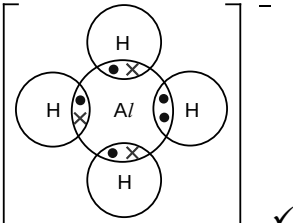
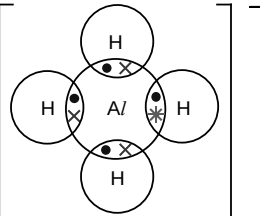


SECTION B

Question	Answer	Marks	Guidance
1 i) (i)		1	IGNORE no brackets, no charge or wrong charge Circles not needed ALLOW different sign for 'extra' electron, e.g.  DO NOT ALLOW 4 dots and 4 crosses
(b)	NH_4^+: tetrahedral AND 109.5° ✓ NH_2^-: non-linear AND 104.5° ✓	2	ALLOW $109-110^\circ$ ALLOW $104-105^\circ$ ALLOW bent, v-shaped, angular IGNORE planar, 'not straight'

Question			Answer	Marks	Guidance
	(c)	(i)	NH_3 has hydrogen bonding OR PH_3 does not have hydrogen bonding ✓ Hydrogen bonding is stronger OR More energy to overcome hydrogen bonding ✓	2	ORA throughout Assume that comparison is with PH_3 DO NOT ALLOW response that implies covalent or ionic bonds breaking
		(ii)	AsH_3 / As has more electrons (than PH_3 / P) ✓ in AsH_3, stronger/more induced dipole–dipole interactions OR stronger/more London forces (than PH_3) OR more energy required to overcome induced dipole–dipole interactions ✓	2	ORA throughout ALLOW larger electron cloud ALLOW ‘forces’ OR ‘bonds’ for ‘interactions’ ALLOW instantaneous/temporary–induced dipole interactions ALLOW dispersion forces IGNORE van der Waals’ / vdW IGNORE permanent dipole–dipole DO NOT ALLOW response that implies covalent or ionic bonds breaking
			Total	7	

Question		Answer	Marks	Guidance
2	(a)	Global rules - C and O electrons must be shown differently, e.g. • for C and × for O - Na electrons shown with different symbol MARKING Bonding around central C atom ✓ 4 electrons for C shown as • OR × 4 electrons for O, different from C as • OR × - C=O bond with 2 C electrons AND 2 O electrons - Two C–O bonds with 1 C electron AND 1 O electron Non-bonded (nb) electrons around 3 O atoms ✓ - C=O oxygen has 4 nb 'O' electrons - Each C–O oxygen has 5 nb 'O' electrons AND 1 'extra' electron with different symbol	2	NOT REQUIRED - Charge ('2-') IGNORE incorrect charges - Brackets - Circles IGNORE inner shells ALLOW rotated diagram ALLOW diagram with missing C or O symbols. In C=O bond, ALLOW sequence × × • • In C–O bond, ALLOW 'extra' electron with different symbol for O electron ALLOW non-bonding electrons unpaired ALLOW 'extra' electron as • OR × if it has been labelled 'extra electron' or similar
		Total	11	

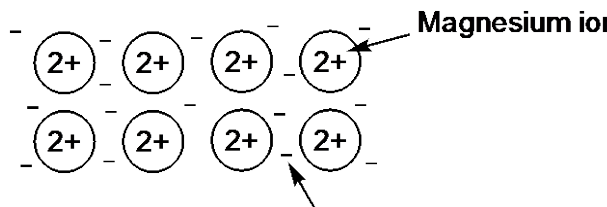
Question	Answer	Marks	AO element	Guidance
3	A	1	AO1.1	

Question	Answer	Marks	AO element	Guidance
4 (a)	$\left[\text{Mg} \right]^{2+}$ $\left[\begin{array}{c} \cdot \\ \times \text{Br} \cdot \\ \cdot \end{array} \right]^{-}$ $\left[\begin{array}{c} \cdot \\ \times \text{Br} \cdot \\ \cdot \end{array} \right]^{-}$ Mg with no (or 8) outer electrons AND 2 × Br with '<i>dot-and-cross</i>' outer octet ✓ Correct charges ✓	2	1.2 2.5	ALLOW 8 electrons in Mg^{2+} BUT 'extra' electron in Br^{-} must match symbol for electrons in Mg^{2+} IGNORE inner shells and circles ALLOW 1 mark if both electron arrangements and charges are correct but only one Br is drawn. ALLOW $2[\text{Br}^{-}]$, $2[\text{Br}]^{-}$ (brackets not required)

