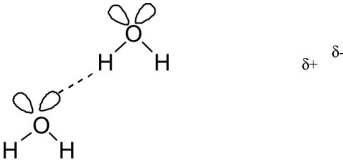
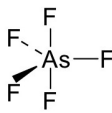
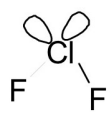
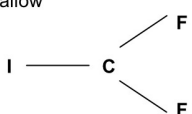



Question	Part	Sub Part	Marking Guidance	Mark	Comments
3	(a)		Hydrogen/H bonds	1	Not just hydrogen
			van der Waals/vdw/ dipole-dipole/London/temporarily induced dipole/dispersion forces	1	Not just dipole
3	(b)			3	M1 for partial charges as indicated in diagram (correct minimum) M2 for all four lone pairs 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 ₂ S) 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	1	Not heavier/greater Mr
			therefore increased <u>Van der Waals/IMF</u> forces	1	Ignore references to dipole-dipole forces

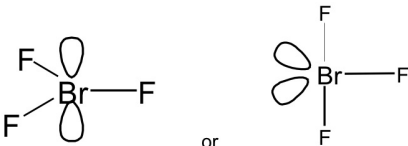
3	(e)	Dative (covalent)/ coordinate	1	If not dative/coordinate CE = 0/2 If covalent or blank read on
		(Lone) pair/both electrons/two electrons on O(H ₂) donated (to H ⁺) OR pair/both electrons come from O(H ₂)	1	Explanation of a coordinate bond specific to oxygen or water required Not just H ⁺ attracted 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

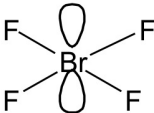
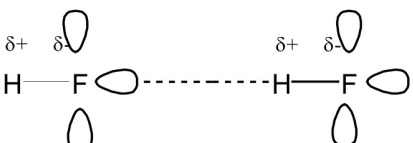
Question	Part	Sub Part	Marking Guidance	Mark	Comments
6				1	Mark M1 – M5 independently M1 for 5 bond pairs around As Do not penalise A for As or F for F
			trigonal / triangular bipyramid(al)	1	
				1	
			Bent / V shape / non-linear / triangular / angular	1	
			104° - 106°	1	
			(For candidates who thought this was ClF ₂ ⁺ which contained iodine allow		
					
			Trigonal / triangular <u>planar</u>		
			120°		Not just triangular

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	$\frac{1}{2} \text{Cl}_2 + \frac{3}{2} \text{F}_2 \rightarrow \text{ClF}_3$	1	Only Ignore state symbols even if wrong
1	b		<p>OR</p>	1	<p>Allow any structure with 4 bp</p> <p>Watch for Cl in centre- it must be Cl</p> <p>Ignore wrong bond angles</p> <p>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.</p> <p> Or </p> <p>Or a structure with 3 bp and 2 lp</p>
1	c		Dipole – dipole	1	Allow van der Waals/ vdw/ London/ dispersion/ temporary dipole - induced dipole Not dipole alone

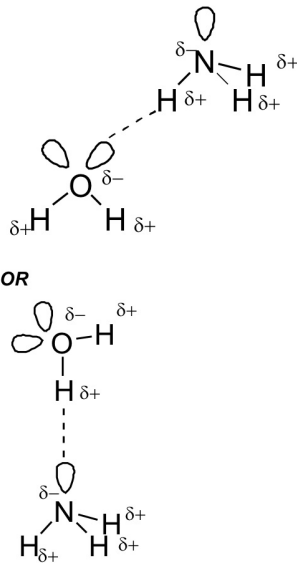
1	d	i	Coordinate/ dative (covalent) (Lone) pair of electrons/ both electrons (on F ⁻) Donated from F / fluoride or donated to the BF ₃	1 1 1	If wrong CE = 0/3 but if 'covalent' or left top line blank, mark on. CE if lone pair is from B Must have the – sign on the F ie F ⁻ Ignore F1 M3 dependent on M2
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 – <u>molecular</u>	1	Not covalent lattice
			Graphite- macromolecular/giant covalent/giant atomic	1	
7	b		<u>Layers</u> of (C atoms)	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 <u>labelled</u> diagram. Need to label or state covalent bonds within the layers. Covalent or ionic or metallic bonds between molecules CE = 0
			Connected by <u>covalent bonds</u> within each layer	1	
			<u>Van der Waals forces/ IMF</u> between layers/ weak forces between layers	1	
			<u>Many/strong covalent bonds need to be broken</u>	1	
7	c		Van der Waals forces are weak or easily broken	1	Not vdw between atoms
			Van der Waals <u>between molecules</u> (or implied)	1	Allow weak IMF = 2
7	d		Does not have delocalised/free <u>electrons</u>	1	Only allow answer with respect to iodine Not all electrons used in bonding Ignore free 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
	Shared <u>pair(s)</u> of electrons / one electron from Br and one electron from F	1	If number of pairs of electrons specified, must be 3 Not 2 electrons from 1 atom Not shared pair between ions/molecules
1(b)(i)	 BrF ₃ if trigonal planar shown = 120° or if T shape shown 84 - 90°	1	BrF ₃ should have 3 bp and 2 lp and correct atoms for the mark Penalise FI
		1	Allow 84 - 90° or 120° and ignore 180° Irrespective of shape drawn

