1 (a)

(i) C_4H_{10} ✓[1]

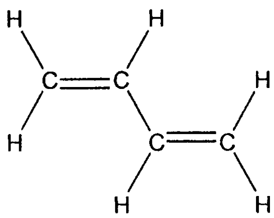
(ii) C_2H_5O ✓ [1]

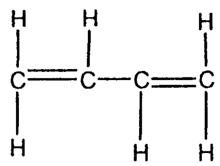
(iii) B and E ✓ [1]

(iv) A and F ✓ [1]

(b) ($C_4H_9OH \rightarrow$) C_4H_8 + H_2O ✓ [1]

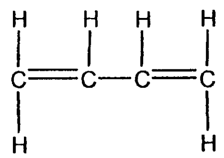
(c) any unambiguous formula:





✓ [1]

$CH_2CHCHCH_2$



buta-1,3-diene ✓ [1]

name ecf to the structure only if structure above has formula C_4H_6

[Total : 7]

2(a)

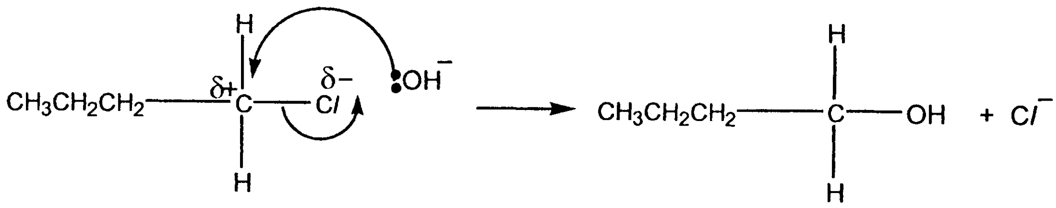
Cl^- must be shown as a product ✓[1]

(at least 1) lone pair of electrons on the O in the OH^- with curly arrow from the lone pair on the OH^- to the $C^{(\delta+)}$ ✓[1]

dipoles on the C-Cl bond ✓[1]

curly arrow from C-Cl bond to the $Cl^{\delta-}$ ✓[1]

The mechanism below would get all 4 marks.



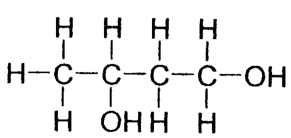
(b) (i) mark for method/dividing by A_r / C, 3.15; H, 6.3; Cl, 1.58. ✓[1]

divide by smallest to get C_2H_4Cl ✓[1]

(ii) $C_4H_8Cl_2$ ✓[1]

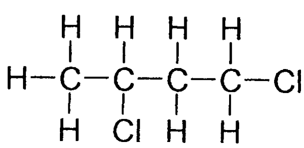
> alternative method:
> % of each element x 127 ÷ A_r of that element = molecular formula, hence deduce empirical formula

(iii) any unambiguous form of:



✓ [1]

(iv) any unambiguous form of:



✓ [1]

ecf to (iii) provided that there are two OH's in (iii)

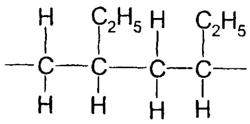
(c) (i) ethanol/ alcohol ✓ [1]

(ii) elimination/dehydrohalgenation/dehydrochlorination ✓[1]

(iii) any unambiguous form of but-1-ene. ✓ [1]

(iv) $C_4H_9Cl + (Na^+)OH^- \rightarrow C_4H_8 + H_2O + (Na^+)Cl^-$ ✓ [1]

(d)



1 mark is available if the backbone consists of 4 C atoms and a reasonable attempt has been made ✓✓ [2]

(e)(i) reagent **J** NH_3 ✓ [1]

(ii) product **K** HBr/NH_4Br ✓ [1]

(iii) ethanol (as solvent)/high temp(heat) + (high) pressure/heat in a sealed tube✓ [1]

[Total : 18]

3 (a)

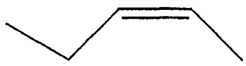
Same molecular formula, different structure /displayed formula/ arrangement of atoms/bonds ✓✓ [2]

(Same formula, different structure/displayed formula/arrangement of atoms ✓ [1])

(b) (i) 3-methylbut-1-ene and 2-methylbut-2-ene
(any unambiguous structure/formula is acceptable) ✓✓[2]

