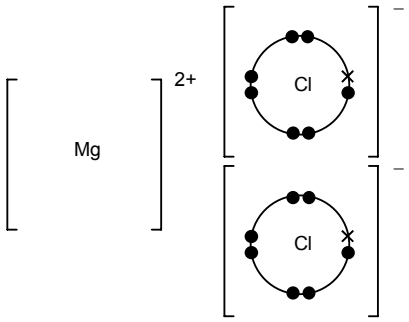
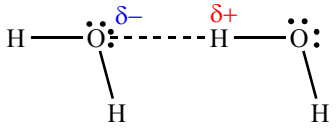
Old Spec - F321 Style - Mark Scheme - January 2008

Question No.			Max Mark
1)	(a)(i)	atoms of same element/same atomic number/same number of protons ….. with different numbers of neutrons/different masses ✓	[1]
	(ii)	isotope protons neutrons electrons ^{10}B 5 5 5 ✓ ^{11}B 5 6 5 ✓	[2]
	(b)(i)	weighted mean mass of an atom/average mass of an atom/average mass of the naturally occurring isotopes ✓ compared with carbon-12 ✓ 1/12th of mass of carbon-12/on a scale where carbon-12 is 12 ✓ *mass of 1 mole of atoms of an element compared with 1/12th the mass of 1 mole of carbon-12 is an alternative* *"mass of the atoms of the element that contains the same number of atoms as are in 1 mole of carbon-12" ⟶ 2 marks (mark lost because of mass units)*	[3]
	(ii)	more of ^{11}B (than ^{10}B) ✓	[1]
	(c)(i)	H_3BO_3 + 3K ⟶ B + 3KOH ✓	[1]
	(ii)	B changes from (+)3 ✓ to 0 ✓ 'oxidation number decreases' with no numbers scores one mark (*must be in terms of ox no. Ignore electrons*) *Mark independently*	[2]
	(d)	**X** = 120° ✓ 3 bonded pairs / 3 bonds ✓ **Y** = 104-105° ✓ 2 lone pairs *AND* (2 bonded pairs *OR* 2 bonds) ✓ electron **pair** repulsion (anywhere) / electron **pairs** get as far apart as possible (anywhere) / lone **pairs** repel (more) / **bonds** repel ✓ *Any reference to **atoms repelling** contradicts 'repel mark'*	[5]
			15

2)	(a)(i)	heating or thermal decomposition of limestone/$CaCO_3$/ correct equation: $CaCO_3 \longrightarrow CaO + CO_2$ ✓	**[1]**
	(ii)	farming: neutralising acid soils/reduces acidity of soil ✓	**[1]**
	(b)(i)	$Ca(OH_2)(aq) + 2\ HNO_3(aq) \longrightarrow Ca(NO_3)_2(aq) + 2\ H_2O(l)$ ✓	**[1]**
		2 sig fig minimum throughout	
	(ii)	$0.0105 \times 22.45/1000 = 2.36 \times 10^{-4}$ ✓ (calc: 2.35725×10^{-4})	**[1]**
	(iii)	ans to (ii) / 2 = 1.18×10^{-4} ✓ (calc: 1.178625×10^{-4})	**[1]**
	(iv)	ans to (iii) x 40 = 0.00472 ✓ (calc: 0.0047145 ⟶ 0.00471)	**[1]**
	(v)	$Ca(NO_3)_2$ = 40.1 + (14 + 48) x 2 = **164.1** (accept 164) / x = 272.1 – 164.1 = **108** ✓ x = 6 / $Ca(NO_3)_2.6H_2O$ ✓ If candidate has based this part on $Ca(OH)_2$, '$11H_2O$' would score 1 mark consequentially If (272.1 – incorrect calculated value for $Ca(NO_3)_2$), then 2nd mark can be achieved consequentially but a whole number is required.	**[2]**
	(c)	$Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$ ✓ for balanced equation ✓ for state symbols of correct species in equation	**[2]**
	(d)(i)	$Ca^+(g) \longrightarrow Ca^{2+}(g) + e^-$ equation ✓ state symbols must be (g), (g) but can be for any attempted equation losing electron(s) ✓	**[2]**
	(ii)	mol Ca = 5.00/40.1 or 0.125 (0.12468379) ✓ 1 mol Ca requires 578 + 1145 = 1723 (kJ) ✓ so energy required = answer above derived from IE data x 0.125 1723 x 0.125 = 215 (kJ) 3 sig figs ✓ eg Use of 1145 only gives 143 kJ consequentially (would score 2)	**[3]** **[4]**
	(iii)	**Assume 'down the group'** ionisation energy decreases ✓ atomic radii increases / there are more shells ✓ there is more shielding ✓ *'**more**' is essential* attraction decreases / increased shielding and distance outweigh the increased nuclear charge ✓	
			19