1(b)(ii)	 <p>BrF₄⁻ 90°</p>	<p>1 BrF₄⁻ should have 4 bp and 2 lp and all atoms for the mark (ignore sign) Allow FI</p> <p>1 Only Ignore 180°</p>
1(c)	<p>Ionic or (forces of) attraction between ions / bonds between ions</p> <p>Strong (electrostatic) attraction / strong bonds / lots of energy needed to break bonds</p> <p>Between K⁺ and BrF₄⁻ ions/oppositely charged ions / + and - ions</p>	<p>1 If molecules, IMF, metallic, CE = 0 If covalent bonds mentioned, 0/3, unless specified <u>within</u> the BrF₄⁻ ion and not broken Ignore atoms</p> <p>1</p> <p>1 If ions mentioned they must be correct Strong bonds between + and - ions = 3/3</p>
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)		<p>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 FI</p> <p>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.</p>

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

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

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

Mark schemes

1

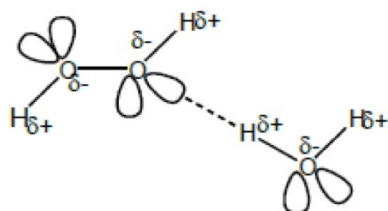
- (a) 94–105.5°

1

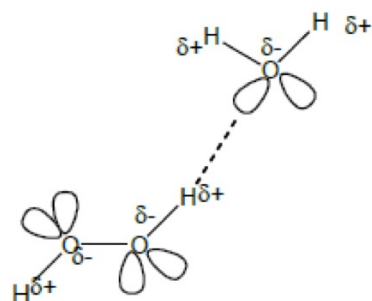
- (b) (i) Hydrogen bond(ing) / H bonding / H bonds
Not just hydrogen

1

- (ii)



OR



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 $H\delta+$ on one molecule to lone pair on O of other molecule

3

- (c) Electronegativity of S lower than O or electronegativity difference between H and S is lower

Mark independently

1

No hydrogen bonding between H_2S_2 molecules

Or only van der Waals / only dipole-dipole forces between H_2S_2 molecules
If breaking covalent bonds $CE = 0$

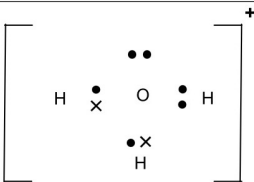
1

[7]

