



Mark Scheme (Results)

January 2024

Pearson Edexcel International Advanced
Subsidiary Level In Chemistry (WCH11)
Paper 01 Structure, Bonding and Introduction
to Organic Chemistry

Section A

Question Number	Answer	Mark
1(a)	<p>The only correct answer is B (element Q, 1521)</p> <p><i>A is incorrect because it has 7 electrons in its outer shell</i></p> <p><i>C is incorrect because it has 1 electron in its outer shell</i></p> <p><i>D is incorrect because it has 2 electrons in its outer shell</i></p>	(1)

Question Number	Answer	Mark
1(b)	<p>The only correct answer is A (element P, 1251)</p> <p><i>B is incorrect because it would not form a compound as it is an inert gas.</i></p> <p><i>C is incorrect because it would not form a covalent compound</i></p> <p><i>D is incorrect because it would not form a covalent compound</i></p>	(1)

Question Number	Answer	Mark
1(c)	<p>The only correct answer is D (element S, 590)</p> <p><i>A is incorrect because it would form a covalent compound</i></p> <p><i>B is incorrect because it would not form a compound as it is an inert gas.</i></p> <p><i>C is incorrect because it would form a compound with the formula YF</i></p>	(1)

Question Number	Answer	Mark
1(d)	<p>The only correct answer is C (element R, 419)</p> <p><i>A is incorrect because it has a smaller atomic radius</i></p> <p><i>B is incorrect because it has a smaller atomic radius</i></p> <p><i>D is incorrect because it has a smaller atomic radius</i></p>	(1)

Question Number	Answer	Mark
2	<p>The only correct answer is C</p> <div style="text-align: center; margin: 10px 0;"> 1s 2s 2p </div> <div style="text-align: center; margin: 10px 0;"> <div style="border: 1px solid black; padding: 2px 10px; display: inline-block; margin-right: 10px;">↑↓</div> <div style="border: 1px solid black; padding: 2px 10px; display: inline-block; margin-right: 10px;">↑↓</div> <div style="display: inline-block; margin-right: 10px;"> <div style="border: 1px solid black; padding: 2px 5px; display: inline-block; margin-right: 2px;">↑</div> <div style="border: 1px solid black; padding: 2px 5px; display: inline-block; margin-right: 2px;">↑</div> <div style="border: 1px solid black; padding: 2px 5px; display: inline-block;">↑</div> </div> </div> <p><i>A is incorrect because the 2s orbital should contain 2 electrons</i></p> <p><i>B is incorrect the 2s orbital should contain 2 electrons and each 2p orbital should have one electron before any are doubled up</i></p> <p><i>D is incorrect because each 2p orbital should have one electron before any are doubled up</i></p>	(1)

Question Number	Answer	Mark
3	<p>The only correct answer is A (a molecule of ethene, $^{12}\text{C}_2\text{}^1\text{H}_4$)</p> <p><i>B is incorrect because it contains 16 neutrons</i></p> <p><i>C is incorrect because it contains 16 neutrons</i></p> <p><i>D is incorrect because it contains 16 neutrons</i></p>	(1)

Question Number	Answer	Mark
4	<p>The only correct answer is D (16, 20)</p> <p><i>A is incorrect because both elements are in the p block</i></p> <p><i>B is incorrect because both elements are in the p block</i></p> <p><i>C is incorrect because both elements are in the p block</i></p>	(1)

Question Number	Answer	Mark
5	<p>The only correct answer is D ($\text{NH}_3(\text{g})$)</p> <p><i>A is incorrect because it is not a polar molecule</i></p> <p><i>B is incorrect because it is not a polar molecule</i></p> <p><i>C is incorrect because it is not a polar molecule</i></p>	(1)

Question Number	Answer	Mark
6	<p>The only correct answer is B(NO₂)</p> <p><i>A is incorrect because it contains 47% N</i></p> <p><i>C is incorrect because it contains 64% N</i></p> <p><i>D is incorrect because it contains 37% N</i></p>	(1)

Question Number	Answer	Mark
7	<p>The only correct answer is B (2.65 g)</p> <p><i>A is incorrect because they have used the atomic numbers to calculate the M_r</i></p> <p><i>C is incorrect because they have used 500 cm³ not 250 cm³.</i></p> <p><i>D is incorrect because they have used 1000 cm³ not 250 cm³.</i></p>	(1)

