
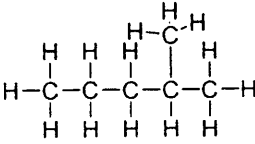
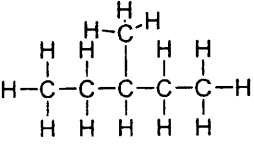
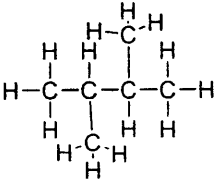


1. (a) (i) $C_6H_{14} \rightarrow C_3H_6 + C_3H_8$ ✓
- (ii) propane ✓
- (b) $C_6H_{14} \rightarrow C_6H_{12}$ or  + H_2 ✓
- (c)
- 

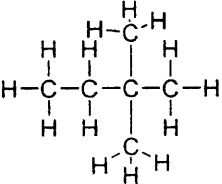
2-methyl pentane



3-methylpentane



2,3-dimethylbutane



2,2-dimethylbutane
- Any two correct formulae and names ✓✓✓✓
- (d) More efficient/useful or better fuels/burn smoother/added to petrol/
increase octane rating or number ✓
- (e) (i) biofuels are fuels produced from plant/animal waste ✓
- (ii) Fossil fuels are non-renewable because they take millions of years to form
Must specify time $>10^6$ years ✓
- Ethanol is renewable because its feedstock (e.g. sugar, glucose, fruit, carbohydrate)
can be continuously re-grown/replaced ✓

[Total: 11]

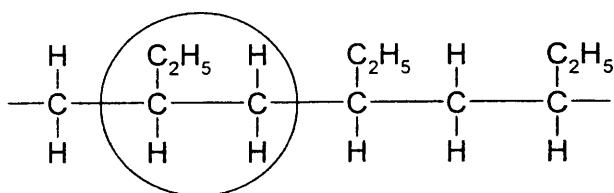
- 2 (a)(i) reaction I $\text{CH}_3\text{CH}_2\text{OH}/\text{C}_2\text{H}_5\text{OH}$ – not $\text{C}_2\text{H}_6\text{O}$ ✓
 reaction II $\text{CH}_2\text{CH}_2/\text{C}_2\text{H}_4$ ✓
- (ii) reaction I nucleophilic ✓ substitution ✓
 reaction II elimination/dehydrohalgenation ✓
- (b) Reagent: NH_3 ✓
 Conditions: ethanol/alc/heat in sealed tube/high T & P ✓

(c) (i)

Alkene	$\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$ ✓	$\text{CH}_3\text{CH}=\text{CHCH}_3$ ✓
Name	But-1-ene ✓	But-2-ene ✓

- (ii) 1 mark for identifying but-2-ene as having *cis-trans* isomers ✓
 1 mark for labelling **both** correctly ✓
- (iii) (C=C) double bond ✓
 each C in the C=C must be bonded to two different atoms/groups ✓

(d) (i)



- (ii) addition ✓
- (iii) $\text{C}_2\text{H}_5\text{CH}=\text{CH}_2$ / but-1-ene – not butene, by relating back to their answer for (c) (i) ✓

[Total : 18]

3

- (a) name/formula of propan-1-ol ✓ name/formula of propan-2-ol ✓
also accept the ether, C₂H₅OCH₃
- (b) (i) 0.15 ✓
- (ii) 0.3 mol of the alcohol, C₃H₈O, reacts with 0.1 mol Na₂Cr₂O₇
hence Na₂Cr₂O₇ is in excess (this mark is only available if first point is made) ✓
- (iii) orange ✓ to green/blue-green/ any tinted green ✓
- (c) (i) 5.22/58 (mark is for M_r = 58) ✓
0.09 ✓
- (ii) 30% e.c.f. c(i) / 0.3 * 100 ✓
- (d) (i) carbonyl/C=O/a list that includes at least **two** of aldehyde, ketone, carboxylic acid and/or ester ✓
- (ii) OH hydrogen bonded in a carboxylic acid ✓
- (iv) propan-1-ol/CH₃CH₂CH₂OH (no marks)
because there is evidence of oxidation to a carboxylic acid ✓

[Total : 12]

4.

