OCR
RECOGNISING ACHIEVEMENT

GCE

Chemistry A

Advanced GCE **A2 H434**

Advanced Subsidiary GCE **AS H034**

Mark Schemes for the Units

January 2009

H034/H434/MS/R/09J

Oxford Cambridge and RSA Examinations

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Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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MARK SCHEME FOR THE UNITS

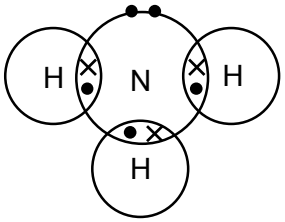
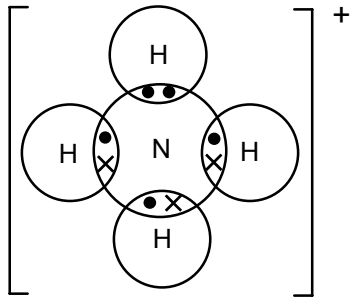
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F321

Question			Expected Answers	Marks	Additional Guidance
1	a	i	(atoms of the) same element **OR** same atomic no. **OR** no. of protons **AND** with different numbers of neutrons **OR** different masses ✓	1	**IGNORE** 'same number of electrons' **DO NOT ALLOW** 'different numbers of electrons' **DO NOT ALLOW** 'different relative atomic masses **DO NOT ALLOW '**elements with different numbers of neutrons' **without** mention of same protons **OR** same atomic number
		ii	**same** (number of) **electrons** (in the outer shell) **OR** same **electron** configuration **OR** structure ✓	1	**DO NOT ALLOW** different number of protons **IGNORE** 'same number of protons' **IGNORE** 'they are both carbon' **OR** 'they are both the same element'
		iii	**mass** of the isotope compared to 1/12th **OR** **mass** of the atom compared to 1/12th ✓ (the mass of a) carbon-12 **OR** ^{12}C (atom) ✓	2	**IGNORE** reference to average **OR** weighted mean (i.e. correct definition of relative atomic mass will score both marks) **ALLOW** mass of a **mole** of the isotope/atom with 1/12th the mass of a **mole OR** 12 g of ✓ carbon-12 ✓ **ALLOW 2 marks for:** '**mass** of the isotope **OR mass** of the atom compared to ^{12}C atom given a mass of 12.0' i.e. 'given a mass of 12' communicates the same idea as 1/12th.'

Question			Expected Answers	Marks	Additional Guidance
					ALLOW 12C **OR** C12 **ALLOW FOR 2 MARKS:** $\frac{\text{mass of the isotope}}{\text{mass of 1/12th mass of carbon - 12}}$ i.e. fraction is equivalent to 'compared to' **ALLOW 1 MARK FOR** a mix of mass of atom and mass of mole of atoms**, i.e.:** 'mass of the isotope/mass of an atom compared with 1/12th the mass of a **mole OR** 12 g of carbon-12.'
	b		giant covalent (lattice) ✓ layers ✓ **Each of the three properties below must be linked to explanation** *good conductor* - because it has mobile electrons **OR** delocalised electrons **OR** electrons can move ✓ *high melting / boiling point* - because strong **OR** covalent bonds have to be broken ✓ *soft* - because there are van der Waals' forces **OR**	**5**	**Use annotations with ticks, crosses etc. for this part.** **All five marking points are independent** **ALLOW** giant atomic **OR** giant molecular **OR** macromolecular **ALLOW** planes **OR** sheets Allow diagram showing at least two layers **Electron(s) must be spelt correctly ONCE** **DO NOT ALLOW** 'strong ionic bonds' **OR** strong metallic bonds.

Question			Expected Answers	Marks	Additional Guidance
			intermolecular forces **OR** weak bonds **OR** weak forces between the layers **OR** *soft* - because layers can slide ✓		
	c	**i**	0.0268 **OR** 0.027 **OR** 0.02675 mol ✓	**1**	**NO OTHER ACCEPTABLE ANSWER**
		ii	1.61×10^{22} ✓	**1**	**ALLOW** 1.6×10^{22} up to calculator value **ALLOW** **ECF** answer to **(i)** × 6.02×10^{23} **ALLOW** any value for N_A in the range: $6.0 \times 10^{23} – 6.1 \times 10^{23}$
			Total	**11**	

