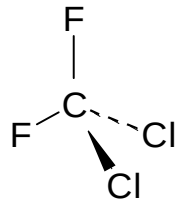
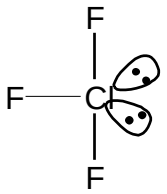
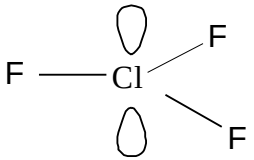
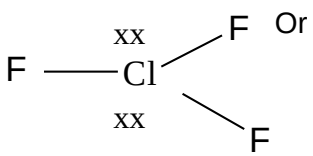
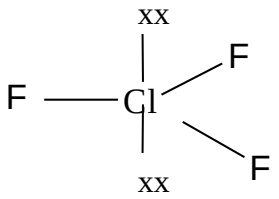
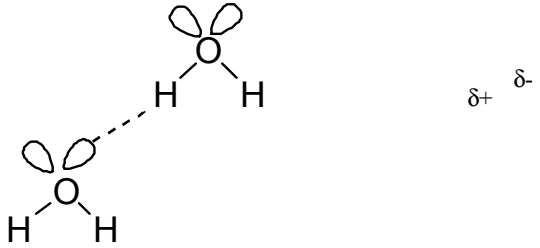
Bonding Answers

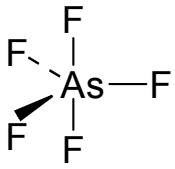
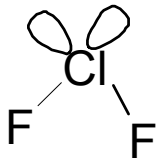
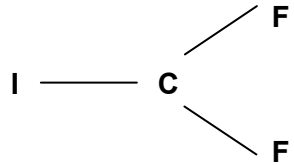
Qu	Part	Sub Part	Marking Guidance	Mark	Comments
1	a	i	shared <u>pair of electrons</u>	1	Can have one electron from each atom contributes to the bond Not both electrons from one atom
1	a	ii	$\frac{1}{2}\ Cl_2 + \frac{3}{2} F_2 \rightarrow ClF_3$	1	Only Ignore state symbols even if wrong
1	b		  **OR** 	1 1	Allow any structure with 4 bp Watch for Cl in centre- it must be C Ignore wrong bond angles Representations of lone pairs allowed are the two examples shown with or without the electrons in the lobe. Also they can show the lone pair for either structure by two crosses /dots or a line with two crosses/dots on it e.g.  Or  Or a structure with 3 bp and 2 lp
1	c		Dipole – dipole	1	Allow van der Waals/ vdw/ London/ dispersion/ temporary dipole - induced dipole Not dipole alone

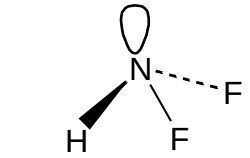
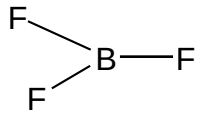
1	d	i	Coordinate/ dative (covalent) (Lone) pair of electrons/ both electrons (on F^-) Donated from F^- / fluoride or donated to the BF_3	1 1 1	If wrong CE = 0/3 but if 'covalent' or left top line blank, mark on. CE if lone pair is from B Must have the – sign on the F ie F^- Ignore Fl^- M3 dependent on M2
1	d	ii	109° to 109.5°	1	
1	e		$\frac{238 \times 100}{438}$ = 54.3%	1 1	For 1 mark allow 238 as numerator and 438 as denominator or correct strings 2 marks if correct answer to 3 sig figs. 54% or greater than 3 sig figs = 1 mark

Qu	Part	Sub Part	Marking Guidance	Mark	Comments
7	a		Iodine – molecular Graphite- macromolecular/giant covalent/giant atomic	1 1	Not covalent lattice
7	b		Layers of (C atoms) Connected by covalent bonds within each layer Van der Waals forces/ IMF between layers/ weak forces between layers Many/strong covalent bonds need to be broken	1 1 1 1	If any other element mentioned other than C, CE = 0 Ignore the no of covalent bonds around the C if mentioned The first 3 marks could be scored with a labelled diagram. Need to label or state covalent bonds within the layers. Covalent or ionic or metallic bonds between molecules CE = 0
7	c		Van der Waals forces are weak or easily broken Van der Waals between molecules (or implied)	1 1	Not vdw between atoms Allow weak IMF = 2
7	d		Does not have delocalised/free electrons	1	Only allow answer with respect to iodine Not all electrons used in bonding Ignore free ions

