

2812	Mark Scheme	June 2001
1 (a)(i)	F	✓
	(ii) C ₆ H ₁₄	✓
	(iii) CH ₂	✓
(b) (i)	C, D and E	✓
	same (molecular) formula/number of atoms of each element, different structure/arrangement of atoms/displayed formula/carbon backbone not "spatial" arrangement	✓
(c) (i)	C	✓
	(ii) C	✓
	(iii) van der Waals	✓

Any mention of van der Waal's /dispersion/London forces gets one mark

C> A & B due to the longer chain /number of electrons **hence the greater the number of vdW's/ surface interaction/ intermolecular forces or converse** ✓

C>D & E the more branched/compact/cannot pack together as close **hence the fewer vdW's/surface interaction/ or converse** ✓

..... Penalise only once

[Total :10]

2. (a) (i) Method mark if each element is divided by its own A_r

	C	.	H	:	O	
÷ by A_r	5.41	.	13.5	.	1.35	✓
÷ by 1.35	4	.	10	:	1	✓

Alternative approach is acceptable and would score both marks.

	C	:	H	:	O	
	$\frac{64.9 \times 74}{100}$:	$\frac{13.5 \times 74}{100}$:	$\frac{21.6 \times 74}{100}$	
	48	:	10(9.99)	:	16(15.9)	✓
<i>Divide each by its own A_r</i>						
	4	:	10	:	1	✓

(ii) $C_4H_{10}O = 48 + 10 + 16 = 74 \therefore$ molecular formula = $C_4H_{10}O$ ✓
 Must be some working as evidence as they are given $M_r = 74$ in the stem

(b)

structural isomer	displayed formula	name	classification
1			primary
2	<pre> H H H H H-C-C-C-C-H H H OH H </pre>	butan-2-ol	
3		2-methylpropan-1-ol	primary
4	<pre> H H-C-H H H H-C-C-C-H H OH H </pre>		tertiary

↑
 Any unambiguous structure gets the marks
 $CH_3CH_2CHOHCH_3$ is OK
 and the minimum allowed for the second is $(CH_3)_3COH$

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3 (a) *If correct formulae are given instead of name do **not** penalise.*

If both formula and name are given and they are conflicting the mark will not be awarded

reaction 1

sodium or potassium hydroxide/ OH⁻/hydroxide/NaOH/KOH ✓
water/(aq)/ H₂O ✓

reaction 2

ammonia/NH₃ ✓
ethanol/ethanol+water/alc/C₂H₅OH ✓

reaction 3

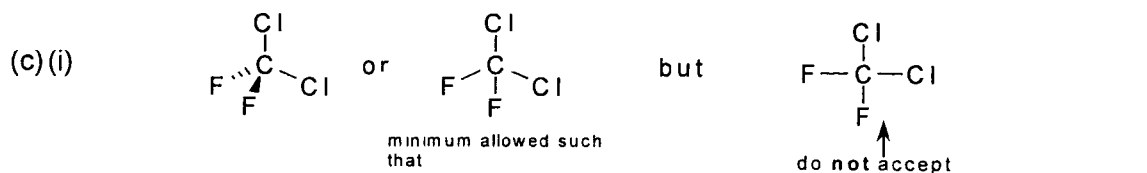
sodium or potassium hydroxide/ OH⁻/hydroxide/NaOH/KOH ✓
ethanol/ alc/ C₂H₅OH ✓

(b) Slower: ✓

C-Cl bond > C-Br bond/ C-Cl bond is shorter/stronger than C-Br bond/ Higher activation energy with C-Cl ✓

*If faster is given this is incorrect and gets no mark
but if they give the reason for it being faster as*

Cl is more electronegative/C-Cl is more polar this gets 1 mark ✓ ecf



(ii) 109° 28' (range 108 – 110°) ✓

(iii) Volatile/low boiling point/ unreactive/ inert/non-flammable/non-toxic ✓

(iv) each takes one (covalent)electron/ Cl₂ → 2Cl• ✓

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- (v) Bond : C-Cl ✓
Reason. C-Cl bond weaker/longer/ C-F bond stronger/ C-F>C-Cl ✓
- (vi) Cl(•) ✓
(•) CClF_2 ✓