3)	(a)	$1s^2 2s^2 2p^6 3s^2 3p^5$ ✓	**[1]**
	(b)(i)	 ✓ for correct dot-and-cross ✓ for charges allow Mg with a 'full' shell; also ignore any inner shells	**[2]**
	(ii)	Mg conducts as there are free/delocalised/mobile electrons ✓ *not just 'sea of electrons'* $MgCl_2$(s) does not conduct as no free/delocalised/mobile electrons or ions or charge carriers ✓ $MgCl_2$(aq) conducts as ions move ✓ $MgCl_2$ dissolves because water is a polar solvent ✓ *Any 3 observations above*	**[3] max**
	(c)	increasing nuclear charge/number of protons ✓ electrons added to same shell /same or similar shielding ✓ electrons experience greater attraction or greater pull ✓	**[3]**
	(d)	moles Cl_2 = 145/24000 = 6.04×10^{-3} mol ✓ *accept 0.006 mol* Cl_2 is in excess as 0.00604 > 0.005 mol Cl_2 / Cl_2 is in excess as 0.01208 > 0.01 mol Cl_2 ✓ *Explanation using equation required for 2nd mark* *ora*	**[2]**
	(e)	*Precipitation* Add $AgNO_3$ / Ag^+ (could be in equation) ✓ $NaCl/Cl^- \rightarrow$ white precipitate / dissolves in dilute NH_3 ✓ $NaBr/Br^- \rightarrow$ cream precipitate / dissolves in conc NH_3 or precipitate does not dissolve in dilute NH_3 ✓ not 'Cl' or 'Br' or 'chlorine' or 'bromine' ……. but ecf for a second occurrence $Ag^+ + Cl^- \longrightarrow AgCl$ ✓ or equation for Br^- or a full equation, *state symbols not required* eg: $AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$ 'precipitate' is required at least once – could be from : white **precipitate** or cream **precipitate** or AgCl**(s)**	**[4]**
	OR	*Displacement* Add chlorine / Cl_2 (could be in equation) ✓ (but not Cl) $NaCl \longrightarrow$ no change/no reaction/pale green ✓ $NaBr \longrightarrow$ goes orange/yellow/brown ✓ *If candidate mentions formation of a **precipitate** do not award observation mark* $2Br^- + Cl_2 \longrightarrow Br_2 + 2Cl^-$ ✓ or a full equation, *state symbols not required* eg: $2NaBr + Cl_2 \longrightarrow 2NaCl + Br_2$	
			16

4)	(a)	H_2O: Hydrogen bonding shown in words or in diagram: H bonding from O of 1 H_2O molecule to H of another ✓ dipoles shown or described ✓ with lone pair of O involved in the bond ✓  Two properties from: Ice is less dense/lighter than water/floats on 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 ✓ *Not just high* Accept: 'unusually high/strangely high/relatively high' explanation: H bonds need to be broken ✓ must imply that intermolecular bonds are broken High surface tension ✓ explanationstrength of H bonds across surface ✓ *mark 2 properties only: max 4*	**[3]** **[4]**
	(b)	CH_4: van der Waals' forces / interactions based on instantaneous/temporary/transient interactions ✓ HCl: (permanent) dipole – (permanent) dipole interactions ✓ intermolecular forces are stronger in HCl than in CH_4 / more energy required to break the intermolecular forces in HCl than in CH_4 ✓	**[3]**
		At least two sentences that show legible text with accurate spelling, punctuation and grammar so that the meaning is clear.✓ (Mark this from anywhere within Q4)	**[1]**
			11