Question			Expected Answers	Marks	Additional Guidance
2	a	i	a shared pair of electrons ✓	1	**ALLOW** any response that communicates electron pair **ALLOW** shared pairs
		ii	 ✓	1	Must be '*dot-and-cross*' circles for outer shells **NOT** needed **IGNORE** inner shells Non-bonding electrons of N do not need to be shown as a pair.
		iii	Shape: pyramidal **OR** (trigonal) pyramid ✓ Explanation: There are 3 bonded pairs and 1 lone pair ✓ Lone pairs repel more than bonded pairs ✓	3	 **ALLOW** 'bonds' for 'bonded pairs' **DO NOT ALLOW** 'atoms repel' **DO NOT ALLOW** electrons repel **ALLOW** LP for 'lone pair' **ALLOW** BP for bonded pair
	b	i	$1s^2 2s^2 2p^6 3s^2 3p^6$ ✓	1	**ALLOW** subscripts
		ii	 '*Dot-and-cross*' diagram to show four shared pairs of electrons one of which is a dative covalent bond (which must consist of the same symbols) ✓	1	**IGNORE** inner shells **IGNORE** '+' sign **BUT** a **DO NOT ALLOW** '–' sign. Brackets and circles not required

Question			Expected Answers	Marks	Additional Guidance
		iii	tetrahedral ✓ 109.5º ✓	2	**ALLOW** 109–110º
		iv	ions **OR** electrons cannot move in a solid ✓ **ions** can move **OR** are mobile in solution ✓	2	**ALLOW** ions can move in liquid **DO NOT ALLOW** ions can move when molten **ALLOW 1 mark for:** 'Ions can only move in solution'
	c	i	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ ✓	1	**ALLOW** $2NH_4OH + H_2SO_4 \rightarrow (NH_4)_2SO_4 + 2H_2O$ **ALLOW** $NH_3 + H^+ \rightarrow NH_4^+$ **ALLOW** any correct multiple **IGNORE** state symbols
		ii	when the H^+ in an acid is replaced by a metal ion **OR** an ammonium ion **OR** a + ion ✓	1	**ALLOW** H for H^+; **ALLOW** 'metal' for 'metal ion **i.e.:** H in an acid can be replaced by a metal
		iii	accepts a proton **OR** accepts H^+ ✓	1	**ALLOW** donates a lone pair **ALLOW** removes H^+ **ALLOW** forms OH^- ions
		iv	132.1 ✓	1	**IGNORE** units **NO OTHER ACCEPTABLE ANSWER**
			Total	15	

Question			Expected Answers	Marks	Additional Guidance
3	a	i	white precipitate **OR** white solid ✓	1	**DO NOT ALLOW** goes white / cloudy / milky / off-white **DO NOT ALLOW** creamy white precipitate **ALLOW** milky white precipitate
		ii	$Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$ Balanced equation correct ✓ **ALL** state symbols correct ✓	2	**ALLOW 2 marks** $AgNO_3(aq) + Cl^-(aq) \longrightarrow AgCl(s) + NO_3^-(aq)$ **(equation mark and state symbol mark)** **ALLOW 1 mark for:** $AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$ **(state symbol mark)** **ALLOW 1 mark for the state symbols for THESE balanced equation ONLY:** $Ag^{2+}(aq) + 2Cl^-(aq) \longrightarrow AgCl_2(s)$ $Ag(aq) + Cl(aq) \longrightarrow AgCl(s)$
		iii	(precipitate) dissolves **OR** disappears **OR** goes colourless **OR** goes clear ✓	1	**ALLOW** forms a solution
	b	i	removes or kills bacteria **OR** kills germs **OR** kills micro-organisms **OR** make it safe to drink **OR** sterilises water ✓	1	**ALLOW** to make water potable **IGNORE** virus **DO NOT ALLOW** 'purifies water' **DO NOT ALLOW** 'antiseptic'
		ii	it is toxic **OR** poisonous **OR** could form chlorinated hydrocarbons ✓	1	**ALLOW forms** carcinogens **OR** forms toxins **DO NOT ALLOW** harmful **DO NOT ALLOW 'it** causes cancer' (chlorine is not a carcinogen) **DO NOT ALLOW 'irritates** lungs'
	c	i	Cl_2 is 0 **AND** HCl is –1 **AND** HClO is (+)1 ✓	**1**	**ALLOW** 1– **ALLOW** 1+

Question			Expected Answers	Marks	Additional Guidance
		ii	It has been both oxidised and reduced **OR** Its oxidation state has increased and decreased ✓ it has been oxidised (from 0) to +1 **AND** it has been reduced (from 0) to –1 ✓ (These two points together subsume the first marking point)	2	**ALLOW** 'chlorine' **OR** 'it' **DO NOT ALLOW** chlor**IDE** **IF CORRECT OXIDATION STATES IN (i), ALLOW 2 marks for:** it is oxidised to form HClO it is reduced to form HCl
		iii	$Cl_2 + 2NaOH \rightarrow NaClO + NaCl + H_2O$ ✓	1	**IGNORE** state symbols
	d	i	$2ClO_2 \rightarrow Cl_2 + 2O_2$ **OR** $ClO_2 \rightarrow ½Cl_2 + O_2$ ✓	1	**IGNORE** state symbols
		ii	divides each % by correct A_r: i.e. $\frac{1.20}{1.0} : \frac{42.0}{35.5} : \frac{56.8}{16.0}$ **OR** 1.20, 1.18, 3.55 ✓ $HClO_3$ ✓	2	**ALLOW 1 mark** for empirical formula of HCl_2O_6 (use of atomic numbers) **ALLOW 1 mark** for empirical formula of H_3Cl_3O (upside-down expression) **ALLOW ECF** for use of incorrect A_r values to get empirical formula but only if no over-rounding **ALLOW 2 marks** for correct answer of $HClO_3$
		iii	the oxidation number of chlorine ✓	1	**ALLOW** 'the oxidation state of chlorine **OR** oxidation number of chlorine is 5' **DO NOT ALLOW** 'it' instead of 'chlorine' **DO NOT ALLOW** 'the oxidation state **OR** number of chlor**IDE** is 5'
			Total	14	