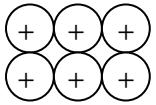
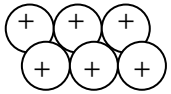
Question	Part	Sub Part	Marking Guidance	Mark	Comments
3	(a)		Hydrogen/H bonds van der Waals/vdw/ dipole-dipole/London/temporarily induced dipole/dispersion forces	1 1	Not just hydrogen Not just dipole
3	(b)			3	M1 for partial charges as indicated in diagram (correct minimum) M2 for all four lone pairs M3 for H bond from the lp to the H (δ+) on the other molecule Lone pair on hydrogen CE = 0 OHO CE = 0 If only one molecule of water shown CE = 0
3	(c)		Hydrogen bonds/IMF (in water) stronger ***OR*** IMF / VDW / dipole-dipole forces (in H_2S) are weaker ***OR*** H bonding is the strongest IMF	1	Ignore energy references Comparison must be stated or implied
3	(d)		Atoms/molecules get larger/more shells/more electrons/ more surface area therefore increased Van der Waals/IMF forces	1 1	Not heavier/greater Mr Ignore references to dipole-dipole forces

3	(e)		Dative (covalent)/ coordinate	1	If not dative/coordinate CE = 0/2 If covalent or blank read on
			(Lone) pair/both electrons/two electrons on O(H_2) donated (to H^+) OR pair/both electrons come from O(H_2)	1	Explanation of a coordinate bond specific to oxygen or water required Not just H+ attracted to lone pair since that is nearer to a H bond
3	(f)		ionic	1	if not ionic CE = 0
			oppositely charged <u>ions</u> /+ and – <u>ions or particles</u>	1	atoms or molecules loses M2 and M3
			ions attract <u>strongly</u> OR strong/many (ionic) bonds must be broken	1	S^- loses M2 Reference to IMF loses M2 and M3

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6				1	**Mark M1 – M5 independently** M1 for 5 bond pairs around As Do not penalise A for As or Fl for F
			trigonal / triangular bipyramid(al)	1	Allow trigonal dipyramid
				1	M3 for 2 bond pairs to F and 2 lone pairs Lone pairs can be shown as lobes with or without electrons or as xx or x x
			Bent / V shape / non-linear / triangular / angular	1	Bent-linear = contradiction Do not allow trigonal
			104° - 106°	1	
			(For candidates who thought this was ClF_2^+ which contained iodine allow 		
			Trigonal / triangular <u>planar</u>		Not just triangular
			120°		

Question	Marking Guidance	Mark	Comments
3(a)	Iodine has more electrons / iodine is bigger (atom or molecule) / iodine has bigger M_r / bigger surface area	1	
	Stronger / more van der Waals forces / vdw / London / temporarily induced dipole / dispersion forces between molecules	1	Stronger VdW intermolecular forces = M2 If stated VdW between atoms lose M2
3(b)(i)		1	Mark is for 3 bp and 1 lp attached to N (irrespective of shape)
		1	Mark is for 3 bp and 0 lp attached to B (irrespective of shape)
	NHF_2 shape - pyramidal / trigonal pyramid	1	Accept tetrahedral / triangular pyramid
	BF_3 shape - trigonal planar	1	Not triangular or triangular planar
3(b)(ii)	107°	1	Allow 106-108°
3(c)	Hydrogen bonds	1	Allow H-Bonds Not just Hydrogen Apply list principle eg Hydrogen bonding and dipole-dipole = 0

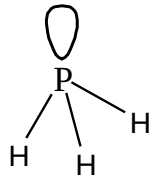
3(d)	Coordinate / dative covalent / dative	1	If covalent mark on If ionic / metallic CE = 0
	Lone pair / both electrons/ 2 electrons <u>on N(HF_2)</u> donated (to BF_3)	1	Direction of donation needed here