Question		Answer			Marks	Guidance
4	(a)		solid	melting point / °C	2	<p>giant AND ionic required</p> <p>simple AND molecular required</p> <p>ALLOW simple covalent</p>
			K	63		
			KBr	734		
			H ₂ O	0		
	(b)	<p><i>Particle mark 1:</i> In K, (electrostatic attraction between) positive ions/cations AND e⁻ / electrons ✓</p> <p><i>Particle mark 2:</i> In KBr, (electrostatic attraction between) oppositely OR positively AND negatively charged ions ✓</p> <p><i>Forces mark:</i> K has metallic bonding OR K has attraction between positive ions and electrons AND KBr has ionic bonding OR KBr has attraction between oppositely charged ions ✓</p> <p><i>In H₂O,</i> <i>Forces mark:</i> hydrogen bonding ✓</p> <p><i>Particles mark (QWC):</i> (Between) molecules ✓</p> <p>Order of strength of forces: KBr > K > H₂O OR ionic bonding > metallic bonding > hydrogen bonding ✓</p>			6	<p>Use annotations with ticks, crosses, ECF etc for this part</p> <p>ALLOW labels from diagrams if not seen in text</p> <p>ALLOW K⁺ and Br⁻ for 'oppositely charged ions'</p> <p>DO NOT ALLOW 'atoms' in KBr</p> <p>IGNORE 'metallic lattice' for metallic bonding' AND 'ionic lattice' for 'ionic bonding'</p> <p>DO NOT ALLOW , for forces mark, incorrect forces for K and KBr, such as covalent, van der Waals' seen anywhere in the response</p> <p>IGNORE references to van der Waals' forces in water</p> <p>ALLOW 'intermolecular' OR 'molecular' for particles mark <i>Quality of Written Communication:</i> 'molecules' OR 'intermolecular' OR 'molecular' spelt correctly once and used in context for the fifth marking point</p> <p>The order of all three substances OR bonding must be referred to for this mark ALLOW responses which use comparatives such as strong and extremely strong to differentiate strength of forces ALLOW answers that inform KBr > K > H₂O IGNORING incorrect forces used above</p>

Question			Answer	Marks	Guidance
4	(c)		FIRST CHECK THE ANSWER ON ANSWER LINE IF answer = 72(.0) (cm ³) award 3 marks amount of K = 0.2346 / 39.1 OR = 6.(00) × 10 ⁻³ OR 0.006(00) mol ✓ amount of H ₂ = (mol of K) / 2 OR = 3.(00) × 10 ⁻³ OR 0.003(00) mol ✓ Volume of gas = (mol of H ₂) × 24000 OR = 72(.0) (cm ³) ✓	3	If there is an alternative answer, check to see if there is any ECF credit possible using working below ALLOW mol of K x 0.5 correctly calculated for 2nd mark ALLOW mol of H ₂ x 24000 correctly calculated for 3rd mark ALLOW 144 (cm ³) from 0.006 x 24000 for two marks ALLOW 0.072 from 0.003 x 24 for two marks ALLOW calculator value or rounding to 2 significant figures or more BUT IGNORE 'trailing' zeroes, eg 0.200 allowed as 0.2
			Total	11	

Question	Answer	Marks	Guidance
5 (a)	<p><i>F₂ forces mark</i> F₂ has van der Waals' (forces) OR F₂ has induced dipole attractions OR interactions OR F₂ has temporary OR instantaneous dipole(–dipole) attraction OR interactions ✓</p> <p><i>HCl forces mark</i> HCl has permanent dipole(–dipole) attractions OR interactions ✓</p> <p><i>Comparison of strength of forces between molecules mark</i> intermolecular force in HCl is stronger than that in F₂ OR permanent dipoles are stronger (than induced dipoles) ✓</p> <p><i>Boiling point mark</i> more energy is required to break stronger (intermolecular) forces ✓</p>	4	<p>Use annotations ie ticks crosses ECF ^ etc for this part</p> <p>ALLOW vdWs for van der Waals' IGNORE F₂ has covalent bond for this mark IGNORE F₂ has 'intermolecular forces'</p> <p><i>Quality of written communication: 'dipole(s)' spelled correctly and used in context for the second marking point</i> IGNORE HCl has 'intermolecular forces' IGNORE van der Waals' forces in HCl/ DO NOT ALLOW hydrogen bonding DO NOT ALLOW ionic bonding</p> <p>Look for strength of force comparison anywhere in the answer ALLOW ECF for hydrogen bonding in HCl being stronger than the stated intermolecular forces in F₂ BUT DO NOT ALLOW this mark if HCl or F₂ has covalent bonds broken OR if HCl has ionic bonds broken (the question asks for forces between molecules) IGNORE HCl has stronger van der Waals' (forces) than F₂ (as they both have the same number of electrons)</p> <p>DO NOT ALLOW fourth mark if covalent bonds are broken in HCl or F₂ OR if ionic bonds are broken in HCl</p> <p>IGNORE 'heat' but ALLOW 'heat energy'</p>