Question Number	Answer	Mark
8	<p>The only correct answer is C (11.34 g cm⁻³)</p> <p><i>A is incorrect because they have divided the A_r by the number of moles</i></p> <p><i>B is incorrect they have used the atomic number not the mass number</i></p> <p><i>D is incorrect because this is the number of moles</i></p>	(1)

Question Number	Answer	Mark
9	<p>The only correct answer is D (sodium, metallic, giant)</p> <p><i>A is incorrect because copper(II) sulfate is an ionic giant substance</i></p> <p><i>B is incorrect because graphene is a covalent giant substance</i></p> <p><i>C is incorrect because iodine has covalent bonds</i></p>	(1)

Question Number	Answer	Mark
10	<p>The only correct answer is A (1.167 g)</p> <p><i>B is incorrect because they have used a 1:2 ratio not 1:1.</i></p> <p><i>C is incorrect because they have used the wrong concentration or volume of the barium chloride</i></p> <p><i>D is incorrect because they have used the wrong concentration or volume of the barium chloride and used a 1:2 ratio not 1:1.</i></p>	(1)

Question Number	Answer	Mark
11	<p>The only correct answer is D (magnesium iodide)</p> <p><i>A is incorrect because Na^+ has a smaller charge than Mg^{2+} and Cl^- is smaller than I^-</i></p> <p><i>B is incorrect because Na^+ has a smaller charge than Mg^{2+}</i></p> <p><i>C is incorrect because Cl^- is smaller than I^-</i></p>	(1)

Question Number	Answer	Mark
12	<p>The only correct answer is D (1.42×10^{21})</p> <p><i>A is incorrect because they have used iodine molecules not atoms and not multiplied by 10</i></p> <p><i>B is incorrect because they have not multiplied by 10</i></p> <p><i>C is incorrect because they have used iodine molecules not atoms</i></p>	(1)

Question Number	Answer	Mark
13	<p>The only correct answer is C (0.00004%)</p> <p><i>A is not correct because the answer shows the percentage equal to ppm</i></p> <p><i>B is not correct because the answer shows the ppm divided by 100</i></p> <p><i>D is not correct because the correct answer has been divided by 100</i></p>	(1)

Question Number	Answer	Mark
14	<p>The only correct answer is C (5)</p> <p><i>A is not correct because there are 5 isomers</i></p> <p><i>B is not correct because there are 5 isomers</i></p> <p><i>D is not correct because there are 5 isomers</i></p>	(1)

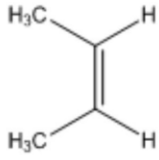
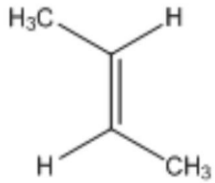
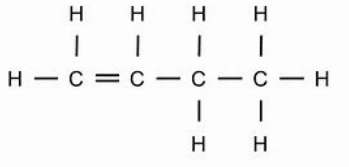
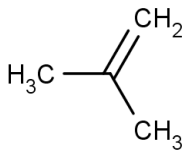
Question Number	Answer	Mark
15	<p>The only correct answer is B (it decolourises bromine water)</p> <p><i>A is not correct because it is an addition polymer</i></p> <p><i>C is not correct because it is non-biodegradable</i></p> <p><i>D is not correct because it has the empirical formula CH₂</i></p>	(1)

Question Number	Answer	Mark
16	<p>The only correct answer is A (butene, pentane and propene)</p> <p><i>B is not correct because there are too many hydrogen atoms in the products</i></p> <p><i>C is not correct because there are too few carbon atoms in the products</i></p> <p><i>D is not correct because there are too many carbon atoms in the products</i></p>	(1)

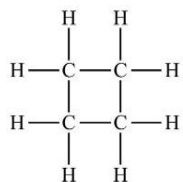
Question Number	Answer	Mark
17	<p>The only correct answer is C (water, carbon dioxide and sulfur dioxide)</p> <p><i>A is not correct because no hydrogen can be produced</i></p> <p><i>B is not correct because no hydrogen chloride can be produced</i></p> <p><i>D is not correct because no hydrogen can be produced</i></p>	(1)

