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General Certificate of Education

Chemistry 1421

CHEM1 Foundation Chemistry

Mark Scheme

2009 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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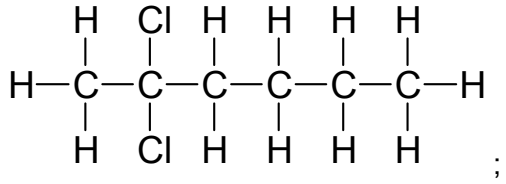
Q	Part	Sub Part	Marking Guidance	Mark	Comments
1	(a)		$2s^2\ 2p^6$;	1	If ignored the $1s^2$ given and written $1s^2 2s^2\ 2p^6$ mark as correct Allow capitals and subscripts
1	(b)	(i)	$Na^+(g) \rightarrow Na^{2+}(g) + e^{(-)}$; $Na^+(g) + e^{(-)} \rightarrow Na^{2+}(g) + 2e^{(-)}$;	2	One mark for equation and one mark for state symbols M2 dependent on M1 Allow $Na^+(g) - e^{(-)} \rightarrow Na(g)$ Allow $X^+(g) \rightarrow X^{2+}(g) + e$ = 1 mark
1	(b)	(ii)	$Na^{(2+)}$ requires loss of e^- from a 2(p) orbital or 2^{nd} energy level or 2^{nd} shell <u>and</u> $Mg^{(2+)}$ requires loss of e^- from a 3(s) orbital or 3^{rd} energy level or 3^{rd} shell / $Na^{(2+)}$ loses e from a lower (energy) orbital/ or vice versa; Less shielding (in Na); e(-) closer to nucleus/ more attraction (of electron to nucleus) (in Na);	1 1 1	Not from 3p Or vice versa for Mg M3 needs to be comparative
1	(b)	(iii)	Aluminium /Al;	1	
1	(c)		Decreases; Increasing nuclear charge/ increasing number of protons; Electrons in same shell or level/ same shielding/ similar shielding;	1 1 1	If not decreases CE = 0 If blank, mark on

1	(d)		Answer refers to Na; Na fewer protons/smaller nuclear charge/ fewer delocalised electrons; Na is a bigger ion/ atom; Smaller attraction between nucleus and delocalised electrons;	 1 1 1	Allow converse answers relating to Mg. Allow Mg is 2+ and Na is +. If vdw CE = 0. If mentioned that charge density of Mg^{2+} is greater then allow first 2 marks. (ie charge / size / attraction). M3 allow weaker metallic bonding.
1	(e)		(Bent) shape showing 2 lone pairs + 2N−H bond pairs; Bent / v shape/ triangular;	1 1	Atoms must be labelled. Lone pairs can be with or without lobes. Not tetrahedral. Allow non-linear. Bent-linear = contradiction.
1	(f)		Ne has full sub-levels/ can't get any more electrons in the sub-levels/ Ne has full shells;	1	Not $2s^2$ $2p^6$ alone. Not stable electron configuration.

Q	Part	Sub Part	Marking Guidance	Mark	Comments
2	(a)	(i)	0.00301/ 3.01x 10^{-3}; Penalise <3sf in (a)(i);	1	Allow 3.01 x 10^{-3} – 3.05 x 10^{-3}. (for candidates who have used Mg as 24)
2	(a)	(ii)	0.00602	1	Allow correct answer a(i) x 2.
2	(a)	(iii)	0.00965/ 9.65 x 10^{-3};	1	Allow 0.009646/ 0.0096-0.0097.
2	(a)	(Iv)	0.00363 moles;	1	Allow range 0.0035 to 0.0037. Allow 2(a)(iii) – 2 (a)(ii) (must be positive).
2	(b)		PV = nRT; V = $\frac{0.512 \times 8.31 \times 298}{96000}$; 0.0132 m^3/ 13.2 dm^3;	1 1 1	Allow all capitals/ lower case. M2 Mark is for all numbers correct . If units in answer are in dm^3 allow this expression with 96 in denominator. M3 Must have correct units/ allow 13200cm^3. Allow min 2 sig figs in answer.
2	(c)		O = 69.6 (%); $\frac{30.4}{14}$ $\frac{69.6}{16}$ 2.17 : 4.35 (1 : 2) NO_2	1 1 1	 Use of 7/8 CE then M1 only. Mark for formula not ratio. If NO_2 and no working shown then allow 1 mark. If 69.6% + NO_2 only = 2. Need to see evidence of M2 working. Allow M2 conseq on the wrong M1 (ie max 1).

