



General Certificate of Education

Chemistry 1421

CHEM1 Foundation Chemistry

Mark Scheme

2010 examination - January series

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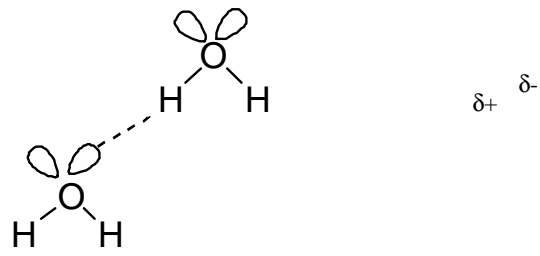
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1	(d)		<p>Lower</p> <p>Two/pair of electrons in (3)p orbital or implied repel (each other)</p>	<p>1</p> <p>1</p> <p>1</p>	<p>If not lower CE = 0/3 If blank mark on Allow does not increase Not 2p</p> <p>M3 dependent upon a reasonable attempt at M2</p>
1	(e)		Boron/B or oxygen/O/ O ₂	1	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	(a)	(i)	$M_r = 132.1$	1	132
			0.0238	1	Allow 0.024 Allow 0.0237 Penalise less than 2 sig fig once in (a)
2	(a)	(ii)	0.0476	1	0.0474-0.0476 Allow (a) (i) x 2
2	(a)	(iii)	1.21	1	Allow consequential from (a) (ii) ie allow (a) (ii) x 1000 / 39.30 Ignore units even if wrong
2	(b)		$\frac{34 \times 100}{212.1}$	1	Allow mass or Mr of desired product times one hundred divided by total mass or Mr of reactants/products If 34/212.1 seen correctly award M1
			= 16.0(3)%	1	Allow 16% 16 scores 2 marks
2	(c)		100(%)	1	Ignore all working
2	(d)		$PV = nRT$ or $n = \frac{PV}{RT}$	1	If rearranged incorrectly lose M1 and M3
			$n = \frac{100000 \times 1.53 \times 10^{-2}}{8.31 \times 310}$	1	M2 for mark for converting P and T into correct units in any expression
			= 0.59(4)	1	Allow 0.593 M3 consequential on transcription error only not on incorrect P and T

2	(e)		(Na_2SO_4) (44.1%) $44.1/142.1$ 0.310 $=1$ $x = 10$	H_2O 55.9% $55.9/18$ 3.11 $=10$	1 1 1	M1 is for 55.9 Alternative method gives 180 for water part = 2 marks $X = 10 = 3$ marks $10.02 = 2$ marks
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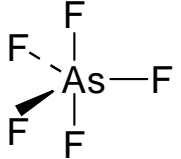
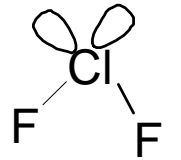
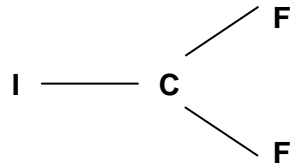
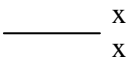
Question	Part	Sub Part	Marking Guidance	Mark	Comments
3	(a)		Hydrogen/H bonds	1	Not just hydrogen
			van der Waals/vdw/ dipole-dipole/London/temporarily induced dipole/dispersion forces	1	Not just dipole
3	(b)			3	M1 for partial charges as indicated in diagram (correct minimum) M2 for all four lone pairs M3 for H bond from the lp to the H ($\delta+$) on the other molecule Lone pair on hydrogen CE = 0 OHO CE = 0 If only one molecule of water shown CE = 0
3	(c)		Hydrogen bonds/IMF (in water) stronger OR IMF / VDW / dipole-dipole forces (in H ₂ S) are weaker OR H bonding is the strongest IMF	1	Ignore energy references Comparison must be stated or implied
3	(d)		Atoms/molecules get larger/more shells/more electrons/ more surface area	1	Not heavier/greater Mr
			therefore increased <u>Van der Waals/IMF</u> forces	1	Ignore references to dipole-dipole forces

3	(e)		Dative (covalent)/ coordinate	1	If not dative/coordinate CE = 0/2 If covalent or blank read on
			(Lone) pair/both electrons/two electrons on O(H ₂) donated (to H ⁺) OR pair/both electrons come from O(H ₂)	1	Explanation of a coordinate bond specific to oxygen or water required Not just H ⁺ attracted to lone pair since that is nearer to a H bond
3	(f)		ionic	1	if not ionic CE = 0
			oppositely charged <u>ions</u> /+ and – <u>ions or particles</u>	1	atoms or molecules loses M2 and M3
			ions attract <u>strongly</u> OR strong/many (ionic) bonds must be broken	1	S ⁻ loses M2 Reference to IMF loses M2 and M3

