OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

CHEMISTRY A F321

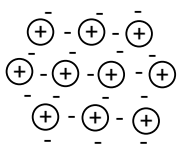
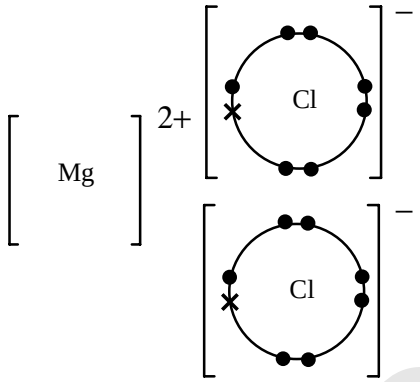
Unit F321: Atoms, Bonds and Groups

Specimen Mark Scheme

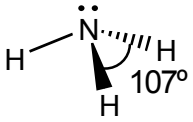
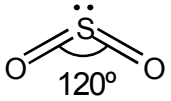
The maximum mark for this paper is **60**.

This document consists of **6** printed pages and **2** blank pages.

Question Number	Answer	Max Mark
1(a)(i)	atoms of the same element with different numbers of neutrons/different masses ✓	[1]
(ii)	^{79}Br 35 protons, 44 neutrons, 35 electrons ✓ ^{81}Br 35 protons, 46 neutrons, 35 electrons ✓	[2]
(iii)	$(1s^2)2s^22p^63s^23p^63d^{10}4s^24p^5$✓	[1]
(b)(i)	iodide has been converted to iodine ✓ (with correct use and spelling of iodide and iodine) The 1st experiment shows that bromine is more reactive than iodine ✓ The 2nd experiment shows that chlorine is more reactive than bromine ✓ *Accept 1 mark for 2nd and 3rd marking points if the correct reactivity order of chlorine > bromine > iodine has been stated.*	[3]
(ii)	$Br_2 + 2I^- \longrightarrow 2Br^- + I_2$ ✓	[1]
(c)	add $AgNO_3/Ag^+$ (to a solution of the food) ✓ $Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$ ✓ degree of cloudiness/whiteness/intensity indicates relative quantity ✓ sodium **ion** content needs to be determined as well ✓	[4]
2(a)(i)	S ✓	[1]
(ii)	Al ✓	[1]
(iii)	B ✓	[1]
(iv)	Ca ✓	[1]
(v)	K ✓	[1]
(vi)	K ✓	[1]
(b)(i)	atomic radii decrease /similar shielding /electrons added to same shell ✓ number of protons in the nucleus increases ✓ nuclear attraction increases ✓	[3]
(b)(ii)	$Na^{2+}(g) \longrightarrow Na^{3+}(g) + e^-$: equation **and** state symbols ✓	[1]
(b)(iii)	large jump (in energy) between the 4th and 5th ionisation energies ✓ four electrons in outer shell so element is Si ✓	[2]

Question Number	Answer	Max Mark
3(a)(i)	 positive ions ✓electrons ✓ (must be labelled)	[2]
(ii)	the electrons move ✓	[1]
(b)(i)	attraction between oppositely charged ions ✓	[1]
(ii)	 Mg and Cl both with 8 electrons in outer shell, (accept 0 electrons for Mg) Cl must have one dot to seven crosses or vice versa ✓ correct charges on each ion✓	[2]
(iii)	$MgCl_2$ does not conduct when solid because ions are fixed in lattice✓ H_2O does not conduct as there are no free charge carriers/water molecules are uncharged ✓ $MgCl_2$ conducts when aqueous because ions are free to move ✓	[3]
(c)	To boil Cl_2, van der Waals' forces/intermolecular forces are broken (with van der Waals/intermolecular spelt correctly)✓ To boil C, covalent bonds are broken ✓ covalent bonds are stronger than van der Waals' forces ✓	[3]

Question Number	Answer	Max Mark
4(a)(i)	Molar mass of $CaCO_3$ = 100.1 g mol^{-1} ✓ 2.68/100.1 = 0.0268/0.027 ✓	**[2]**
(ii)	0.0268 mol x 24,000 = 643 cm^3 ✓	**[1]**
(iii)	moles HNO_3 = 2 x 0.0268 = 0.0536 /0.054 mol ✓ *(i.e. answer to (i) x 2)* volume of HNO_3 = 0.0536 x 1000/2.50 = 21.4 cm^3 ✓	**[2]**
(b)	Molar mass of anhydrous calcium nitrate = 164.1 g mol^{-1} ✓ Ratio $Ca(NO_3)_2$: H_2O = 69.50/164.1 : 30.50/18 or 0.4235 : 1.694 or 1 : 4 ✓ Formula = $Ca(NO_3)_2 \cdot 4H_2O$ ✓	**[3]**
(c)(i)	because Ca has changed from 0 to +2 ✓ and H has changed from +1 to 0 ✓	**[2]**
(ii)	Calcium reacts with water producing hydrogen/H_2/calcium/hydroxide/$Ca(OH)_2$ ✓ (i.e. one product) $Ca(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$ ✓ (i.e. full equation) Equation would subsume both two marks	**[2]**

Question Number	Answer	Max Mark
5(a)(i)	H_2O NH_3 2 3 ✓ 2 1 ✓	**[2]**
(ii)	 shape ✓ bond angle labelled on diagram as 107 ° ✓  shape ✓ bond angle labelled on diagram as 110–120° ✓	**[4]**
(b)	H bonding from lone pair on O of 1 H_2O molecule to H of another ✓ dipoles shown ✓ Two properties: Ice is lighter than water/ max density at 4°C ✓ explanation: H bonds hold H_2O molecules apart / open lattice in ice / H-bonds are longer ✓ Higher melting/boiling point than expected ✓ explanation: strength of H bonds that need to be broken ✓ *must imply that intermolecular bonds are broken* High surface tension/viscosity ✓ explanation:strength of H bonds across surface ✓	**[6]**
	Paper Total	**[60]**

Assessment Objectives Grid (includes QWC)

Question	AO1	AO2	AO3	Total
1(a)(i)	1			**1**
1(a)(ii)	2			**2**
1(a)(iii)		1		**1**
1(b)(i)		3		**3**
1(b)(ii)	1			**1**
1(c)			4	**4**
2(a)(i)		1		**1**
2(a)(ii)		1		**1**
2(a)(iii)	1			**1**
2(a)(iv)		1		**1**
2(a)(v)	1			**1**
2(a)(vi)	1			**1**
2(b)(i)	3			**3**
2(b)(ii)	1			**1**
2(b)(iii)		2		**2**
3(a)(i)	2			**2**
3(a)(ii)	1			**1**
3(b)(i)	1			**1**
3(b)(ii)		2		**2**
3(b)(iii)		3		**3**
3(c)	3			**3**
4(a)(i)		2		**2**
4(a)(ii)		1		**1**
4(a)(iii)		2		**2**
4(b)		3		**3**
4(c)(i)		2		**2**
4(c)(ii)		2		**2**
5(a)(i)	2			**2**
5(a)(ii)	2	2		**4**
5(b)	6			**6**
Totals	**28**	**28**	**4**	**60**

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