Q	Part	Sub Part	Marking Guidance	Mark	Comments
3	(a)	(i)	Covalent; Shared <u>pair of electrons</u> (one from each atom);	1 1	If not covalent CE = 0. If blank, mark on. Not shared electrons.
3	(a)	(ii)	Hydrogen bonds / H bonds; Van der Waals/London/dispersion forces/temporary induced dipole;	1 1	Not just hydrogen.
3	(b)		Showing all the lone pairs on both molecules; Showing the partial charges on O and H on both molecules; Showing the Hydrogen bond from the lone pair on O of one molecule to the delta + on the H of the other molecule;	1 1 1	Allow showing both lone pairs on the O involved in the H-bond. Allow showing both partial charges on the O and H of the other molecule involved in the H bond.
3	(c)	(i)	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$;	1	Accept multiples. Allow C_2H_6O.
3	(c)	(ii)	CO is (produced which is) toxic/ poisonous/C (may be produced) which is toxic/ C is a respiratory irritant/ C (particles) exacerbate asthma/C causes global dimming/ smog;	1	Must relate to C or CO. Any mention of SO_2 NO_2 or other pollutants CE=0.

3	(c)	(iii)	More fuel needed (which costs more)/Wastes fuel/ less fuel burnt (so need more to buy more)/engine gets sooty so need to pay for engine to be cleaned/Have to fit catalytic converter;	1	Not just costs more. Not engine gets sooty unless qualified.
3	(d)	(i)	(React) with CaO/ calcium oxide/quicklime/lime; All the sulfur dioxide may not react with the CaO or $CaCO_3$ / may not have time to react/ incomplete reaction;	1 1	Accept $CaCO_3$/ calcium carbonate/limestone. Not chalk. Accept Incomplete reaction.
3	(d)	(ii)	Occupies a (much) smaller volume;	1	Not easier to store or transport.

Q	Part	Sub Part	Marking Guidance	Mark	Comments
4	(a)		General formula; Chemically similar; Same functional group; Trend in physical properties eg inc bp as M_r increases; Contains an additional CH_2 group;	2 max	Any two points.
4	(b)	(i)	 ; C_3H_6Cl;	1 1	All bonds and atoms must be shown. Allow any order of elements. Do not allow EF consequestial on their wrong displayed formula.
4	(b)	(ii)	Same Molecular formula/ both $C_6H_{12}Cl_2$/ same number and type of atoms; Different structural formula/ different structure/ different displayed formula;	1 1	Not atoms or elements with same MF CE=O. Allow different C skeleton. If same chemical formula can allow M2 only. M2 insufficient to say atoms arranged differently. M2 consequential on M1.
4	(c)		M_r =228 for total reactants; $\frac{155 \times 100}{228}$ = 67.98%;	1 1	 Allow 67.98 or 68.0 or 68%.

4	(d)	(i)	Bp increases with increasing (molecular) size/ increasing M_r/ increasing no of electrons/increasing chain length; Increased VDW forces (between molecules) (when larger molecule)/ bigger IMFs;	1 1	Atoms CE =0. QWC Not dipole-dipole or hydrogen bonds. If VDW between atoms in M2 CE=0.
4	(d)	(ii)	Fractional distillation/ fractionation/ GLC/chromatography;	1	

Q	Part	Sub Part	Marking Guidance	Mark	Comments
5	(a)	(i)	Average/mean mass of 1 atom (of an element); Mass 1/12 atom of ^{12}C;	1 1	Average mass of 1 atom x 12. Mass 1 atom of ^{12}C. QWC.
5	(a)	(ii)	Other isotope = 46.0%; $107.9 = \frac{(54 \times 107.1) + (46 \times ?)}{100}$; 108.8; Same electronic configuration/ same number of electrons (in outer shell)/ both have 47 electrons;	1 1 1 1	 M2 whole expression. Answer 108.8 (3 marks). Answer min 1 d.p.. Ignore protons and neutrons unless incorrect . Not just electrons determine chemical properties.
5	(b)		Ionisation; high energy electrons fired at sample; Acceleration; With electric field/accelerating potential/potential difference; Deflection; With electromagnet/ magnet/ magnetic field;	1 1 1 1 1 1	 Allow electron gun /blasted with electrons. Allow by negative plate. M2 dependent on M1. M4 dependent on M3. M6 dependent on M5.

5	(c)		(Silver) metallic (bonding); Regular arrangement of same sized particles; + charge in each ion;	1 1 1	Vdw/molecules CE=0. Ignore multiple positive charges. Candidates do not need to show delocalised electrons.
5	(d)		Ionic (bonds); Minimum 4 ions shown in 2D square arrangement placed Correctly; Further 3 ions shown correctly in a cubic lattice; Strong (electrostatic) forces/bonds; Between + and – ions;	1 1 1 1 1	 Do not allow multiple charges on ions. If vdw/molecules/covalent mentioned CE=0 for M4 and M5. Accept between oppositely charged ions.