TOTAL FOR SECTION A = 20 MARKS

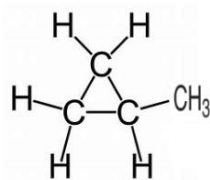
Section B

Question Number	Answer	Additional Guidance	Mark
18(a)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> A  <i>cis- / Z-</i> but-2-ene B  <i>trans- /E-</i> but-2-ene C <div style="display: flex; align-items: center; justify-content: space-around;"> <div style="text-align: center;">  but-1-ene </div> <div style="text-align: center;">  methylprop-1-ene </div> </div> 	<p>Allow structural/skeletal/displayed or any combination.</p> <p>Both name and structure required for each mark</p> <p>A and B can be swapped over</p> <p>If both A and B structures are correct but names wrong score 1 (and vice versa)</p> <p>Ignore lack of hyphens</p> <p>(1)</p> <p>(1)</p> <p>(1) Either structure allowed Allow C₂H₅CHCH₂</p> <p>Allow 2-methylprop-1-ene, methylpropene</p>	(4)

• **D**



cyclobutane



methylcyclopropane

(1)

Either structure allowed

If both C and D structures are correct but names wrong score 1 (and vice versa)

Only penalise missing Hs once if displayed or structural given

Allow cyclicbutane

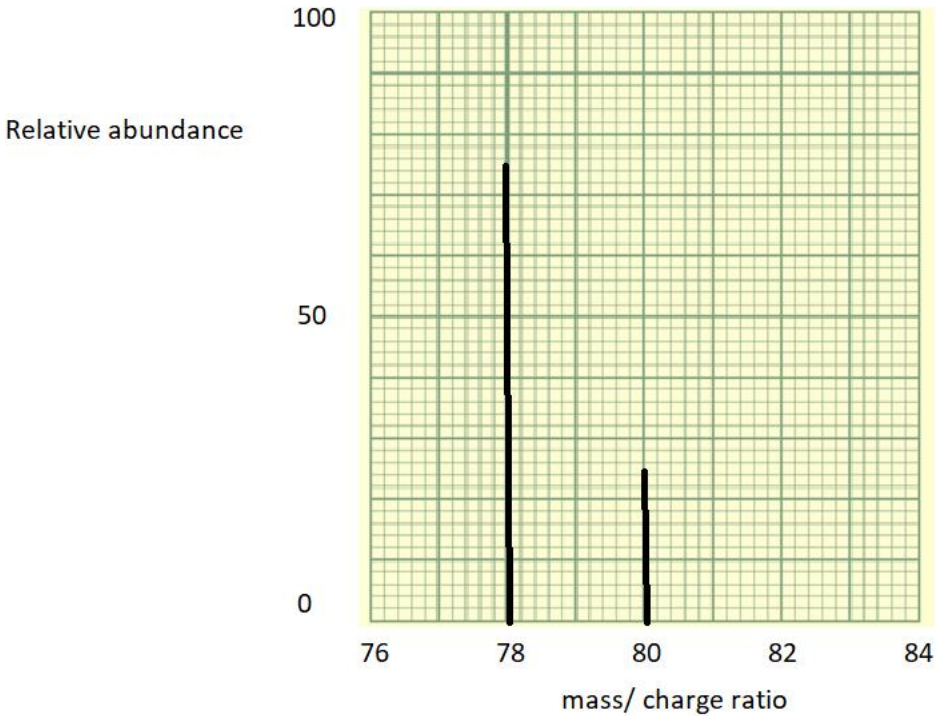
If no other mark is awarded score 1 mark for any 2 correct structures or names in correct position

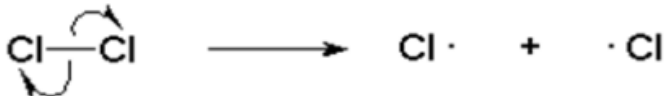
Question Number	Answer	Additional Guidance	Mark
18(b)	<p>An answer that makes reference to the following points:</p> <div data-bbox="398 300 736 555" data-label="Chemical-Block"> </div> <ul style="list-style-type: none"> • diagram showing electron density of σ bond • diagram showing electron density of π bond <div data-bbox="358 734 1232 1104" data-label="Chemical-Block"> </div> <div data-bbox="313 1165 1198 1428" data-label="Chemical-Block"> </div>	<p>(1)</p> <p>(1) Only one pi bond needs to be labelled</p> <p>Can be shown by 2 separate diagrams</p> <p>All the examples on the left score M1 and M2</p> <p>If both diagrams are correct but names reversed score 1</p> <p>Do not award electron rings, single lines or contour lines</p>	(4)