If (c) (v) incorrectly identified as C-F you (vi) can be marked consequentially

[Total : 16]

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4. (a)	Water/ H ₂ O/cyclohexanol/C ₆ H ₁₁ OH/C ₆ H ₁₂ O (not H ₃ PO ₄ as it boils/dehydrates @ 213 °C)	✓
(b) (i)	100	✓
(ii)	0.1 mark ecf to (i)	✓
(iii)	82 (<i>used for M_r of cyclohexene</i>)	✓
	0.045 (<i>gets both marks</i>)	✓
(iv)	$\frac{\text{moles of cyclohexene}}{\text{moles of cyclohexanol}} \times 100$	✓
	45%	✓

Part (iv) can be marked consequentially from parts (ii) and (iii) such that

(iii)/(ii) x 100 gets 1 mark

and would get both marks if the mathematics are carried out correctly

[Total : 7]

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5. (a)(i)	An Electrophile is an electron/lone pair acceptor	✓
(ii)	Example anything with a + charge (except a metal ion) e.g. Cl^+ , NO_2^+ , H^+ also accept Br_2 , Cl_2 , H_2SO_4 , HBr , H_2	✓
(iii)	Balanced equation for electrophilic addition, $\text{C}_2\text{H}_4 + \text{XY} \rightarrow \text{C}_2\text{H}_4\text{XY}$ / $\text{C}_2\text{H}_4 + \text{X}_2 \rightarrow \text{C}_2\text{H}_4\text{X}_2$	✓
(b)(i)	Nucleophile is a electron/lone pair donor	✓
(ii)	Example Cl^- , OH^- , CN^- , NH_3 , H_2O , ROH	✓
(iii)	Balanced equation for nucleophilic substitution, $\text{RX} + \text{Y}^- \rightarrow \text{RY} + \text{X}^-$ / $\text{RX} + \text{HY} \rightarrow \text{RY} + \text{HX}$ typically Y^- could be anyone of Cl^- , OH^- , CN^- whilst HY could be anyone of NH_3 , H_2O , ROH	✓
(c)(i)	Free radical has a single/unpaired electron (not a free electron)	✓
(ii)	Example any suitable radical e.g. $\bullet\text{Cl}$, $\bullet\text{CH}_3$, $\text{Br}\bullet$	✓
(iii)	Balanced equation for a free radical substitution. $\text{CH}_4 + \bullet\text{Cl} \rightarrow \bullet\text{CH}_3 + \text{HCl}$ / $\bullet\text{CH}_3 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \bullet\text{Cl}$ / $\text{CH}_4 + \text{Cl}_2$ or $2\text{Cl}\bullet \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$	✓

[Total : 9]

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6. (a)(i) (will be marked as a single sub-unit worth 4 marks) There are 5 marking points with a maximum of 4. If MnO_4^- used max = 3 marks

5	marking points for	4	marks
4	marking points for	3	marks
3	marking points for	2	marks
2	marking points for	1	mark

$\text{Cr}_2\text{O}_7^{2-}$ / dichromate/ sodium or potassium dichromate/ $\text{Na}_2\text{Cr}_2\text{O}_7$ / $\text{K}_2\text{Cr}_2\text{O}_7$ ✓

Acidified/ H^+ / sulphuric acid / H_2SO_4 ✓

reflux/heat/warm ✓
Orange ✓ to Green ✓ ✓

Record marks in the margin as 5 → 4 or 3 → 2

- (ii) Reflux: ✓

to ensure complete oxidation/ avoid partial oxidation/to form the acid/to avoid distillation of aldehyde ✓

- (iii) $\text{C}_7\text{H}_{16}\text{O}$ / $\text{C}_7\text{H}_{15}\text{OH}$ ✓

- (iv) $\text{C}_7\text{H}_{16}\text{O} + 2[\text{O}] \rightarrow \text{C}_7\text{H}_{14}\text{O}_2 + \text{H}_2\text{O}$ (1mark for both products) ✓✓

Correctly balanced equation gets both marks

- (v) aldehyde/ $\text{C}_7\text{H}_{14}\text{O}$ / 2-ethyl-3-methylbutanal ✓

- (b) (2-ethyl-3-methylbutan-2-ol is a tertiary alcohol) ✓

tertiary alcohols are **not** (readily) oxidised/does not react with $(\text{H}^+)/\text{Cr}_2\text{O}_7^{2-}$ ✓

