**1.**

(a)(i) B ✓ [1]

(ii) C ✓ [1]

(iii) B ✓ [1]

(iv) A ✓ [1] and C ✓ [1]

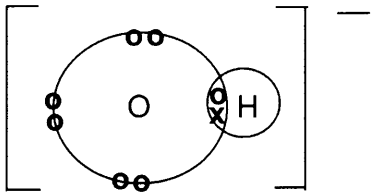
(b) equation $C_4H_9Br + NH_3 \rightarrow C_4H_9NH_2 + HBr$ (or $C_4H_9NH_3^+Br^-$) ✓ [1]

name: 1-aminobutane/(n-)butylamine/butan-1-amine ✓ [1]

solvent ethanol/alcohol ✓ [1]

(c) (i) lone pair (of electrons) donor ✓ [1]

(ii)



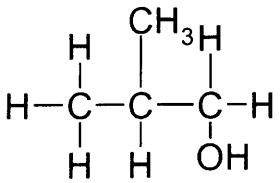

If diagram shows a total of 8 electrons ✓[1]

and has a negative charge. ✓[1]
only award if the diagram shows 8 electrons

(iii) unambiguous identification of organic product:

2-methylpropan-1-ol,

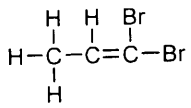
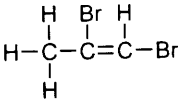
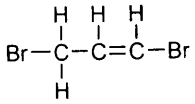
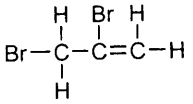
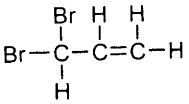
$(CH_3)_2CHCH_2OH$ ✓ [1]




[Total : 12]

**2.** (a)(i) same molecular formula -different structure ✓✓ [2]
*same formula -different structure only scores 1 mark*

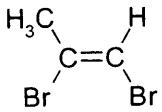
(ii)

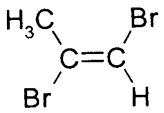
| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
|  |  |  |  |  |
| | ✓[1] | ✓[1] | ✓[1] | |

(iii) 1,1-dibromopropene ✓ [1]

(b) (i)

✓[1]


cis


trans

✓[1]

(ii) bond angle = $120^{o} \pm 4^{o}$ ✓ [1]

(iii) Each C in the C=C is **not** bonded to two different atoms/groups/ or equivalent. ✓ [1]

(iv) Must be 1,3-dibromopropene. ✓ [1]

[Total : 11]

**3.**

(a)

(i) H ✓ [1]

(ii) G ✓ [1]

(iii) van der Waals/ instantaneous or temporary induced dipoles ✓ [1]

(b)

(i) contains a single/unpaired/lone electron/ **not** free electron ✓ [1]

(ii) $Br_2 \rightarrow 2\ Br\bullet$ ✓ [1]

(iii) Homolysis/ homolytic fission/homolytic cleavage ✓ [1]

(iv) $Br\bullet + C_5H_{12} \rightarrow \bullet C_5H_{11} + HBr$ ✓ [1]

$\bullet C_5H_{11} + Br_2 \rightarrow C_5H_{11}Br + Br\bullet$ ✓ [1]

(c) I isomer **G**, 1 ✓ [1]

II isomer **H**, 3 ✓ [1]

III isomer **I**, 4 ✓ [1]

[Total : 11]

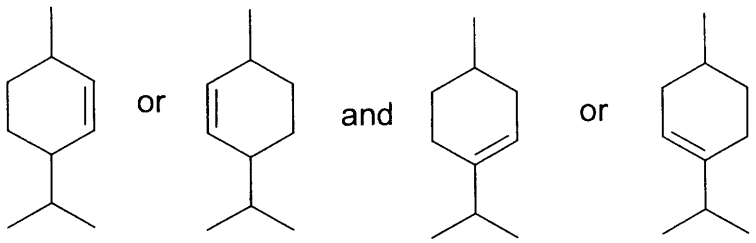
**4.** (a)

(i) $C_{10}H_{20}O$ ✓ [1]

(ii) alcohol/ OH/ hydroxy(*l*) ✓ [1]

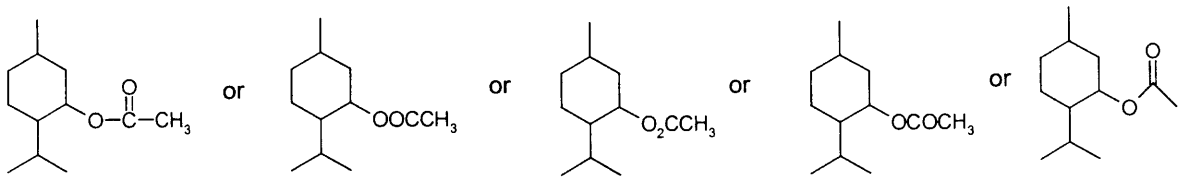
secondary ✓ [1]

(b)




1 mark for each alkene ✓✓ [2]