	<ul style="list-style-type: none"> • σ bond head/end on overlap of (<i>p</i>) orbitals 	(1)	Allow overlap along the axis between the atoms/ nuclei Allow axial overlap	
	<ul style="list-style-type: none"> • π bond sideways overlap of (<i>p</i>) orbitals 	(1)	Allow parallel overlap Allow lateral overlap Ignore above and below/horizontal	

Question Number	Answer	Additional Guidance	Mark
18(c)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> restricted/ no rotation about the double bond/C=C (1) (two) different groups on each carbon (of the double bond)/the carbons (of the double bond) (1) 	<p>Allow no or restricted free rotation Ignore lack of twisting/bending/movement</p> <p>Allow different elements/atoms/functional groups Allow an explanation or diagram of the positions of the CH₃ and H. Ignore just the position of the CH₃ Do not award different compounds/molecules</p>	(2)

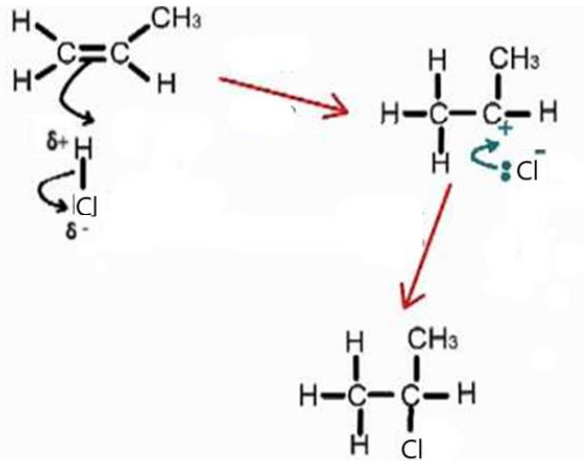
(Total for Question 18 = 10 marks)

Question Number	Answer	Additional Guidance	Mark
19(a)	<p>A description that makes reference to the following points:</p> <ul style="list-style-type: none"> • two peaks at 78 and 80 • peak at 78, 3 x higher than peak at 80 	<p>(1) If there are more than 2 peaks score 0</p> <p>(1) Allow within 1 small square</p> <p>If the peaks are wrong but the lower mass/ charge one is 3x higher than the other, M2 can be scored as a TE.</p> <p>Ignore any labels on the peaks</p>	(2)

Question Number	Answer	Additional Guidance	Mark
19(b)(i)	<p>An answer that makes reference to the following points:</p> <div style="text-align: center;">  </div> <ul style="list-style-type: none"> • diagram showing curly half-arrows forming 2 free radicals (1) • uv (radiation / light) or sunlight (1) 	<p>Both arrows can come from the same side of the bond</p> <p>Ignore just light</p>	(2)

Question Number	Answer	Additional Guidance	Mark
19(b)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> • homolytic: each atom gets one electron/ the electron pair splits evenly (1) • free radical: species with an unpaired electron (1) 	<p>Allow equal splitting of the electrons (in the bond)</p> <p>Allow atom/ element Allow lone electron Ignore free electron</p>	(2)

Question Number	Answer	Additional Guidance	Mark
19(b)(iii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> multiple substitutions can occur/ more than one (organic) product 	<p>Allow more products formed//more waste products Allow termination products Allow side products/reactions Allow further reactions</p> <p>Ignore chain reaction Ignore poor yield/atom economy Ignore forms impurities Ignore references to HCl being formed/toxic</p>	(1)

Question Number	Answer	Additional Guidance	Mark
19(c)(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> • 1 dipole on H–Cl • 2 curly arrow from H–Cl bond to Clδ^- • 3 curly arrow from double bond to H(δ^+) • 4 correct carbocation intermediate • 5 curly arrow from lone pair on Cl • 6 arrow to C$^+$ on intermediate • 7 charge on chloride ion <p>All 7 marking points score 4 marks, 5/6 points score 3 marks, 3/4 points score 2, 2 points score 1 mark</p>	 <p>Arrows must start from the covalent bond or lone pair From the H—Cl bond it must go to the Cl or beyond. From the C=C bond it must go to the H or in the space. From the lone pair on the Cl it must go to the C$^+$ on the intermediate. If wrong alkene used just penalise 1 marking point. If primary carbocation is formed just penalise marking point 4 If half curly arrows used penalise 1 marking point If HBr/HI used penalise 1 marking point</p>	(4)

