

Chemistry A

Advanced GCE A2 H434

Advanced Subsidiary GCE AS H034

Mark Schemes for the Units

January 2009

H034/H434/MS/R/09J

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

CONTENTS

Advanced GCE Chemistry (H434)

Advanced Subsidiary GCE Chemistry (H034)

MARK SCHEME FOR THE UNITS

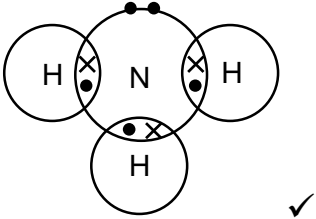
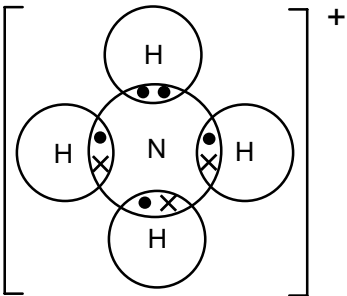
Unit/Content	Page
F321	1
Grade Thresholds	11

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
			<p>ALLOW 12C OR C12</p> <p>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'</p> <p>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.'</p>
b	<p>giant covalent (lattice) ✓</p> <p>layers ✓</p> <p>Each of the three properties below must be linked to explanation <i>good conductor</i> - because it has mobile electrons OR delocalised electrons OR electrons can move ✓</p> <p><i>high melting / boiling point</i> - because strong OR covalent bonds have to be broken ✓</p> <p><i>soft</i> - because there are van der Waals' forces OR</p>	5	<p>Use annotations with ticks, crosses etc. for this part.</p> <p>All five marking points are independent</p> <p>ALLOW giant atomic OR giant molecular OR macromolecular</p> <p>ALLOW planes OR sheets Allow diagram showing at least two layers</p> <p>Electron(s) must be spelt correctly ONCE</p> <p>DO NOT ALLOW 'strong ionic bonds' OR strong metallic bonds.</p>

Question			Expected Answers	Marks	Additional Guidance
			intermolecular forces OR weak bonds OR weak forces between the layers OR <i>soft</i> - 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) $\times 6.02 \times 10^{23}$ 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 ' <i>dot-and-cross</i> ' 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	 ' <i>Dot-and-cross</i> ' 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 ✓ 109.5° ✓	2	ALLOW 109–110°
	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	$2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$ ✓	1	ALLOW $2\text{NH}_4\text{OH} + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4 + 2\text{H}_2\text{O}$ ALLOW $\text{NH}_3 + \text{H}^+ \rightarrow \text{NH}_4^+$ 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	$\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \longrightarrow \text{AgCl}(\text{s})$ Balanced equation correct ✓ ALL state symbols correct ✓	2	ALLOW 2 marks $\text{AgNO}_3(\text{aq}) + \text{Cl}^-(\text{aq}) \longrightarrow \text{AgCl}(\text{s}) + \text{NO}_3^-(\text{aq})$ (equation mark and state symbol mark) ALLOW 1 mark for: $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$ (state symbol mark) ALLOW 1 mark for the state symbols for THESE balanced equation ONLY: $\text{Ag}^{2+}(\text{aq}) + 2\text{Cl}^-(\text{aq}) \longrightarrow \text{AgCl}_2(\text{s})$ $\text{Ag}(\text{aq}) + \text{Cl}(\text{aq}) \longrightarrow \text{AgCl}(\text{s})$
		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 chlorIDE IF CORRECT OXIDATION STATES IN (i), ALLOW 2 marks for: it is oxidised to form HClO it is reduced to form HCl
	iii	$\text{Cl}_2 + 2\text{NaOH} \rightarrow \text{NaClO} + \text{NaCl} + \text{H}_2\text{O}$ ✓	1	IGNORE state symbols
d	i	$2\text{ClO}_2 \rightarrow \text{Cl}_2 + 2\text{O}_2$ OR $\text{ClO}_2 \rightarrow \frac{1}{2}\text{Cl}_2 + \text{O}_2$ ✓	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 ₂ O ₆ (use of atomic numbers) ALLOW 1 mark for empirical formula of H ₃ Cl ₃ O (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 chlorIDE is 5'
		Total	14	

Question			Expected Answers	Marks	Additional Guidance
4	a	i	<p>Magnesium ions have a greater charge ✓</p> <p>Magnesium has more (delocalised OR outer) electrons ✓</p> <p>Magnesium has greater attraction between ions and electrons OR has stronger metallic bonds ✓</p>	3	<p><i>USE annotations with ticks, crosses, etc, etc for this part.</i></p> <p>ALLOW REVERSE ARGUMENT e.g. sodium ions have a smaller charge ALLOW Mg²⁺ / Mg ion / Na ion / Na⁺ ion ALLOW 'charge density' as alternative to 'charge'</p> <p>ALLOW REVERSE ARGUMENT e.g. sodium has fewer electrons</p> <p>ALLOW REVERSE ARGUMENT e.g. sodium has less attractions between ions and electrons OR has weaker metallic bonds ✓</p>
		ii	<p>Cl₂ OR S₈ has intermolecular OR van der Waals' forces ✓</p> <p>S₈ has stronger intermolecular forces OR van der Waals' forces than Cl₂</p> <p>OR S₈ has more electrons ✓</p>	2	<p>ALLOW REVERSE ARGUMENT ie Cl₂ has weaker intermolecular forces OR van der Waals' forces DO NOT ALLOW comparison involving covalent bonds</p> <p>ALLOW REVERSE ARGUMENT Cl₂ has fewer electrons</p>

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

Question		Expected Answers	Marks	Additional Guidance
5	a	BaO ✓ Ba ₃ N ₂ ✓	2	Treat any shown charges as working and ignore. Treat B for Ba as a slip.
	b	i	1	mark is for the working out which MUST lead to the correct answer of 8×10^{-4} up to calculator value
		ii	1	ALLOW 19 up to calculator value.
		iii	1	ALLOW 8.01×10^{-3} up to calculator value.
		iv	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 ₃ N 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.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

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14 – 19 Qualifications (General)

Telephone: 01223 553998

Facsimile: 01223 552627

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