[Total . 12]

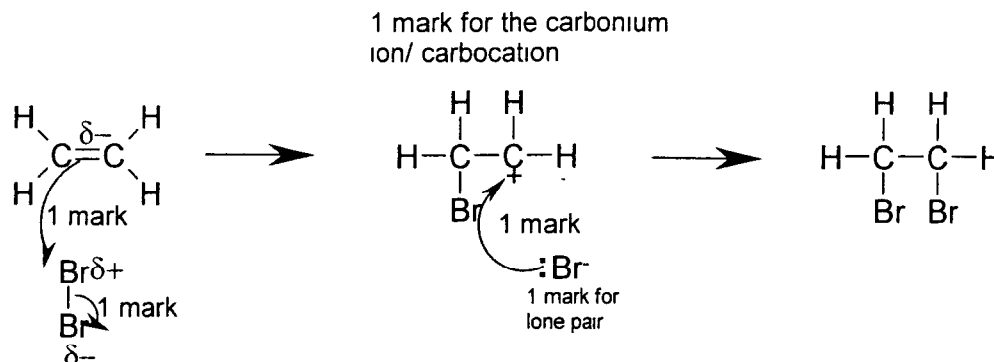
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7. (bromine is) decolourised (do not accept clear) ✓
 Product: 1,2-dibromoethane ✓

Maximum of 4 marks for the mechanism



- Electrophilic addition ✓
 Induced dipole in the Br₂/ dipoles shown correctly on the Br-Br bond ✓
 curly arrow on Br-Br bond as shown/hetrolytic fission ✓
 Curly arrow from the π- bond to the bromine or words to that effect ✓
 Intermediate carbonium ion/ carbocation ✓
 Curly arrow from Br⁻ back to the carbonium ion/ carbocation/nucleophilic attack/Br⁻ forms a covalent bond with the carbocation ✓
 Lone pair of electrons shown on the Br⁻ (and curly arrow from lone pair to the carbonium ion/ carbocation)/ Br⁻ acts as a lone pair donor ✓

[9marks; max = 6]

1 mark for quality of written expression awarded for the description / layout of the mechanism making use of appropriate chemical terms/symbols. The mark should be awarded if two or more of the following are used correctly:

- lone pair
- polarised
- hetrolytic fission/hetrolysis
- induced dipole
- curly arrows
- carbonium ion/ carbocation
- electrophilic addition

If two or more chemistry marks are awarded for the mechanism I would also expect the QWC to be awarded. ✓

Record marks for the question by counting ✓ given for the chemistry as a total (max =6) followed by either ✓QWC or xQWC and the total for the question {chemistry + QWC} circled at the end of the question. It should look something like:

5
 ✓QWC

6

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8. (a) **Cracking:**

The lighter/smaller/shorter fractions are the more useful/ in demand ✓

Heavier/longer chains cracked into shorter chains + alkene ✓

Suitable balanced equation ✓

Using heat/catalyst/ both ✓

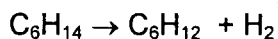
Point of fission is variable therefore get a great variety of products ✓

Alkenes have great importance as a starting point for other products/suitable example/equation e.g. ethanol/polymers etc ✓

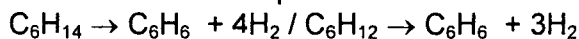
Reforming:

(Reforming converts straight chains into) ring compounds/cycloalkanes/arenes ✓

Suitable balanced equation for cycloalkane ✓



Suitable balanced equation for arene ✓



Isomerisation:

Isomerisation converts straight chains into branched chains. ✓

Suitable example. ✓

Ring compounds and/or branched chain compounds are better fuels than straight chain compounds (*not just good fuels, there must be a comparison*)/ added to petrol to promote smoother combustion/ avoid knocking/ increase octane number or rating. ✓

12 max = 9

(1 mark is available for the quality of written communication.)

This mark should be awarded for spelling, punctuation and grammar. It will be unusual **not** to give the mark. ✓

Record marks for the question by counting ✓ given for the chemistry as a total (max =9) followed by either ✓QWC or xQWC and the total for the question {chemistry + QWC} circled at the end of the question It should look something like:

7
✓QWC

8