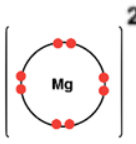
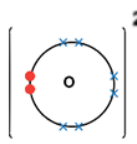
Question Number	Answer	Additional Guidance	Mark
19(c)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> • (the formation of 1-chloropropane goes via a) primary carbocation • (which is) less stable than the secondary carbocation (formed when of 2-chloropropane is produced) 	<p>(1) Do not award 1-chloropropane is a primary carbocation or 2-chloropropane is a secondary carbocation but only penalise once,</p> <p>(1) Allow the correct comparison between a tertiary and primary or secondary carbocation for 1 mark Allow reverse argument</p>	(2)

(Total for Question 19 = 13 marks)

Question Number	Answer	Additional Guidance	Mark
20(a)(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> • calculation of the % abundance of the third isotope • substitute equation • calculation of the mass of the 3rd isotope • answer to 2 SF only 	<p><u>Example of calculation</u></p> <p>(1) $100 - 78.99 - 10.00 = 11.01(\%)$</p> <p>(1) $24.32 = \frac{(24 \times 78.99) + (25 \times 10) + (y \times 11.01)}{100}$</p> <p>(1) $y = \frac{2432 - (24 \times 78.99) - (25 \times 10)}{11.01}$</p> <p>$y = 25.998$</p> <p>(1) mass number = 26</p> <p>Correct answer with some correct working beyond M1 scores 4</p>	(4)

Question Number	Answer	Additional Guidance	Mark
20(a)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> • same number of protons <p>and</p> <p>different number of neutrons</p>	<p>Allow same atomic number/ same number of electrons/ same electronic configuration/ same reactivity/chemical properties Ignore they are the same element</p> <p>and</p> <p>Allow different number of nucleons/ different mass number/different (atomic) mass Do not award relative atomic mass</p>	(1)

Question Number	Answer	Additional Guidance	Mark
20(a)(iii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> • ^{24}Mg and lowest mass or lowest m/z ratio (so deflected more by the magnetic field) 	<p>Allow ^{24}Mg is lightest Allow $^{24}\text{Mg}^+$ Ignore just the lowest mass</p>	(1)

Question Number	Answer	Additional Guidance	Mark
20(b)(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> correct structure of Mg ion and charge correct structure of O ion and charge 	<p>Example of diagrams Allow any combination/position of dots and crosses or just dots or just crosses.</p> <p>   </p> <p>Accept Mg with charge but no electrons and/or no circle Penalise lack of charges once only</p>	(2)

Question Number	Answer	Additional Guidance	Mark
20(b)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> oxide/ O^{2-} smaller than sulfate/ SO_4^{2-} stronger (electrostatic) attraction between the (Mg^{2+} and O^{2-}) ions 	<p>Allow just the oxide is smaller or vice versa Do not award comparison with sulfur or sulfide</p> <p>Allow stronger ionic bond Allow more energy required to break the ionic bond Allow reverse argument Ignore reference to lattice energy Ignore reference to distortion/polarisation Any reference to intermolecular forces /covalent bond/molecular structure score 0</p>	(2)

Question Number	Answer	Additional Guidance	Mark
20(c)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> Mg: has delocalised electrons (that are free to move) when solid and liquid MgO: ions are only free to move when liquid 	<p>(1) Allow has electrons that are free to move</p> <p>(1) Allow ions are not free to move when solid Ignore ions/electrons carrying charge</p>	(2)

Question Number	Answer	Additional Guidance	Mark
20(d)(i)	<p>Example of equation</p> $\text{Mg(s)} + \text{H}_2\text{SO}_4(\text{aq}) \longrightarrow \text{MgSO}_4(\text{aq}) + \text{H}_2(\text{g})$ <ul style="list-style-type: none"> correct balanced equation correct state symbols 	<p>$\text{Mg(s)} + 2\text{H}^+(\text{aq}) \longrightarrow \text{Mg}^{2+}(\text{aq}) + \text{H}_2(\text{g})$</p> <p>(1) Allow multiples Allow ionic equation</p> <p>(1) M2 dependent on M1 or having the correct species in an unbalanced equation</p>	(2)

Question Number	Answer	Additional Guidance	Mark
20(d)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> bubbles (of gas)/ fizzing/ effervescence Mg disappears/ disintegrates /gets smaller /dissolves <p>OR</p> <p>mixture gets warmer/ temperature increase</p>	<p>(1) Ignore just hydrogen/gas produced</p> <p>(1) Allow solid disappears Ignore Mg floats</p> <p>Ignore just exothermic/ temperature changes</p> <p>Do not award white ppt</p>	(2)