Question	Marking Guidance	Mark	Comments
4(a)(i)	Metallic	1	Allow body centred cubic
4(a)(ii)	 OR  Na^+ Na^+ Na^+ Na^+ Na^+ Na^+	1 1	One mark for regular arrangement of particles. Can have a space between them Do not allow hexagonal arrangement One mark for + in each Ignore electrons If it looks like ionic bonding then CE = 0/2
4(b)(i)	<u>Ionic</u>	1	CE = 0 for 4(b)(i) and 4(b)(ii) if not ionic
4(b)(ii)	Strong (electrostatic) attraction Between <u>oppositely</u> charged ions / particles	1 1	Any mention of IMF or molecules / metallic / covalent in 4(b)(ii) then CE 0/2 Or + and – ions
4(c)	Iodide / I^- bigger (ion) (so less attraction to the Na+ ion)	1	Need comparison Do not allow iodine is a bigger atom Ignore I^- has one more e- shell CE = 0 if IMF / covalent / metallic mentioned

Question	Marking Guidance	Mark	Comments
1(a)	Water or H_2O or molecules (in ice) are held further apart (than in liquid water)/(more) space/gaps/holes in structure/ Water or H_2O or molecules (in ice) are more spread out	1	Allow water (liquid) is more compact / less space/gaps/holes CE if holes filled with air, O_2 etc CE if macromolecule CE if atoms further apart (since ambiguous) Ignore spaces filled with H_2O Ignore reference to H bonds Allow better tessellation in liquid water
1(b)(i)	Hydrogen bonding	1	Allow H bonds Do not allow 'hydrogen' only but mark on
1(b)(ii)	Van der Waals' / VdW	1	Allow London forces, dispersion forces, temporary induced dipole forces

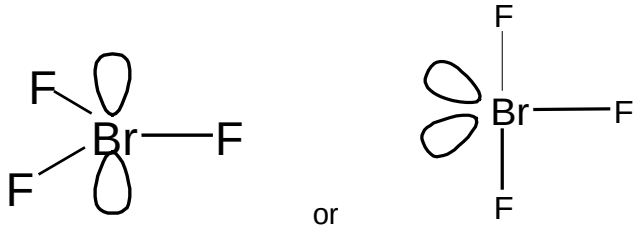
1(b)(iii)	Hydrogen bonding is stronger (than van der Waals forces) / IMF in ice stronger (than IMF in methane)/ H bonds take more energy to break	1	Not H Bonds are strong (needs comparison)
			If (b)(i) OR (ii) is incorrect, cannot award (b)(iii)
			If (b)(i) and /or (ii) is blank, can score (b)(iii)

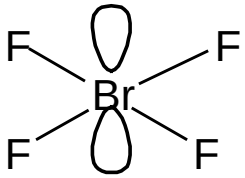
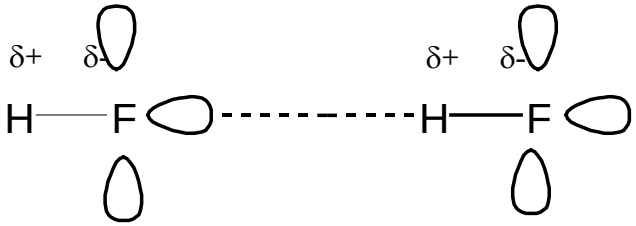
1(c)(i)	Structure showing 3 bonds to H and 1 lone pair (trigonal) pyramid(al) /(distorted) tetrahedral	1 1	do not insist on the + sign Allow triangular pyramid Not square pyramid Ignore bond angles in structure M2 independent of M1
1(c)(ii)	107°	1	Allow range106 - 108° Ignore ° (C)
1(c)(iii)	NH_3 /ammonia	1	Contradictions (eg NH_4 ammonia) CE = 0
1(d)	3	1	Allow three/ III/ 3 lone pairs/ 3lp/ 3 lone pairs of electrons

Question	Marking Guidance	Mark	Comments
3(a)		1	Need to see 3 P-H bonds and one lone pair (ignore shape).
3(b)	Coordinate / dative Pair of electrons on P(H_3) donated (to H+)	1 1	If not coordinate / dative then chemical error CE=0 unless blank or covalent then M1 = 0 and mark on. Do not allow a generic description of a coordinate bond.
3(c)	109.5° / 109½ / 109° 28’	1	Allow answers in range between 109° to 109.5°
3(d)	Difference in electronegativity between P and H is too small	1	Allow P not very electronegative / P not as electronegative as N, O and F / P not electronegative enough / P not one of the 3 most electronegative elements. Do not allow phosphine is not very electronegative.