Question		Answer	Marks	AO element	Guidance
4	(b)*	<i>Refer to marking instructions on page 5 of mark scheme for guidance on marking this question.</i> Level 3 (5–6 marks) Explains all three melting point values and conductivities in terms of structure, bonding, particles and relative strengths of the forces. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Attempts to explain all three melting point values and conductivities in terms of the structure, bonding, particles of all three substances, but explanations may be incomplete or may contain only some correct statements or comparisons. OR Correctly explains two of the melting point values and conductivities in terms of the structure, bonding, particles. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Identifies only some of the structures, forces and particles AND Attempts to explain the melting point values OR conductivities in terms of the structure, bonding, particles <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>	6	1.1×3 2.1×3	Indicative scientific points may include: <u>Structure and bonding</u> Magnesium • Structure: giant lattice • Metallic bonding • Delocalised electrons Bromine • Structure: simple molecular • induced dipole dipole forces (London forces) • (Between) molecules DO NOT ALLOW (between) atoms Magnesium bromide • Structure: giant lattice • Ionic bonding • (Between) oppositely charged ions <u>Comparison of bond strengths</u> • Metallic and ionic bonds are stronger than London forces OR Metallic and Ionic bonds need more energy to break than London forces <u>Conductivity</u> • Magnesium: conducts due to delocalised electrons can move/mobile. IGNORE 'Carry' charge for movement • Magnesium bromide: In solid IONS cannot move; in solution IONS can move. DO NOT ALLOW electrons. • Bromine: Does not conduct as no mobile charge carriers.

Question	Answer	Marks	AO element	Guidance
5	C	1	AO1.1	

Question	Answer	Marks	AO element	Guidance
6	B	1	AO2.1	

Question		Answer	Marks	AO element	Guidance
7	(a)	 (delocalised) electrons Diagram with regular arrangement of labelled 'Mg²⁺ ions' OR '2+ ions' AND attempt to show electrons ✓ Labelled electrons between other species AND statement anywhere of delocalised electrons (can be in text or in diagram) Electrons move ✓	3		Regular arrangement must have at least two rows of correctly charged ions and a minimum of two ions per row ALLOW as label: +2 ions OR + 2 cations OR +2/2+ seen within circle ALLOW e⁻ or 'e' as a label for electron IGNORE "-" for electron label ALLOW mobile/flow for move IGNORE 'carry charge'

Question	Answer	Marks	AO element	Guidance
8	A	1	1.2	

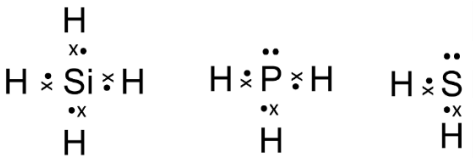
Question	Answer	Marks	AO element	Guidance
9	A	1	AO1.1	

Question	Answer	Marks	AO element	Guidance
10	B	1	AO1.2	

Question	Answer	Marks	Guidance
11	B	1	

Question			Answer	Marks	Guidance
12	(a)	(i)	There are 3 bonding regions OR 3 <u>double bonds</u> (round the S atom).	1	ALLOW electron regions / areas of <u>electron density</u> ALLOW - It has a resonance structure with all 3 bonds being the same/inbetween a single and double bond OR has 3 σ bonds. DO NOT ALLOW bonding pairs
		(ii)	S/Sulfur and O/Oxygen have different electronegativities (and S–O bonds are polar) ✓ (SO ₂ lone pair gives) non-linear shape / asymmetrical AND dipoles don't cancel / dipoles do not act in opposite directions OR uneven electron charge density AND dipoles don't cancel ✓	2	ALLOW if partial charges are seen on diagram. DO NOT ALLOW sulfur is more electronegative than oxygen For non-linear, ALLOW bent OR v-shaped IGNORE shapes seen in diagrams, treat as rough working IGNORE polar bonds cancel IGNORE polarity cancels DO NOT ALLOW charges cancel ORA e.g. SO ₃ trigonal planar shape/symmetrical AND dipoles cancel / dipoles act in opposite directions OR even electron charge density AND dipoles cancel

Question	Answer	Marks	Guidance
13	C	1	

Question	Answer	Mark	Guidance
14 (a)*	Level 3 (5–6 marks) For all three molecules: correct dot and cross diagrams drawn AND correct shapes AND correct trend of bond angles AND an explanation of electron pair repulsion on shape <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) For two molecules: correct dot and cross diagrams drawn AND correct shapes AND correct trend of bond angles AND an explanation of electron pair repulsion on shape OR For all three molecules: One correct and three <i>attempts</i> from: dot cross diagrams shapes trend in bond angles explanation of electron pair repulsion on the shapes <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i>	6	Indicative scientific points may include: <u>Dot and cross diagrams</u>  <u>Shapes</u> SiH₄ tetrahedral PH₃ (trigonal) pyramidal H₂S v-shaped / bent / angular / non-linear IGNORE planar / 'not straight' <u>Trend of bond angles</u> Bond angles in the order (numerical bond angles are not required) SiH₄ > PH₃ > H₂S SiH₄ = 109.5° > PH₃ (less than 109.5) > H₂S (less than PH₃) > 90° <u>Explanation of bond angles</u> SiH₄ Four bonding pairs (no lone pairs) PH₃ Three bonding pairs one lone pair H₂S Two bonding pairs two lone pairs Electron pairs repel Lone pairs repel more than bonding pairs ALLOW lp for lone pair (of electrons) ALLOW bp for bonding pair (of electrons) ALLOW regions for electron pairs (electron pairs seen in diagram) IGNORE electron density IGNORE 'bonds' for 'bonded pair' IGNORE 'electrons repel' DO NOT ALLOW 'atoms repel'