Question Number	Answer	Additional Guidance	Mark
20(e)(i)	<ul style="list-style-type: none"> number of moles of sulfuric acid 	<p>Example of calculation</p> $30 \times 0.5 \div 1000 = 0.015/ 1.5 \times 10^{-2} \text{ (mol)}$ <p>Do not award 1 SF.</p>	(1)

Question Number	Answer	Additional Guidance	Mark
20(e)(ii)	<ul style="list-style-type: none"> mass of Mg 	<p>Example of calculation</p> $0.015 / 1.5 \times 10^{-2} \times 24.3 = 0.3645 \text{ (g)}$ <p>Ignore SF except 1SF</p> <p>TE on (e)(i).</p>	(1)


Question Number	Answer	Additional Guidance	Mark
20(e)(iii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> to ensure all the sulfuric acid is used up/ sulfuric acid is limiting 	<p>Allow all the sulfuric acid is neutralised</p> <p>Allow Mg is easy to remove from the reaction mixture.</p> <p>Ignore so that the Mg is in excess</p>	(1)

Question Number	Answer	Additional Guidance	Mark
20(e)(iv)	<p>An answer that refers to the following point:</p> <ul style="list-style-type: none"> (gravity) filtration 	<p>Ignore any heating after filtration</p>	(1)

Question Number	Answer	Additional Guidance	Mark
20(e)(v)	<ul style="list-style-type: none"> maximum mass of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ calculation of % yield moles of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ calculation of % yield 	<p><u>Example of calculation</u></p> <p>(1) $0.015 / 1.5 \times 10^{-2} \text{ (mol)} \times 246.4 = 3.696 \text{ g}$</p> <p>(1) $2.78 \div 3.696 \times 100 = 75.216 \%$</p> <p>Ignore SF except 1SF</p> <p>TE on (e)(i)</p> <p>OR</p> <p>(1) $2.78 \div 246.4 = 0.011282 \text{ (mol)}$</p> <p>(1) $0.011282 / 0.015 \times 100 = 75.216 \%$</p> <p>Ignore SF except 1SF</p> <p>TE on (e)(i)</p> <p>TE on calculated molar mass of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ as long as the % is less than 100%</p> <p>Correct answer with some working scores 2</p>	(2)

(Total for Question 20 = 22 marks)

Question Number	Answer	Additional Guidance	Mark																								
21(a)	<ul style="list-style-type: none">M1 % (of hydrogen) (1)M2 calculation of moles (1)M3 divide by the lowest number of moles to get empirical formula (1)M4 calculation of M_r of empirical formula (1)M1 % (of hydrogen) (1)M2 multiplication of % by M_r (row 2) (1)M3 calculation of ratio number (row 3) (1)M4 divide by the lowest number to get empirical formula (row 4) (1)	<p><u>Example of calculation</u></p> <p>$100 - 17.48 - 77.67 = 4.85$ (%)</p> <table><tr><th>B</th><th>O</th><th>H</th></tr><tr><td>17.48/10.8</td><td>77.67/16</td><td>4.85/1</td></tr><tr><td>1.6185</td><td>4.854</td><td>4.85</td></tr><tr><td>1.6185/1.6185 = 1</td><td>4.85/1.6185 = 2.996</td><td>4.85/1.6185 = 2.996</td></tr></table> <p>$1 \times 10.8 + 3 \times 16 + 3 \times 1 = 61.8$ (g mol⁻¹)</p> <p>If they only use 2 elements, they can score one mark for M2 and M3 being correct for both B and O</p> <p>Or</p> <table><tr><th>B</th><th>O</th><th>H</th></tr><tr><td>$17.48 \times 61.8/100$</td><td>$77.67 \times 61.8/100$</td><td>$4.85 \times 61.8/100$</td></tr><tr><td>= 10.8</td><td>= 48</td><td>= 3</td></tr><tr><td>10.8/10.8 = 1</td><td>48/16 = 3</td><td>3/1 = 3</td></tr></table>	B	O	H	17.48/10.8	77.67/16	4.85/1	1.6185	4.854	4.85	1.6185/1.6185 = 1	4.85/1.6185 = 2.996	4.85/1.6185 = 2.996	B	O	H	$17.48 \times 61.8/100$	$77.67 \times 61.8/100$	$4.85 \times 61.8/100$	= 10.8	= 48	= 3	10.8/10.8 = 1	48/16 = 3	3/1 = 3	(4)
B	O	H																									
17.48/10.8	77.67/16	4.85/1																									
1.6185	4.854	4.85																									
1.6185/1.6185 = 1	4.85/1.6185 = 2.996	4.85/1.6185 = 2.996																									
B	O	H																									
$17.48 \times 61.8/100$	$77.67 \times 61.8/100$	$4.85 \times 61.8/100$																									
= 10.8	= 48	= 3																									
10.8/10.8 = 1	48/16 = 3	3/1 = 3																									

