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2002

**XVIII**

1583

Time allowed  
**50 Minutes**

Score

**/42**

Percentage

**%**

**CHEMISTRY**

**Edexcel  
AS & A LEVEL**

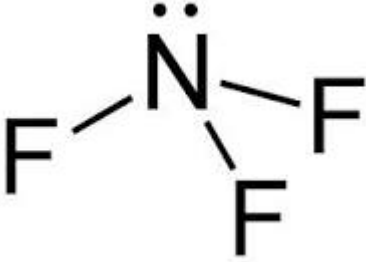
**Mark Scheme**

**Paper 2: Advanced Organic  
and Physical Chemistry**

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Question Number	Acceptable Answers	Reject	Mark
<b>1</b> (a)(i)	Ignore drawn shapes  Shape is trigonal planar/ triangular planar (1)  Bond angle 120(°) (1)  Mark independently BUT no TE on incorrect shape	...pyramidal  Just planar  °C	(20)

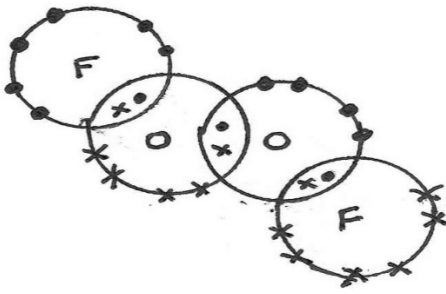
Question Number	Acceptable Answers	Reject	Mark
*1(a)(ii)	<p>(Shape) Ignore references to tetrahedral/pyramidal</p>  <p>NOTE: Lone pair on central N atom NOT required ALLOW: Any correct variation as long as the shape is clear (1)</p> <p>(Bond angle) 107° ALLOW Any angle between 106° – 108° OR 102° (as this is the actual bond angle) (1)</p> <p>Mark independently</p> <p>(Explanation) Minimum repulsion/maximum separation (between pairs of electrons) (1)</p> <p>Lone pair-bond pair repulsions are greater/more than bond pair-bond pair repulsions ...between atoms / Just bonds repel</p> <p>ALLOW Lone pair(s) repel more than bond pair(s) (1)</p> <p>Mark independently</p>	<p>No M1 if incorrect name for shape eg bipyramidal</p>	(4)



Question Number	Correct Answer	Reject	Mark
<b>1(a)(iii)</b>	<p>M1</p> $\begin{array}{c} \text{F} \quad \text{F} \\   \quad   \\ \text{F}-\text{N} \rightarrow \text{B}-\text{F} \\   \quad   \\ \text{F} \quad \text{F} \end{array}$ <p>OR</p> $\begin{array}{c} \text{F} \quad \text{F} \\   \quad   \\ \text{F}-\text{N}-\text{B}-\text{F} \\   \quad   \\ \text{F} \quad \text{F} \end{array}$ <p>OR</p> <p>Dot and cross diagram, allow all dots or crosses.</p> <p>IGNORE omission of non-bonding electrons on Fs.</p> <p>But no mark if dot and cross shown for N-B bond.</p> <p>(1)</p> <p>M2 Dative covalent (bond)</p> <p>(1)</p> <p>Mark independently</p>	<p>No M1 if dative bond categorically from B to N</p>	(2)

Question Number	Correct Answer	Reject	Mark
<b>1(b)(i)</b>	+2 ALLOW 2+		(1)

Question Number	Correct Answer	Reject	Mark
<b>1(b)(ii)</b>	$\text{OF}_2 + \text{H}_2\text{O} \rightarrow 2\text{HF} + \text{O}_2$ <p>Ignore state symbols even if incorrect</p> <p>Allow multiples</p>	$\text{H}_2\text{F}_2$	(1)

Question Number	Correct Answer	Reject	Mark
1(c)	Accept all dots OR all crosses 		(1)



Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (a)(i)	$\begin{array}{c} \text{H} \quad \text{H} \\ \cdot \times \quad \cdot \times \quad \times \times \\ \text{H} \cdot \times \text{C} \cdot \times \text{C} \cdot \times \text{S} \times \cdot \text{H} \\ \cdot \times \quad \cdot \times \quad \times \times \\ \text{H} \quad \text{H} \end{array}$ All Bonding electrons (1)  Ignore any circles/bonds with electrons  Two lone pairs on sulfur Dependent on eight electrons around sulfur (1) Accept all dots/crosses  Fully correct methanethiol 1max	missing Hs/Cs (-1)	2

Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (a)(ii)	104.5 ( $^{\circ}$ ) ( accept 91 to 105)(1)  (Four pairs/two bonding pairs and two non-bonding pairs of electrons in) minimum repulsion/maximum separation/as far apart as possible (tetrahedral arrangement) Ignore the number of pairs of electrons (1)  And lone/non bonding pair(s) of electrons repel more (than bond pairs/CH bonds) (1)  Mark independently	atoms...  Linear shape (-1)  ...repel any sort of atoms	3

Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (b)(i)	Two pairs of electrons/two bonds (around the H atom)  OR Can be shown on a diagram either with electrons or bonds (in approximate straight line) around the hydrogen (1)  (Repel to) maximum separation/minimum repulsion/as far apart as possible (1)  Dependent on first mark except:  Allow: It has a linear shape due to maximum separation/minimum repulsion 1 max	Linear shape on its own	2

Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (b) (ii)	Sulfur is less electronegative (than oxygen)/not electronegative enough  OR oxygen is more electronegative (than sulfur) / electronegative enough  OR Hydrogen bonds can only occur between H and either N, O, or F due to the large difference in electronegativity	Bigger/higher rmm/ atom/molecule alone   Hydrogen not bonded to N, O, or F alone	1

Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (c) (i)	Temporary asymmetrical distribution/ random arrangement of electrons/ charge (density)  Ignore references to atoms/molecules  OR instantaneous/temporary dipole (1)  (these produce) induced dipoles OR description of induction (1)  Mark independently  Ignore references to atoms/molecules	Any mention of permanent dipoles = 0/2   d+ and d- / $\delta$ + and $\delta$ - unless clearly temporary	2

Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (c) (ii)	Ethanethiol/sulfur has more electrons (so forces are stronger)  Allow sulfur has an extra shell of electrons  OR ethanol/oxygen has fewer/less electrons (so forces are weaker)  Allow oxygen has one fewer shell of electrons	Larger charge cloud/ larger electron cloud/ more outer electrons on their own Any reference to size/radius/rmm unless with correct answer	1

Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (d) (i)	Any one from: Bubbles (of gas) /fizzing /effervescence Sodium disappears/dissolves/gets smaller White solid forms  Multiple answers: number correct minus number wrong to give a maximum of 1 and a minimum of 0  Ignore: sodium floats or sinks and/or heat given out and/or hydrogen produced	Sodium rushes about (i.e. any confusion with reaction of sodium with water) Flames Steam	1

Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (d) (ii)	$\text{Na} + \text{CH}_3\text{CH}_2\text{SH} \rightarrow \text{CH}_3\text{CH}_2\text{SNa} + \frac{1}{2}\text{H}_2$  Accept multiples  Ignore charges on sodium salt/state symbols even if incorrect	H for hydrogen $\text{CH}_3\text{CH}_2\text{NaS}$	1

Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (e) (i)	$\text{C}_2\text{H}_5\text{Br} + \text{KOH} \rightarrow \text{C}_2\text{H}_5\text{OH} + \text{KBr} / \text{K}^+ + \text{Br}^-$  Accept ionic equation $\text{C}_2\text{H}_5\text{Br} + \text{OH}^- \rightarrow \text{C}_2\text{H}_5\text{OH} + \text{Br}^-$  Allow molecular formula of alcohol, $\text{C}_2\text{H}_6\text{O}$		1

Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (e) (ii)	Type – substitution (1) Mechanism – Nucleophilic (1)  Accept words in either order. Both words may be given on either line. <u>N.B. This is the only way to score 2 marks!</u>		2

Question Number	Acceptable Answers	Reject	Mark
<b>2</b> (e) (iii)	KSH /NaSH  Allow KHS/NaHS or $\text{H}_2\text{S}$  Ignore state symbols		1