Question			Expected Answers	Marks	Additional Guidance
4	a	i	Magnesium ions have a greater charge✓ Magnesium has more (delocalised **OR** outer) **electrons**✓ Magnesium has greater attraction between **ions** and **electrons OR** has stronger **metallic** bonds ✓	3	***USE annotations with ticks, crosses, ecf, etc for this part.*** **ALLOW REVERSE ARGUMENT** e.g. sodium ions have a smaller charge **ALLOW** Mg^{2+} / Mg ion / Na ion / Na^{+} ion **ALLOW** 'charge density' as alternative to 'charge' **ALLOW REVERSE ARGUMENT** e.g. sodium has fewer electrons **ALLOW REVERSE ARGUMENT** e.g. sodium has less attractions between **ions** and **electrons** **OR** has weaker **metallic** bonds ✓
		ii	Cl_2 **OR** S_8 has intermolecular **OR** van der Waals' forces ✓ S_8 has stronger intermolecular forces **OR** van der Waals' forces than Cl_2 **OR** S_8 has more electrons ✓	2	**ALLOW REVERSE ARGUMENT** ie Cl_2 has weaker intermolecular forces **OR** van der Waals' forces **DO NOT ALLOW** comparison involving covalent bonds **ALLOW REVERSE ARGUMENT** Cl_2 has fewer electrons

Question			Expected Answers	Marks	Additional Guidance
	b			3	***USE annotations with ticks, crosses, ecf, etc for this part.***
			nuclear charge increases/ protons increase ✓		**Nuclear OR proton(s) OR nucleus spelt correctly ONCE** **IGNORE** 'atomic number increases' **IGNORE** 'nucleus gets bigger' 'charge increases' is not sufficient **ALLOW** 'effective nuclear charge increases' **OR** 'shielded nuclear charge increases'
			electrons added to the same shell **OR** screening **OR** shielding remains the same ✓		**IGNORE** reference to atomic radius staying the same **ALLOW** shielding is similar **DO NOT ALLOW** extra shielding
			greater attraction **OR** greater pull ✓		A comparison **must** be included: i.e. '**greater** pull', '**more** pull', 'held **more** tightly';
			Total	**8**	

Question			Expected Answers	Marks	Additional Guidance
5	a		BaO ✓ Ba_3N_2 ✓	2	Treat any shown charges as working and ignore. Treat B for Ba as a slip.
	b	i	$\frac{0.11}{137.3}$ ✓	1	mark is for the **working out** which **MUST** lead to the correct answer of 8 x 10^{-4} up to calculator value
		ii	19.2 **OR** calculated answer to **(b)(i)** x 24000 ✓	1	**ALLOW** 19 up to calculator value.
		iii	8.0 x 10^{-3} **OR** calculated answer to **(b)(i)** x 10 ✓	1	**ALLOW** 8.01 x 10^{-3} up to calculator value.
		iv	any pH > 7 but <15 ✓	1	**ALLOW** a correct range of pH.
	c		Less barium to react **OR** some barium has already reacted ✓	1	**ALLOW** less volume because contains some BaO or Ba_3N_2
	d		reactivity increases (down the group) ✓ atomic radii increase **OR** there are more shells ✓ there is **more** shielding **OR more** screening ✓ the nuclear attraction decreases **OR** Increased shielding and distance outweigh the increased nuclear charge ✓ easier to remove (outer) electrons **OR** ionisation energy decreases ✓	5	***USE annotations with ticks, crosses, ecf, etc for this part.*** **DO NOT ALLOW** more orbitals **OR** more sub-shells '**More'** *is essential* **ALLOW** 'more electron repulsion from inner shells' **ALLOW** 'nuclear pull' **IGNORE** any reference to 'effective nuclear charge' **ALLOW** easier to form positive ion
			Total	12	

Grade Thresholds

Advanced GCE Chemistry A (H034)
January 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
F321	Raw	60	46	40	34	28	23	0
	UMS	90	72	63	54	45	36	0

Specification Aggregation Results

The specification will be aggregated for the first time in June 2009.

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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