Question	Marking Guidance	Mark	Comments
4(a)(i)	Macromolecular / giant covalent / giant molecular / giant atomic	1	If covalent, molecular, giant, lattice, hexagonal or blank mark on. If metallic, ionic or IMF chemical error CE = 0 for 4(a)(i), 4(a)(ii) and 4(a)(iii).
4(a)(ii)	Delocalised electrons / free electrons Able to move / flow (through the crystal)	1 1	 Allow M2 for electrons can move / flow. Ignore electrons can carry a current / charge.
4(a)(iii)	Covalent bonds Many /strong / hard to break / need a lot of energy to break	1 1	 M2 dependent on M1. Ignore van der Waals' forces.
4(b)(i)	(Giant) metallic / metal (lattice)	1	If FCC or BCC or HCP or giant or lattice, mark on. If incorrect 4(b)(i), chemical error CE for 4(b)(ii) and 4(c)(ii).
4(b)(ii)	Nucleus / protons / positive ions and delocalised electrons (are attracted) Strong attraction	1 1	QWC Must be delocalised electrons – not just electrons. Chemical error = 0/2 for 4(b)(ii) if other types of bonding or IMF mentioned. Allow strong metallic bonding for one mark if M1 and M2 are not awarded.
4(c)(i)	Layers of atoms/ions slide (over one another)	1	Do not allow just layers.

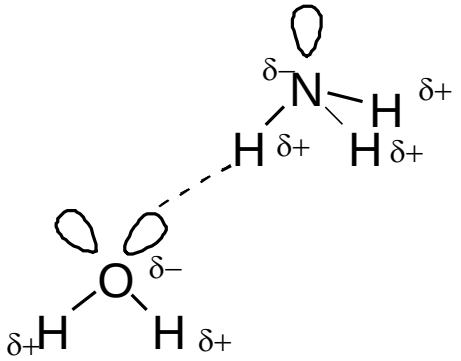
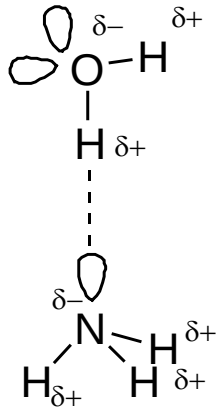
4(c)(ii)	(Strong) (metallic) bonding re-formed / same (metallic) bonding / retains same (crystal) structure / same <u>bond strength</u> / same attraction between protons and delocalised electrons as before being hammered or words to that effect	1	If IMF, molecules, chemical error CE = 0/1 for 4(c)(ii). If metallic not mentioned in 4(b)(i) or 4(b)(ii) it must be mentioned here in 4(c)(ii) to gain this mark. Do not allow metallic bonds broken alone. Ignore same shape or same strength.
4(d)	(giant) Ionic Between + and – ions / oppositely charged ions or Mg^{2+} and O^{2-} <u>Strong attraction</u>	1 1 1	If not ionic, chemical error CE = 0/3 If molecules mentioned in explanation lose M2 and M3 Allow one mark for a strong attraction between incorrect charges on the ions.