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	(a)	(i)	single (C-C) bonds <u>only</u> / no double (C=C) bonds	1	Allow all carbon atoms bonded to four other atoms Single C-H bonds only = 0 C=H CE
			C and H (atoms) <u>only/purely/solely/entirely</u>	1	Not consists or comprises Not completely filled with hydrogen CH molecules = CE Element containing C and H = CE
4	(a)	(ii)	C_nH_{2n+2}	1	<i>Formula only</i> C_xH_{2x+2}
4	(b)	(i)	$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$	1	Accept multiples Ignore state symbols
4	(b)	(ii)	gases produced are greenhouse gases/contribute to Global warming/effect of global warming/climate change	1	Allow CO ₂ or water is greenhouse gas/causes global warming Acid rain/ozone CE = 0
4	(c)		carbon	1	Allow C Allow soot
4	(d)	(i)	$C_9H_{20} \rightarrow C_5H_{12} + C_4H_8$	1	Accept multiples
			OR $C_9H_{20} \rightarrow C_5H_{12} + 2C_2H_4$		
4	(d)	(ii)	Plastics, polymers	1	Accept any polyalkene / haloalkanes / alcohols
4	(d)	(iii)	so the <u>bonds</u> break OR because the <u>bonds</u> are strong	1	IMF mentioned = 0
4	(e)	(i)	1,4-dibromo-1-chloropentane / 1-chloro-1,4-dibromopentane	1	Ignore punctuation
4	(e)	(ii)	Chain/position/positional	1	Not structural or branched alone

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	(a)		<p><u>Average/mean mass of (1) atom(s) (of an element)</u> 1/12 mass of one atom of ^{12}C</p> <p>OR</p> <p><u>(Average) mass of one mole of atoms</u> 1/12 mass of one mole of ^{12}C</p> <p>OR</p> <p><u>(Weighted) average mass of all the isotopes</u> 1/12 mass of one atom of ^{12}C</p> <p>OR</p> <p>Average mass of an atom/isotope compared to C-12 on a scale in which an atom of C-12 has a mass of 12</p>	1 1	<p>If moles and atoms mixes Max = 1</p> <p>This expression = 2 marks</p>
5	(b)		<p>d block</p> <p>$[\text{Ar}] 3d^2 4s^2$</p> <p>27</p>	1 1 1	<p>Allow 3d/D</p> <p>Other numbers lose M1</p> <p>Ignore transition metals</p> <p>Can be written in full</p> <p>Allow subscripts</p> <p>$3d^2$ and $4s^2$ can be in either order</p>

5	(c)		$\frac{(90 \times 9) + (91 \times 2) + (92 \times 3) + (94 \times 3)}{17}$	(= 1550) (or Σ their abundances)	1	<p>If one graph reading error lose M1 and allow consequential M2 and M3.</p> <p>If 2 GR errors penalise M1 and M2 but allow consequential M3</p> <p>If not 17 or Σ their abundances lose M2 and M3</p> <p>91.2 = 3 marks provided working shown.</p> <p>M4 -allow nearest consequential element from M3</p> <p>accept Zr in any circumstance</p>
			=91.2		1	
			Zr/ Zirconium		1	
5	(d)		High energy electrons/bombarded or hit with electrons		1	<p>accept electron gun</p> <p>If not 90 lose M3 and M4</p> <p>If charge is wrong on 90 isotope lose M3 only</p> <p>Accept any symbol in place of Z</p> <p>Allow lightest</p>
			knocks out electron(s) (to form ions)		1	
			$Z^+ = \underline{90}$ deflected most		1	
			since lowest mass/lowest m/z		1	
5	(e)		(ions hit detector and) cause current/(ions) accept electrons/cause electron flow		1	QWC
			bigger current = more of that isotope/current proportional to abundance		1	Implication that current depends on the number of ions

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6			 <p>trigonal / triangular bipyramid(al)</p>  <p>Bent / V shape / non-linear / triangular / angular</p> <p>104° - 106°</p> <p>(For candidates who thought this was ClF₂⁺ which contained iodine allow</p>  <p>Trigonal / triangular <u>planar</u></p> <p>120°</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>Mark M1 – M5 independently M1 for 5 bond pairs around As Do not penalise A for As or FI for F</p> <p>Allow trigonal dipyramid</p> <p>M3 for 2 bond pairs to F and 2 lone pairs Lone pairs can be shown as lobes with or without electrons or as xx or</p> <p style="text-align: center;">  </p> <p>Bent-linear = contradiction Do not allow trigonal</p> <p>Not just triangular</p>