Question	Answer	Marks	Guidance
5 (b) (i)	 <p>Two <i>dot-and-cross</i> bonding pairs of electrons and one dative covalent bond pair of electrons consisting of either two dots or two crosses ✓</p> <p>One non-bonding pair of electrons AND which match the dative covalent bond pair of electrons ✓</p>	2	<p>Must be '<i>dot-and-cross</i>' Must be H₃O for either mark Circles for shells not needed IGNORE inner shells IGNORE lack of positive charge and square brackets</p> <p>DO NOT ALLOW second marking point if negative charge is shown on the ion Non-bonding electrons do not have to be seen as a pair</p> <p>ALLOW second mark for one non-bonding pair of electrons and three <i>dot-and-cross</i> bonding pairs of electrons</p>

Question	Answer	Marks	Guidance
5 (c) (i)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE IF answer = 7.624 OR 7.62 (g) award 3 marks</p> <p>Molar mass of borax = $381.2 \text{ (g mol}^{-1}\text{)}$ ✓</p> <p>Correctly calculates the mass of borax in 1000 cm^3 = 0.0800×381.2 $= 30.496 \text{ g}$ OR 30.50 g OR 30.5 g ✓</p> <p>Correctly calculates the mass of borax in 250 cm^3 = $30.496/4$ $= 7.624 \text{ g}$ OR 7.62 g ✓</p> <p>OR</p> <p>Molar mass of borax = $381.2 \text{ (g mol}^{-1}\text{)}$ ✓</p> <p>Amount of borax in 250 cm^3 of solution = $0.0800 \times 250 / 1000 = 0.02(00) \text{ mol}$ ✓</p> <p>Mass of borax = $0.02(00) \times 381.2$ of borax $= 7.624 \text{ g}$ OR 7.62 g ✓</p>	3	<p>If there is an alternative answer, check to see if there is any ECF credit possible using working below</p> <p>ALLOW 381 DO NOT ALLOW 380</p> <p>ALLOW $0.0800 \times [\text{molar mass of borax}]$ correctly calculated for 2nd mark (ie mass of borax in 1000 cm^3)</p> <p>ALLOW $[\text{mass of borax in } 1000 \text{ cm}^3] / 4$ correctly calculated for 3rd mark</p> <p>ALLOW calculator value or rounding to three significant figures or more IGNORE (if seen) a second rounding error</p> <p>ALLOW 381 DO NOT ALLOW 380</p> <p>ALLOW $[\text{incorrect amount of borax}] \times 381.2$ OR $[\text{incorrect amount of borax}] \times [\text{incorrect molar mass of borax}]$ OR $0.02(00) \times [\text{incorrect molar mass of borax}]$ correctly calculated for this mark</p> <p>ALLOW calculator value or rounding to three significant figures or more IGNORE (if seen) a second rounding error</p>

Question	Answer	Marks	Guidance
5 (d) (i)	<p>Correctly calculates the amount of borax used = $0.0800 \times 22.5/1000$ $= 1.8(0) \times 10^{-3} \text{ mol}$ OR $0.0018(0) \text{ mol}$ ✓</p>	1	
(ii)	<p>Correctly calculates the amount of HCl used = $1.8(0) \times 10^{-3} \times 2 \text{ mol}$ $= 3.6(0) \times 10^{-3} \text{ mol}$ OR $0.0036(0) \text{ mol}$ ✓</p>	1	<p>ALLOW $[\text{incorrect amount of borax}] \times 2$ correctly calculated for the 2nd mark. ALLOW calculator value or rounding to 3 significant figures or more BUT IGNORE 'trailing' zeroes, eg 0.200 allowed as 0.2</p>
(iii)	<p>Correctly calculates the concentration of HCl = $3.6(0) \times 10^{-3} / (25 / 1000) = 0.144 \text{ (mol dm}^{-3}\text{)}$ ✓</p>	1	<p>ALLOW $[\text{incorrect amount of HCl}] / (25/1000)$ correctly calculated for the 3rd mark given to 3 SF</p>
	Total	12	