Question	Marking Guidance	Mark	Comments
1(a)	Covalent	1	If not covalent CE = 0/2 If dative covalent CE = 0/2 If blank mark on Ignore polar If number of pairs of electrons specified, must be 3
	Shared <u>pair</u>(s) of electrons / one electron from Br and one electron from F	1	Not 2 electrons from 1 atom Not shared pair between ions/molecules
1(b)(i)	 or BrF_3 if trigonal planar shown = 120° or if T shape shown 84 - 90°	1 1	BrF_3 should have 3 bp and 2 lp and correct atoms for the mark Penalise Fl Allow 84 - 90° or 120° and ignore 180° Irrespective of shape drawn

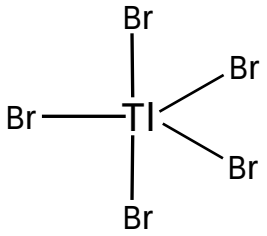
1(b)(ii)	 BrF_4^- 90°	1 1	BrF_4^- should have 4 bp and 2 lp and all atoms for the mark (ignore sign) Allow Fl Only Ignore 180°
1(c)	Ionic or (forces of) attraction between ions / bonds between ions Strong (electrostatic) attraction / strong bonds / lots of energy needed to break bonds Between K^+ and BrF_4^- ions/oppositely charged ions / + and - ions	1 1 1	If molecules, IMF, metallic, CE =0 If covalent bonds mentioned, 0/3, unless specified <u>within</u> the BrF_4^- ion and not broken Ignore atoms If ions mentioned they must be correct Strong bonds between + and – ions =3/3
1(d)(i)	Hydrogen <u>bonds</u>/hydrogen <u>bonding</u>/H <u>bonds</u>/H <u>bonding</u>	1	Not just hydrogen
1(d)(ii)		3	One mark for 4 partial charges One mark for 6 lone pairs One mark for H bond from the <u>lone pair to the Hδ+</u> Allow Fl If more than 2 molecules are shown they must all be correct. Treat any errors as contradictions within each marking point. CE = 0/3 if incorrect molecules shown.

1(e)	vdw / van der Waals forces between molecules	1	QoL Not vdw between HF molecules, CE = 0/2 vdw between atoms, CE = 0/2 If covalent, ionic, metallic, CE=0/2
	IMF are weak / need little energy to break IMF / easy to overcome IMF	1	

Question	Marking Guidance	Mark	Comments
3(a)	Giant covalent / giant molecular / macromolecular	1	Not giant alone. Not covalent alone.
3(b)	Shared pair of electrons / one electron from each C atom	1	
3(c)	No delocalised / free / mobile electrons	1	Allow all (outer) electrons involved in (covalent) bonds. Ignore ions.
3(d)	CH	1	Allow HC C and H must be capital letters.

Question	Marking Guidance	Mark	Comments
4(a)	Hydrogen bonding / hydrogen bonds / H-bonding / H-Bonds	1	Not just hydrogen.
4(b)	 ***OR*** 	3	One mark for minimum of 4 correct partial charges shown on the N-H and O-H One mark for the 3 lone pairs. One mark for H bond from the lone pair on O or N to the $H^{\delta+}$ The N-H-O should be linear but can accept if the lone pair on O or N hydrogen bonded to the $H^{\delta+}$ If wrong molecules or wrong formula, CE = 0/3

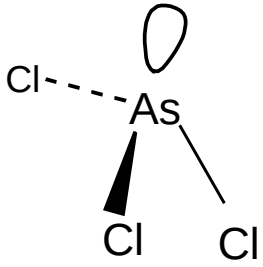
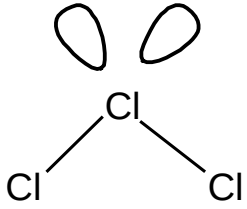
4(c)	(Phosphine) does not form hydrogen bonds (with water)	1	

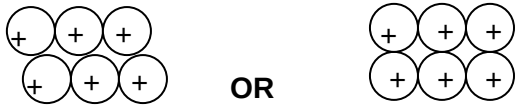
Question	Marking Guidance	Mark	Comments
5(a)	$Al + 1.5Cl_2 \rightarrow AlCl_3$	1	Accept multiples. Also $2Al + 3Cl_2 \rightarrow Al_2Cl_6$ Ignore state symbols.
5(b)	Coordinate / dative (covalent) Electron pair on Cl^- donated to Al(Cl_3)	1 1	If wrong CE=0/2 if covalent mark on. QoL Lone pair from Cl^- not just Cl Penalise wrong species.
5(c)	Al_2Cl_6 or $AlBr_3$	1	Allow Br_3Al or Cl_6Al_2 Upper and lower case letters must be as shown. Not $2AlCl_3$
5(d)	$SiCl_4$ / silicon tetrachloride	1	Accept silicon(4) chloride or silicon(IV) chloride. Upper and lower case letters must be as shown. Not silicon chloride.
5(e)	 Trigonal bipyramid(al)	1 1	Accept shape containing 5 bonds and no lone pairs from Tl to each of 5 Br atoms. Ignore charge.