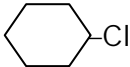
Question Number	Acceptable Answers	Reject	Mark
<b>2 (f)</b>	<p>Sulfur dioxide/SO<sub>2</sub> (1)</p> <p>Causes acid rain (1)</p> <p>Allow effects of acid rain e.g. acid lakes/lake pollution/ crop or forest damage/limestone building damage/named metal which corrodes. [It is quite possible candidates will give details of oxidation of sulfur dioxide to sulfur trioxide and formation of sulfuric acid. Ignore any of this additional information.]</p> <p>Allow triggers asthma</p> <p>Ignore any reference to greenhouse gas/global warming/any reference to sea pollution or sea creatures</p> <p>Second mark dependent on first mark except allow: If SO<sub>2</sub> not mentioned then, SO<sub>3</sub>/H<sub>2</sub>SO<sub>4</sub> causes acid rain for 1 mark</p>	<p>SO<sub>3</sub> CO<sub>2</sub></p> <p>Attacks ozone layer CO<sub>2</sub> causes acid rain</p>	2



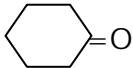
<b>3(a)(i)</b>	109 (°) / 109.5 (°) / 109° 28'	1
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Question Number	Acceptable Answers	Reject	Mark
<b>3(a)(ii)</b>	104 – 106 (°) (1)  O atom has two lone pairs (and 2 bonding pairs) (1) This mark can be given independently of the first and third mark  Lone pairs repel each other more than bonding pairs / angle is reduced to minimise repulsion (by lone pairs) / to maximise separation (of lone pairs) (1)  Ignore 'bonds repel each other'  Angle in (ii) must be smaller than in (i) for third mark to be given	Lone pairs repel H atoms	3

Question Number	Acceptable Answers	Reject	Mark
<b>3(b)(i)</b>	Any two from Fizzing / effervescence / bubbles (of gas) (1)  Sodium dissolves / disappears / reduces in size (1)  White solid / precipitate forms (1)  Ignore identification of products even if incorrect.  Ignore sodium melting / moving around / sinking / floating  Ignore colourless solution forms  Ignore temperature changes / sodium going on fire	Just "Hydrogen forms"/"gas forms"  Fumes	2

<b>3(b)(ii)</b>	$\text{C}_6\text{H}_{11}\text{OH} + \text{PCl}_5 \rightarrow \text{HCl} + \text{C}_6\text{H}_{11}\text{Cl} + \text{POCl}_3$ <p style="text-align: center;">(1)                      (1)</p> <p>(1) for HCl (1) for rest of the equation correct</p> <p>Cyclohexanol can be skeletal, <math>\text{C}_6\text{H}_{11}\text{OH}/\text{C}_6\text{H}_{12}\text{O}</math></p> <p>Accept 'PCl<sub>3</sub>O' instead of POCl<sub>3</sub> Accept skeletal formula for <math>\text{C}_6\text{H}_{11}\text{Cl}</math></p> <div style="text-align: center;">  </div> <p>Ignore state symbols</p>	$\text{C}_5\text{H}_{11}\text{COH}$  $\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CHOH}$ Unless a bond is shown connecting C1 and C6	2
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Question Number	Acceptable Answers	Reject	Mark
<b>3(b)(iii)</b>	White smoke / solid with ammonia Allow white fumes / dense white fumes / steamy white fumes OR White precipitate with silver nitrate  Ignore reference to ammonia solution unless HCl is specifically bubbled into solution  Ignore using an indicator to show gas is acidic with one of the above tests  Ignore description of appearance of HCl before testing	Just steamy / misty fumes  Just testing with an indicator  Bleaches litmus	1

Question Number	Acceptable Answers	Reject	Mark
<b>3(b)(iv)</b>	<div style="text-align: center;">  </div>		1

Question Number	Acceptable Answers	Reject	Mark
<b>3(b)(v)</b>	(Colour change from) Orange to green / blue / brown	blue- green green-blue yellow to green	1

Question Number	Acceptable Answers	Reject	Mark
<b>3(c)</b>	$\text{C}_6\text{H}_{10}^{(+)}$	$\text{C}_6\text{H}_{10}^-$ $(\text{CH}_2)_5\text{C}$ $\text{C}_5\text{H}_{10}\text{C}$ $\text{C}_6\text{H}_{11}$ $(\text{CH})_5\text{OH}$ $\text{C}_2(\text{CH}_2)_8\text{O}$	1