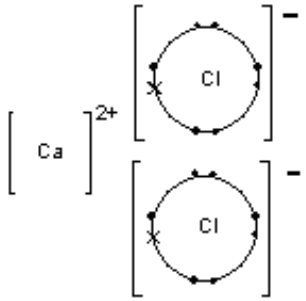
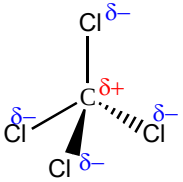
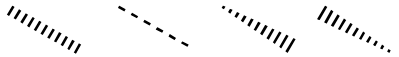
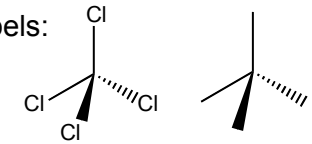
Old Spec - F321 Atoms, bonds and groups - Jan 2009

Question			Expected Answers	Marks	Additional Guidance
1	(a)	i	20✓	1	
		ii	2✓	1	
		iii	5 ✓	1	
	(b)	i	69.8 ✓	1	
		ii	96.0 ✓	1	**Allow** 96
		iii	moles of $NaNO_3$ = 0.05 ✓ mass = 0.05 x 85 = 4.25 (g) ✓	2	4.8 g worth 1 (wrong M_r) Accept 4.3 but not 4.2 (ecf for calculated moles x 85)
		iv	2.51 x 10^{21}✓	1	**Allow** 2.5 x 10^{21} Calc: 2.508333333 x 10^{21} **Allow** calc value and any degree of correct rounding down to 2.5 x 10^{21}
	(c)		(+)7 ✓	1	Sign not required but do not credit '–7' Accept VII
			Total	**9**	

Question			Expected Answers	Marks	Additional Guidance
2	(a)		Energy change when **each atom in 1 mole** ✓ of **gaseous** atoms ✓ **loses an electron** ✓ (to form 1 mole of gaseous 1+ ions)	3	Not 'element' alone Compensate missed marks from correct equation
	(b)		Si ✓ Sharp rise in successive ionisation energy between 4th and 5th IE ✓ marking a change to a new shell / there are 4 electrons in the outer shell✓	3	Not consequential Not sub-shell
	(c)		 atomic radii increases/ there are more shells/atoms get bigger ✓ there is more shielding/ more screening ✓ ionisation energy decreases because the Increased shielding and distance outweigh the increased nuclear charge / the nuclear attraction decreases ✓	3	***USE annotations with ticks, crosses, con, ecf, etc for this part.*** 'down the group' not required '**more'** *is essential* allow 'more electron repulsion from inner shells' **Allow** 'nuclear pull' ignore any reference to 'effective nuclear charge'
			Total	**9**	

Question			Expected Answers	Marks	Additional guidance
3	(a)		Ca^{2+}: 20 protons; 18 electrons ✓ Cl^-: 17 protons; 18 electrons ✓	2	
	(b)		cation shown with either 8 or 0 electrons ***AND*** anion shown with 8 electrons ***AND*** correct number of crosses and dots ✓ Correct charges on both ions ✓  	2	**For 1st mark,** if 8 electrons shown around cation then 'extra' electron(s) around anion must match symbol chosen for electrons in cation. *Circles not required* **Ignore** inner shell electrons For charges, **Allow:** $2[Cl^-]$ $2[Cl]^-$ $[Cl^-]_2$ (brackets not required except for last one) Do **not** allow: for $CaCl_2$, $[Cl_2]^{2-}$ $[Cl_2]^-$ $[2Cl]^{2-}$ $[Cl]$ Max 1 if only one Cl^-
	(c)		solid: ions are fixed (AW) ✓ aqueous: ions are free (to move) (AW) ✓	2	If charge carriers are wrong but comparison is given, then award one mark, *e.g.* solid: *electrons* are fixed in lattice *AND* aqueous: *electrons* are free to move ✓ (1 mark
	(d)	i	molar mass $CaCO_3$: 100.1 (g mol^{-1}) ✓ 4.85/100.1 = 0.0485 mol ✓	2	Not 100 for molar mass calc. 0.048451548 **Allow** rounding of calculator value back to 2 sig figs allow 0.048-0.049 **ECF** If working shown for an incorrect molar mass, then the 2nd mark can be awarded as 4.85/calculated molar mass
		ii	5.38 or 5.39 g or 5.4 g ✓	1	For information: 0.0485 x 111.1 = 5.39 0.048451548 x 111.1 = 5.38