5(f)(i)	Cl—— Tl —— Cl	1	Accept this <u>linear</u> structure only with no lone pair on Tl
5(f)(ii)	(Two) bonds (pairs of electrons) repel equally / (electrons in) the bonds repel to be as far apart as possible	1	Dependent on linear structure in 5(f)(i). Do not allow electrons /electron pairs repel alone.
5(g)	Second	1	

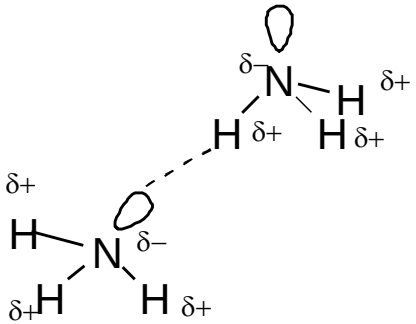
Question	Marking Guidance	Mark	Comments
3(a)(i)	The power of an <u>atom</u> or <u>nucleus</u> to withdraw or attract electrons ***OR*** electron density ***OR*** a pair of electrons (towards itself)	1	Ignore retain
	In a <u>covalent</u> bond	1	
3(a)(ii)	More protons / bigger nuclear charge	1	
	Same or similar shielding / electrons in the same shell or principal energy level / atoms get smaller	1	Not same sub–shell Ignore more electrons
3(b)	Ionic	1	If not ionic then CE = 0/3 If blank lose M1 and mark on
	Strong or many or lots of (electrostatic) <u>attractions</u> (between ions)	1	If molecules / IMF / metallic / atoms lose M2 + M3, penalise incorrect ions by 1 mark
	Between + and – ions / between Li^+ and F^- ions / oppositely charged ions	1	Allow strong (ionic) bonds for max 1 out of M2 and M3
3(c)	Small electronegativity difference / difference = 0.5	1	Must be comparative Allow 2 non-metals
3(d)(i)	(simple) <u>molecular</u>	1	Ignore simple covalent
3(d)(ii)	$OF_2 + H_2O \longrightarrow O_2 + 2HF$	1	Ignore state symbols Allow multiples Allow OF_2 written as F_2O

3(d)(iii)	45.7% O (O F) ($\frac{45.7}{16}$ $\frac{54.3}{19}$) (16 19) (2.85 2.85) (1 1) EF = $\frac{OF \text{ or } FO}{}$ MF (= 70.0/35) = O_2F_2 or F_2O_2	1 1 1 1	 If students get M2 upside down lose M2 + M3 Check that students who get correct answer divide by 16 and 19 (not 8 and 9). If dividing by 8 and 9 lose M2 and M3 but could allocate M4 ie max 2 Calculation of OF by other correct method = 3 marks Penalise Fl by 1 mark

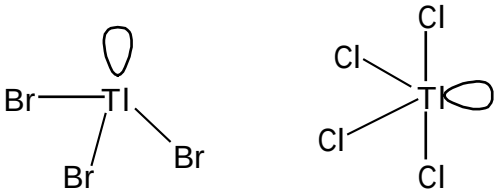
Question	Marking Guidance	Mark	Comments
6(a)		1	Mark is for 3 As-Cl bonds and 1 lone pair
	(Trigonal) pyramid(al) / tetrahedral	1	Allow triangular pyramid
		1	Mark is for 2 Cl-Cl bonds and 2 lone pairs Do not penalise if + not shown
	Bent / V-shaped / triangular	1	Not trigonal
6(b)	There are 4 bonds or 4 pairs of electrons (around As)	1	Can show in a diagram. If lone pair included in shape, CE = 0/2
	(Electron pairs / bonds) repel equally	1	QoL