(c)




or full structural formula showing all the atoms

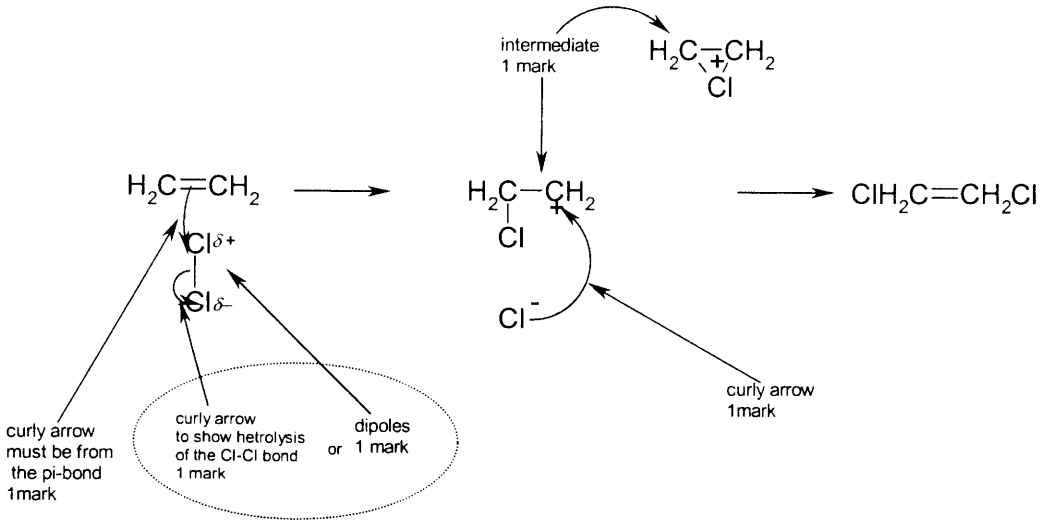
1 mark is available for the ester group showing $CH_3$ bonded via COO to a ring

2 marks for structure as shown ✓✓ [2]

[Total : 7]

**5.** (a) (i) electrophilic ✓ [1] addition ✓ [1]

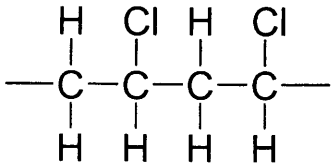
(ii)




4 marking points: curly arrow from double bond to $Cl_2$,
curly arrow showing movement of electrons in the Cl-Cl bond **or** the dipole in the Cl-Cl,
Intermediate carbocation/carbonium ion,
Curly arrow from $Cl^-$ to intermediate. ✓✓✓✓ [4]

(c) (i)

look for 2 Cl + backbone of 4 C's



✓ [1]

"must show end-bonds"

(ii) *general problems:*

non-biodegradable/ not broken down by bacteria/ do not decompose ✓ [1]

when burnt toxic fumes are produced ✓ [1]

*specific problem of PVC:*

also produce HCl/ Cl free radicals when burnt ✓ [1]

(iii) removal of toxic products or HCl formed during combustion by gas scrubbers/ by dissolving in a spray of alkali/ recycling/feedstock recycling/use energy from combustion for domestic heating/ manufacture biodegradable polymers . ✓ [1]

[Total : 10]

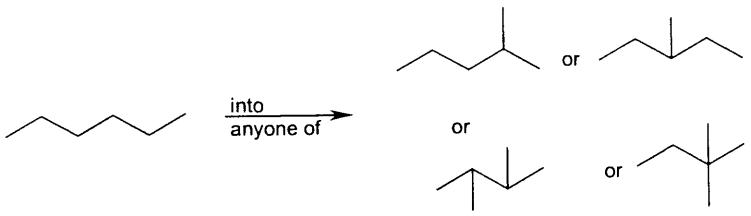
**6.** 3 marks for equations,
2 marks for correctly explaining (in words) each of the 3 processes.
1 mark for correctly explaining (in words) 2 of the processes.

**Cracking.** equation for long chain alkane into shorter chain alkane + alkene. ✓ [1]

**Isomerisation**

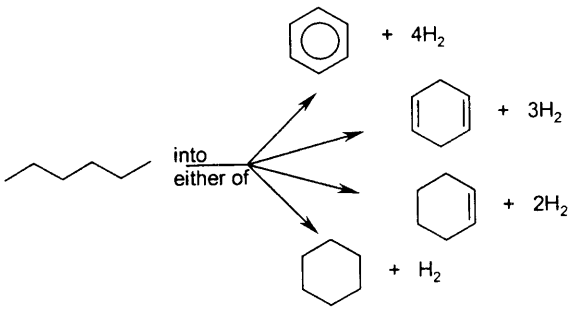
equation for straight chain alkane converted into a branched chain alkane ✓ [1]

equation could be in the form of:




**Reforming**

to show straight chain into ring (& must be balanced with appropriate number of $H_2$.) ✓[1]




(All three processes require) the use of heat and/or a catalyst (Allow once) ✓ [1]

**Importance of the products:** max of 3 marks. ✓✓✓ [3]

- more volatile/lower boiling points
- used in fuels because they burn better/smoother/more efficiently/more efficient fuel
- additive to petrol
- reduce knocking/pinking/increase octane number or rating
- alkenes can form polymers/PVC (see Q5)/alcohols etc

1 mark for quality of written communication to be awarded for clear presentation and SPAG. ✓ [1]

[Total :8]