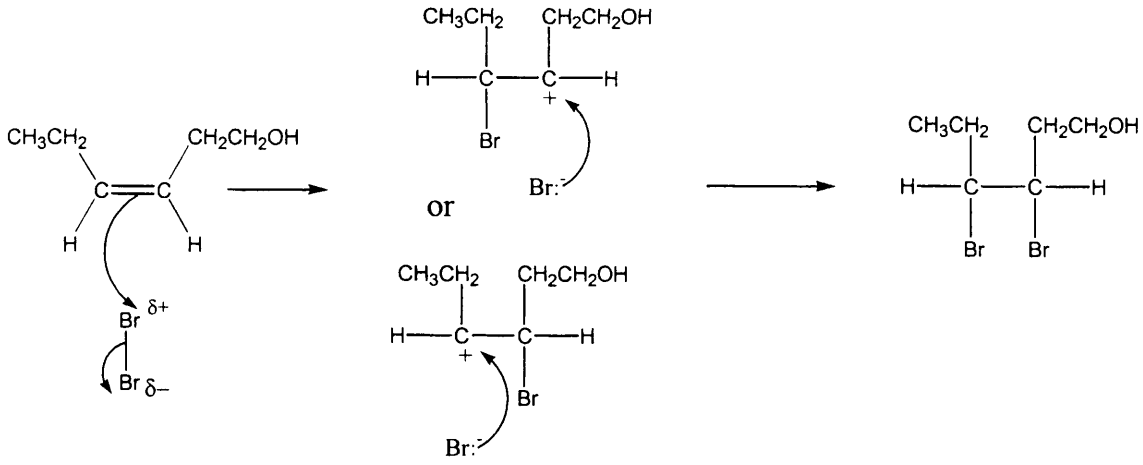




max of two marks

(b) (i) decolourises ✓

(ii)



curly arrow from C=C bond to bromine ✓

dipoles on Br_2 or curly arrow to show movement of bonded pair of electrons ✓

intermediate carbonium ion/carbocation ✓

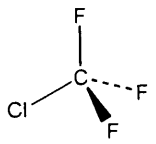
curly arrow from lone pair on the Br^- ion to carbonium ion ($Br^{\delta-}$ loses 1 mark) ✓

[Total: 10]

3. (a) (i) C_4H_{10} ✓

(ii) $C_4H_{10} + 6\frac{1}{2}O_2 \longrightarrow 4CO_2 + 5H_2O$ ✓
(CO_2 & H_2O as products ✓)

(iii) propan-2-ol ✓

(b) (i) 

require an attempt at a 3D structure and bond angles must clearly not be 90°.

require at least one 'wedge' bond or one 'dotted' bond

✓
✓

(ii) 108 –111° ✓

(iii) volatile/low boiling/gas/non-toxic/non-flammable/unreactive/liquefied under pressure/inert ✓

(iv) homolytic = bonded pair split <u>equally</u>/ each retains 1 electron ✓

fission = <u>bond</u> breaking ✓

(v) C-Cl (no mark) because it is the <u>weaker bond</u> ✓

(vi) Cl• ✓

•CF_3 (allow CF_3•) *(lack of 'dots' penalise once)* ✓

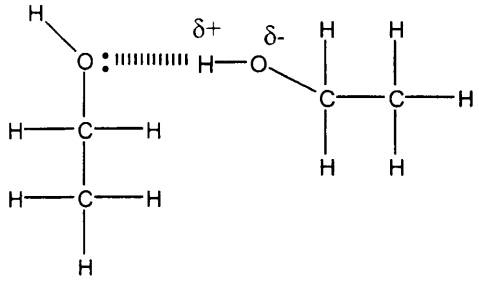
[Total: 12]

4.

(a) $C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$ ✓✓

(C_2H_5OH & CO_2 ✓)

(b)



dipoles ✓

hydrogen bond between O in one O-H and H in the other O-H ✓

lone pair from O involved in the H-bond ✓

(c) (i) (volatile components) can escape/distil out ✓

ethanal is most volatile/b pt less than 60 °C/partial oxidation ✓

(ii) (volatile components) cannot escape/ refluxed ✓

complete oxidation will be achieved/oxidised to the acid ✓

(d) $C_2H_5OH + 2[O] \longrightarrow CH_3COOH + H_2O$ ✓✓

($CH_3COOH + H_2O$ ✓)

(e) spectrum C ✓

spectrum C only shows absorption at 1700 cm^{-1} for the C=O ✓

the other two spectra contain the OH group absorption at approx 3000 cm^{-1} ✓

[Total: 14]

5.

identifies the three process as cracking, reforming, isomerisation ✓

recognises the need for high temperature or a catalyst ✓

equation for cracking ✓

equation for isomerisation ✓

state that reforming converts chains into rings/cyclic compounds ✓

equation for reforming (balanced with H_2 could score two marks) ✓

sub-section mark = 6

oil is finite/non-renewable ✓

ethanol is renewable/sustainable ✓

from plants/crops/sugar cane/sugar beet/glucose/sugar/fermentation ✓

$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$ ✓

sub-section mark = 4

QWC

- organise relevant information clearly and coherently, using specialist vocabulary when appropriate (minimum of 4 from cracking/ isomerisation/ reforming/ renewable/ feedstock/ finite/fermentation/non-renewable/sustainable/zeolite/bimetallic catayst/ etc)
- reasonable spelling, punctuation and grammar throughout ✓

[Total: 11]