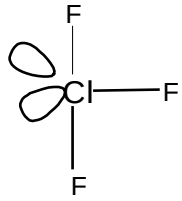
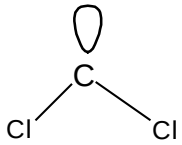
Question	Marking Guidance	Mark	Comments
3(a)(i)	d (block) **OR** D (block)	1	Ignore transition metals / series. Do not allow any numbers in the answer.
3(a)(ii)	Contains positive (metal) ions or protons or nuclei and <u>delocalised / mobile / free / sea of</u> electrons <u>Strong attraction</u> between them or <u>strong metallic</u> bonds	1 1	Ignore atoms. Allow 'needs a lot of energy to break / overcome' instead of 'strong'. If strong attraction between incorrect particles, then CE = 0/2 If molecules / intermolecular forces / covalent bonding / ionic bonding mentioned then CE=0
3(a)(iii)	 **OR**	2	M1 is for regular arrangement of atoms / ions (min 6 metal particles). M2 for + sign in each metal atom / ion. Allow 2+ sign.
3(a)(iv)	<u>Layers / planes / sheets of atoms or ions</u> can slide over one another	1	QoL
3(b)(i)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8\ (4s^0)$	1	Only.

3(b)(ii)	$NiCl_2 \cdot 6H_2O$ + **6** $SOCl_2$ $\longrightarrow$ $NiCl_2$ + **6** SO_2 + **12** HCl	1	Allow multiples.
	NaOH / NH_3 / $CaCO_3$ / CaO	1	Allow any name or formula of alkali or base. Allow water.

Question	Marking Guidance	Mark	Comments
4(a)(i)	Hydrogen bonds / H bonds	1	Not just hydrogen.
4(a)(ii)		3	M1 – lone pair on each N M2 – correct partial charges must be shown on the N and H of a bond in each molecule. M3 – for the H bond from lone pair on N to the Hδ+ on the other NH_3 molecule. If not ammonia molecules, CE = 0/3
4(b)	Lone pair / both electrons / 2 electrons / electron pair on N(H_3) is donated to B(Cl_3)	1	Allow both electrons in the bond come from N(H_3)

4(c)(i)	The power of an atom or nucleus to withdraw or attract electrons or electron density or a pair of electrons (towards itself) in a covalent bond	1 1	
4(c)(ii)	LiF **OR** Li_2O **OR** LiH	1	Allow Li_2O_2, allow correct lithium carbide formula.
4(c)(iii)	BH_3 / H_3B	1	Allow B_2H_6 / H_6B_2 Do not allow lower case letters.

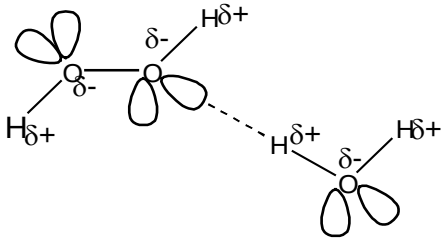
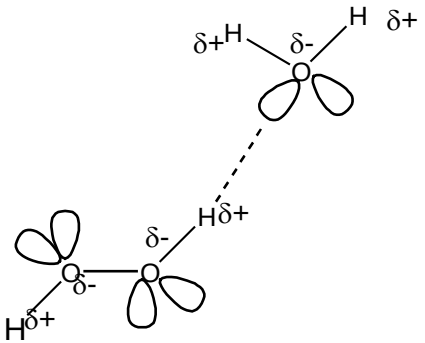
Question	Marking Guidance	Mark	Comments
7(a)		2	Mark is for correct number of bonds and lone pair in each case. Ignore charges if shown.
	Pyramidal/ trigonal pyramid	1	Allow tetrahedral.
	107^0	1	Allow 107 to 107.5º
7(b)	M1 Ionic	1	CE = 0/3 if not ionic.
	M2 Oppositely charged ions / Tl^+ and Br^- ions	1	If molecules / intermolecular forces / metallic bonding, CE=0
	M3 <u>Strong attraction</u> between ions	1	M3 dependent on M2 Allow 'needs a lot of energy to break / overcome' instead of 'strong'.
7(c)	$Tl + \frac{1}{2}Br_2 \longrightarrow TlBr$	1	Allow multiples. Ignore state symbols even if incorrect.