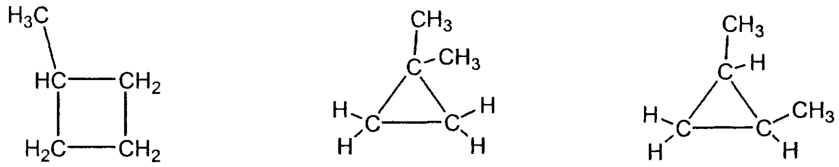
(ii) 2-methylbut-1-ene/2-methyl-1-butene ✓ [1]

(iii)

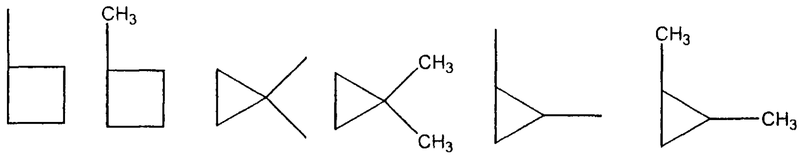


✓ [1]

(c)(i) any two from methylcyclobutane, 1,1-dimethylcyclopropane and 1,2-dimethylcyclopropane



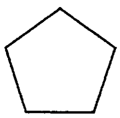
allow



✓✓[2]

(ii) cyclopentane ✓ [1]

(iii)



✓ [1]

(d)(i) homolytic ✓ [1]

(ii) $Cl_2 \rightarrow 2Cl\bullet$ *(need • on the Cl... penalise only once in the 3 equations)* ✓[1]

(iii)

I (C_5H_{10})+ <u>Cl•</u> → $(\bullet C_5H_9)$ + <u>HCl</u> ✓ [1]

II $(\bullet C_5H_9)$+ <u>Cl_2</u> → <u>C_5H_9Cl</u> + <u>Cl•</u> ✓ [1]

[Total : 14]

4.(a) (i) Alkene/C=C ✓ [1]

Alcohol/ROH/hydroxy/hydroxyl/OH (not OH^- or hydroxide) ✓ [1]

(ii) One of the C in both C=C is joined to two atoms or groups that are the same ✓ [1]

(b) Observation decolourisation(of Br_2) ✓ [1]

Molecular formula $C_{10}H_{18}OBr_4$ ✓✓[2]

$C_{10}H_{18}OBr_2$ gets 1 mark

(c) reagent CH_3COOH ✓ [1]

catalyst H_2SO_4/H^+/HCl *(aq) or dilute loses the mark* ✓ [1]

(d)(i) $C_{10}H_{18}O + 2[O] \rightarrow C_{10}H_{16}O_2 + H_2O$ ✓✓ [2]

1 mark for H_2O and 1 mark for 2[O]

(ii) The infra-red spectrum was of compound **Y**

because absorption between 1680 – 1750 cm^{-1} indicates a C=O ✓ [1]

and the absence of a peak between 2500 – 3300 cm^{-1} shows the absence of the OH hydrogen bonded in a carboxylic acid ✓ [1]

[Total : 12]

5 Variation in boiling points. **(max = 4 marks)**

As chain length increases, boiling point increases ✓[1]

due to increased number of electrons/ surface area/ more van der Waals forces / intermolecular forces/ more surface interactions ✓[1]

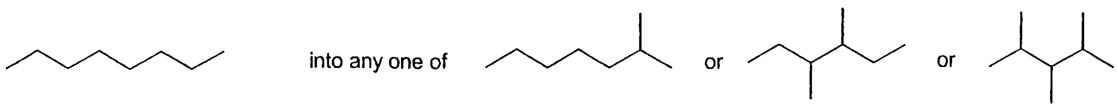
As branching increases, boiling point decreases ✓[1]

straight chains can pack closer together/ straight chains have greater surface area/ ✓[1]
more van der Waals forces /more intermolecular forces/ more surface interactions

Isomerisation **(max = 4 marks)**

(produces) branched chain alkanes ✓[1]

equation to illustrate any isomerisation (of octane)✓[1]



or any other branched isomer of octane

Branched chains are better/more efficient fuels/used as additives ✓[1]

because they are more volatile/easier to ignite/burn more easily/higher octane number(rating)/lower boiling points/reduces knocking(pinking) ✓[1]

QWC mark

- use of suitable chemical terms such as van der Waals, intermolecular forces/ intermolecular bonds/volatile/ knocking/ pinking/pre-ignition
- reasonable spelling, punctuation and grammar throughout ✓[1]

[Total : 9]