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General Certificate of Education

Chemistry 1421

CHEM1 Foundation Chemistry

Mark Scheme

2010 examination - January series

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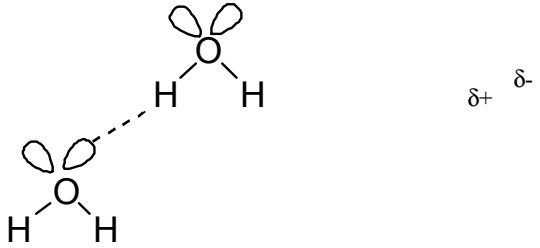
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Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	(a)		$2s^2 2p^6 3s^1$	1	$1s^2$ can be rewritten Allow $2s^2 2p_x^2 2p_y^2 2p_z^2 3s^1$ Allow subscripts and capitals
1	(b)	(i)	Energy/enthalpy (needed) to remove one mole of electrons from one mole of atoms/compounds/molecules/elements ***OR*** Energy to form one mole of positive ions from one mole of atoms ***OR*** Energy/enthalpy to remove one electron from one atom In the gaseous state (to form 1 mol of gaseous ions)	1 1	Energy given out loses M1 M2 is dependent on a reasonable attempt at M1 Energy needed for this change $X(g) \rightarrow X^+(g) + e^{(-)}$ = 2 marks This equation alone scores one mark
1	(b)	(ii)	$Mg^+(g) \rightarrow Mg^{2+}(g) + e^{(-)}$ $Mg^+(g) + e^{(-)} \rightarrow Mg^{2+}(g) + 2e^{(-)}$ $Mg^+(g) - e^{(-)} \rightarrow Mg^{2+}(g)$	1	Do not penalise MG Not equation with X
1	(b)	(iii)	Electron being removed from a positive ion (therefore need more energy)/ electron being removed is closer to the nucleus/Mg^+ smaller (than Mg)/Mg^+ more positive than Mg	1	Allow from a + particle/ species Not electron from a higher energy level/or higher sub-level More protons = 0
1	(b)	(iv)	Range from 5000 to 9000 kJ mol^{-1}	1	
1	(c)		Increase Bigger nuclear <u>charge</u> (from Na to Cl)/more <u>protons</u> electron (taken) from same (sub)shell/ similar or same shielding/ electron closer to the nucleus/smaller atomic radius	1 1 1	If decrease CE = 0/3 If blank mark on QWC If no shielding = 0 Smaller ionic radius = 0

1	(d)		Lower Two/pair of electrons in (3)p orbital or implied repel (each other)	1 1 1	If not lower CE = 0/3 If blank mark on Allow does not increase Not 2p M3 dependent upon a reasonable attempt at M2
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 0.0238	1 1	132 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)		$\frac{34 \times 100}{212.1}$ = 16.0(3)%	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 Allow 16% 16 scores 2 marks
2	(c)		100(%)	1	Ignore all working
2	(d)		PV = nRT or $n = \frac{PV}{RT}$ $n = \frac{100000 \times 1.53 \times 10^{-2}}{8.31 \times 310}$ = 0.59(4)	1 1 1	If rearranged incorrectly lose M1 and M3 M2 for mark for converting P and T into correct units in any expression 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 gives180 for water part =2 marks X = 10 = 3 marks 10.02 = 2 marks

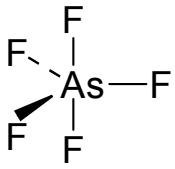
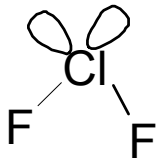
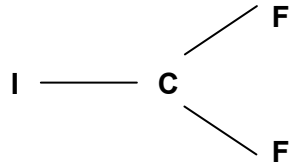
Question	Part	Sub Part	Marking Guidance	Mark	Comments
3	(a)		Hydrogen/H bonds van der Waals/vdw/ dipole-dipole/London/temporarily induced dipole/dispersion forces	1 1	Not just hydrogen Not just dipole
3	(b)			3	M1 for partial charges as indicated in diagram (correct minimum) M2 for all four lone pairs M3 for H bond from the lp to the H (δ+) 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_2S) 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 therefore increased Van der Waals/IMF forces	1 1	Not heavier/greater Mr 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 C and H (atoms) <u>only/purely/solely/entirely</u>	1 1	Allow all carbon atoms bonded to four other atoms Single C-H bonds only =0 C=H CE 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	*Formula only* 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)	$C_9H_{20} \rightarrow C_5H_{12} + C_4H_8$ ***OR*** $C_9H_{20} \rightarrow C_5H_{12} + 2C_2H_4$	1	Accept multiples
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)		Average/mean mass of (1) atom(s) (of an element) 1/12 mass of one atom of ^{12}C ***OR*** (Average) mass of one mole of atoms 1/12 mass of one mole of ^{12}C ***OR*** (Weighted) average mass of all the isotopes 1/12 mass of one atom of ^{12}C ***OR*** 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	1 1 This expression = 2 marks	If moles and atoms mixes Max = 1
5	(b)		d block [Ar] $3d^2 4s^2$ 27	1 1 1	Allow 3d/D Other numbers lose M1 Ignore transition metals Can be written in full Allow subscripts $3d^2$ and $4s^2$ can be in either order

5	(c)		$\frac{(90x9) + (91x2) + (92x3) + (94x3)}{17}$ (= 1550) (or ∑ their abundances)	1 1	If one graph reading error lose M1 and allow consequential M2 and M3. If 2 GR errors penalise M1 and M2 but allow consequential M3 If not 17 or ∑ their abundances lose M2 and M3
			=91.2	1	91.2 = 3 marks provided working shown.
			Zr/ Zirconium	1	M4 -allow nearest consequential element from M3 accept Zr in any circumstance
5	(d)		High energy electrons/bombarded or hit with electrons	1	accept electron gun
			knocks out electron(s) (to form ions)	1	
			Z^+ = 90 deflected most	1	If not 90 lose M3 and M4 If charge is wrong on 90 isotope lose M3 only Accept any symbol in place of Z
			since lowest mass/lowest m/z	1	Allow lightest
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				1	**Mark M1 – M5 independently** M1 for 5 bond pairs around As Do not penalise A for As or Fl for F
			trigonal / triangular bipyramid(al)	1	Allow trigonal dipyramid
				1	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 x x
			Bent / V shape / non-linear / triangular / angular	1	Bent-linear = contradiction Do not allow trigonal
			104° - 106°	1	
			(For candidates who thought this was ClF_2^+ which contained iodine allow 		
			Trigonal / triangular <u>planar</u>		Not just triangular
			120°		