1(d)(i)	 	1 1	Or any structure with 3 bonds and 2 lone pairs Ignore any angles shown Or a structure with 2 bonds and 1 lone pair
1(d)(ii)	Bent / v shape	1	Ignore non-linear, angular and triangular Apply list principle
1(d)(iii)	$\frac{1}{2}Cl_2 + \frac{3}{2}F_2 \longrightarrow ClF_3$	1	No multiples Ignore state symbols

Question	Marking Guidance	Mark	Comments
3(a)	Macromolecular / giant covalent / giant molecule	1	Not giant atomic
3(b)	No delocalised electrons / no free ions / no free charged particles	1	
3(c)	$SiO_2 + 6HF \longrightarrow H_2SiF_6 + 2H_2O$	1	Accept multiples

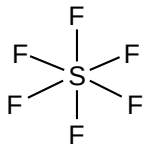
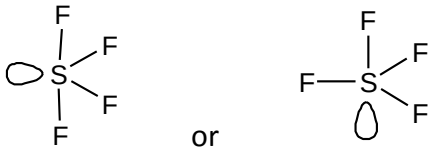
			M1: record an IR spectrum M2: peak between 3230 and 3550 (cm^{-1})

Question	Marking Guidance	Mark	Comments
5(a)	94–105.5^{o}	1	
5(b)(i)	Hydrogen bond(ing) / H bonding/H bonds	1	Not just hydrogen

5(b)(ii)	 **OR** 	3	1 mark for all lone pairs 1 mark for partial charges on the O and the H that are involved in H bonding 1 mark for the H-bond, from Hδ+ on one molecule to lone pair on O of other molecule
5(c)	Electronegativity of S lower than O or electronegativity difference between H and S is lower No hydrogen bonding <u>between H_2S_2 molecules</u> Or <u>only</u> van der Waals / <u>only</u> dipole-dipole forces <u>between H_2S_2 molecules</u>	1 1	Mark independently If breaking covalent bonds CE = 0

Question	Marking Guidance	Mark	Comments
2(a)	Electron movement in first molecule / temporary dipole Induces a dipole in another molecule (induced-temporary) attraction or δ+ attracts δ- in different/adjacent molecules	1 1 1	allow description allow description M3 dependent on M1 and M2 allow electrostatic attraction M3 could be scored in diagram If other type of force / metallic / ionic / polar bonds / permanent dipoles / difference in electronegativity mentioned CE = 0
2(b)(i)	(methanol) H-bonds / hydrogen bonding (methanethiol) dipole-dipole forces or van der Waals H-bonds are a stronger / are the strongest IMF	1 1 1	 Allow H-bonds require more energy to overcome If M1 and M2 not scored, allow 1 for methanol has stronger IMFs If breaking covalent bonds then CE=0
2(b)(ii)	(Fractional) distillation	1	Allow description Do not allow heating unqualified

2(c)	(Methaneselenol is a) bigger molecule / larger Mr / larger no of electrons / Se bigger atom With <u>stronger/more</u> <u>vdw</u> forces <u>between molecules</u>	1 1	 If breaking covalent bonds then CE=0

2(d)(i)		1	diagram showing 6 bond pairs
	(bond angle) 90° for SF_6	1	ignore 180°
	Octahedral	1	
		1	diagram showing 4 bond pairs <u>and 1 lone pair</u>
	(bond angles) for SF_4 Any **two** from: • Allow 85 – 89° • Allow 100 – 119° • Allow 170 – 179°	 2	If shape of SF_4 is not based on 4 bond pairs <u>and 1 lone pair</u> cannot score M4 or M5 Do not allow 90° Do not allow 120° Do not allow 180°

2(d)(ii)	NaCl **(**as product in any equation) 3 SCl_2 + 4 NaF → SF_4 + S_2Cl_2 + 4 NaCl	1 1	 Allow multiples Ignore states