(a)(i) Empirical formula: 3.2(25) : 9.7 : 3.2(25) ✓

CH₃O ✓

(ii) Molecular formula C₂H₆O₂ ✓

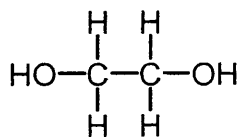
Alternative method:

%	C	:	H	:	O
	38.7 x 62/100		9.7 x 62/100		51.6 x 62/100
	24		6		32
÷Ar	2		6		2

∴ (molecular) formula = C₂H₆O₂ gets all two marks, but must also state that the empirical formula is CH₃O to get the third mark.

(b) Shows hydrogen bonds in alcohol ✓

(c) ethane-1,2-diol



✓

(d) hydrogen bonds ✓

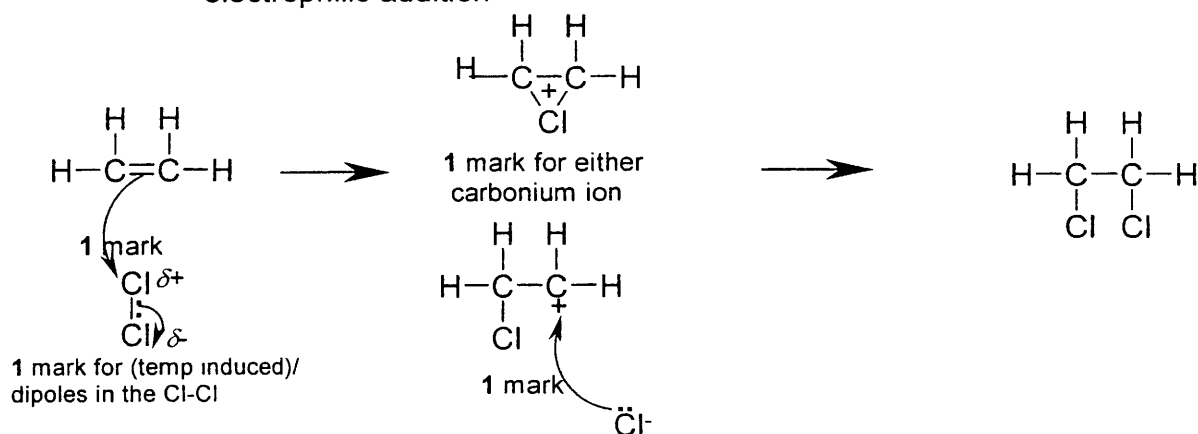
[6]

5. **chlorine and methane** *6 available marks*

free radical substitution		✓
Initiation	$\text{Cl}_2 \rightarrow 2\text{Cl}\bullet$	✓
Propagation 1	$\text{CH}_4 + \text{Cl}\bullet \rightarrow \text{HCl} + \text{CH}_3\bullet$	✓
Propagation 2	$\text{CH}_3\bullet + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{Cl}\bullet$	✓
Termination	Any two free radicals	✓
Homolytic fission		✓

chlorine and ethene *6 available marks*

electrophilic addition ✓



marking points for the mechanism:

- curly arrow from the C=C bond to the Cl_2
- correct dipoles on the Cl-Cl bond or curly arrow showing movement of bonded pair of electrons
- intermediate carbonium ion/carbocation
- curly arrow from Cl^- to the intermediate

✓✓✓✓

Heterolytic Fission

✓

1 mark is available in this question for the quality of the written communication. SPAG plus correct use of at least four of the following terms: *free radical, substitution, initiation, propagation, termination, homolytic fission or equivalent term, electrophilic, addition, heterolytic fission or equivalent term, carbonium ion, carbocation, photochemical, photodissociation.*

Show the QWC mark at the end by either ✓QWC or ✗QWC

[13]