Question			Expected Answers	Marks	Additional guidance
					ECF: moles from (i) x 111.1 or 111
		iii	0.0970 or 0.097 or 0.0969 ✓ volume = 64.7 or 64.6 cm^3 or 65 ✓	2	For information: 2 x 0.0485 = 0.0970 mol 2 x 0.048451548 = 0.0969 **ECF** moles from (i) x 2 For information (0.0970/1.50) x 1000 = 64.7 cm^3 (0.0969/1.50) x 1000 = 64.6 cm^3 **ECF** (moles above/1.50) x 1000
	(e)		$Ca/CaO/Ca(OH)_2$ ✓ $Ca + 2HCl \longrightarrow CaCl_2 + H_2$ / $CaO + 2HCl \longrightarrow CaCl_2 + H_2O$ / $Ca(OH)_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O$ ✓	2	Ignore state symbols **Allow** any other suitable alternatives
	(f)	**i**	Ca : H : S : O = 19.82/40.1 : 0.99/1 : 31.74/32.1 : 47.45/16 or 1 : 2 : 2 : 6 ✓ empirical formula = $CaH_2S_2O_6$ ✓	2	Using atomic numbers gives $CaHS_2O_6$ worth 1 **Allow** $Ca(HSO_3)_2$!
		ii	$Ca(OH)_2 + 2SO_2 \longrightarrow CaH_2S_2O_6$ ✓	1	If you see it, **allow** $Ca(HSO_3)_2$!
			Total	**16**	

Question			Expected Answers	Marks	Additional Guidance
4	(a)		down group/from Cl to I/, number of electrons/shells increases ✓ more/ stronger/ van der Waals'/ intermolecular forces/ induced dipoles/ instantaneous dipoles ✓ greater forces to break/more energy has to be put in to break forces ✓	3	Answers involving ionisation energies score 0
	(b)		$I_2 \rightarrow IO^-$, 0 to +1 ✓: oxidised $I_2 \rightarrow I^-$, 0 to –1 ✓: reduced **correct** 'oxidised' **and** 'reduced' above/I is both oxidised and reduced / disproportionation ✓	3	Sign not required but do not credit '–1' '–' Sign required here
	(c)	i	goes orange/red/yellow ✓ $Cl_2 + 2Br^- \longrightarrow Br_2 + 2Cl^-$ ✓	2	Ignore brown Ignore spectator ions
		ii	$Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$ correct equation ✓ correct state symbols ✓	2	Allow state symbols for (slightly) incorrect equations
	(d)	i	attraction of an atom for electrons ✓ in a (covalent) bond/ bonding pair ✓	2	
		ii	correct 3-D tetrahedral shape shown showing one outward wedge and 1 inward wedge; 3 bonds below horizontal ✓ correct dipoles: δ+ on C and δ– on each Cl ✓  	2	For bond into paper, accept:  **Allow** correct shape with no atom labels:  Only need to show one dipole
		iii	the polarities/ dipoles cancel out / the molecule is symmetrical	1	
			Total	**15**	

Question			Expected Answers	Marks	Additional Guidance
5			Magnesium structure/bonding: giant ✓ metallic ✓ conducts by delocalised/free/mobile electrons ✓ melting point high because of the electrostatic attraction / attraction between (positive) ions and electrons ✓ Diamond does not conduct/poor conductor: no mobile charge carriers/electrons/ions ✓ structure/bonding: giant (✓) covalent ✓ melting point: high because strong/ lots of (covalent) bonds are broken ✓ Ice does not conduct: no mobile charge carriers/electrons/ions ✓ structure/bonding: H-bonds/intermolecular forces/ simple molecular ✓ melting point: Low because H bonds/intermolecular/ weak forces between molecules (are broken)/ higher than expected because H-bonds broken/ H-bonds stronger than other (named) intermolecular forces ✓	10	***USE annotations with ticks, crosses, con, ecf, etc for this part.*** ***Credit information if given in annotated diagrams*** ***Watch out for contradictions, especially of bonding type*** **Allow**: positive ions with a sea of electrons for both structure and bonding marks if labelled, one if not. Giant only awarded if not given above must refer to bonds being broken once
			QWC – At least two sentences that show legible text with accurate spelling, punctuation and grammar so that the meaning is clear. ✓	1	QWC mark **must** be indicated with a tick or cross through the Quality of Written Communication prompt at the bottom of page 9. **Then scroll up to start of (b), counting ticks.**
			Total	**11**	