Question Number	Answer	Additional Guidance	Mark
21(b)(i)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> • correct electrons around B • correct electrons around the oxygens • correct electrons round the hydrogens 	<p>Example of diagram Allow any combination of dots and crosses or just dots or just crosses.</p> <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> <p>(1)</p> <p>(1)</p> <p>(1)</p> </div>  </div> <p>Ignore how the lone pair electrons are arranged in oxygen. The marks are only awarded if the bond and number of bonds is correct between the correct two atoms.</p> <p>Anything ionic score 0</p>	(3)

Question Number	Answer	Additional Guidance	Mark
21(b)(ii)	<p>An answer that makes reference to the following points:</p> <ul style="list-style-type: none"> • bond angle 120° • 3 (bonding) pairs of electrons (round B) adopt a position of minimum repulsion 	<p>(1) Ignore trigonal planar/any shape even if incorrect</p> <p>(1) Allow maximum separation of 3 electron pairs</p> <p>No TE on incorrect bond angle for M2 Do not award bonds for electrons Ignore electron pairs have equal repulsion</p> <p>Allow TE on structure in (b)(i)</p> <p>If structure in (b)(i) has 3 bonding and 1 lone pair of electrons</p> <p>M1 bond angle of 107° (allow 106-108)</p> <p>M2 lone pairs repel more than bonding pairs (and adopt a position of minimum repulsion/maximum separation)</p> <p>Any ionic structure from (b)(i) will score 0</p>	(2)

(Total for Question 21 = 9 marks)

Question Number	Answer	Additional Guidance	Mark
22(a)	<ul style="list-style-type: none"> conversion of dm^3 to m^3 (1) conversion of temperature to K (1) rearrangement of ideal gas equation (1) evaluation to give number of moles (1) calculation of molar mass (1) 	<p><u>Example of calculation</u></p> <p>$1 \div 1000 = 0.0010 / 1.0 \times 10^{-3} (\text{m}^3)$</p> <p>$273 + 20 = 293$</p> <p>$n = \frac{pV}{RT}$</p> <p>$\frac{101000 \times 1.0 \times 10^{-3}}{8.31 \times 293} = 0.04148 / 4.148 \times 10^{-2} (\text{mol})$</p> <p>$\frac{0.656}{0.04148} = 15.81 = 16 (\text{g mol}^{-1})$</p> <p>Ignore SF except 1SF Allow TE throughout Allow conversion of Pa to kPa and use of dm^3 Do not award a TE on a molar mass less than 2 Correct answer with some working scores 5</p>	(5)

	<p>Alternative method</p> <ul style="list-style-type: none"> • conversion of any volume in dm³ to m³ by dividing by 1000 (e.g. 24 in this case) • conversion of temperature to K • rearrangement of ideal gas equation • evaluation to give number of moles • calculation of mass in volume chosen in M1 (eg 24 dm³ as shown) and calculation of molar mass 	$24 \div 1000 = 0.024 \text{ (m}^3\text{)}$ $273 + 20 = 293$ $n = \frac{pV}{RT}$ $\frac{101000 \times 0.024}{8.31 \times 293} = 0.99556 \text{ (mol)}$ $0.656 \times 24 = 15.744 \text{ (g)}$ and $15.744 \div 0.99556 \text{ (mol)} = 15.81 \text{ (g mol}^{-1}\text{)}$	
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Question Number	Answer	Additional Guidance	Mark
22(b)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> • methane/CH₄ 	TE on a hydrocarbon that fits the molar mass from (a)	(1)

(Total for Question 22 = 6 marks)

TOTAL FOR SECTION B = 60 MARKS

TOTAL FOR PAPER = 80 MARKS