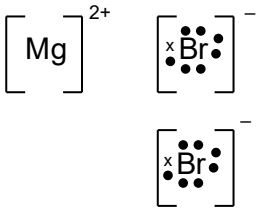
SECTION B

Question			Answer	Marks	AO element	Guidance
16	(a)		(The mean/average mass) taking into account the relative abundancies of the isotopes ✓	1	1.1	**ALLOW** sum of (isotopic mass × %abundance) sum of (isotopic mass × abundance) / total abundance **DO NOT ALLOW** average mass of the isotopes
		(i)	 Mg with no (or 8) outer electrons **AND** 2 × Br with '*dot-and-cross*' 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** $2[Br^-]$, $2[Br]^-$ (brackets not required)
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.71×10^{22} award 3 marks** --- $n(MgBr_2) = \frac{1.74}{184.1} = 0.00945\ldots..$ mol ✓ Moles of ions = 0.00945…. × 3 = 0.0283…. mol ✓ Number of ions = 0.0283... × 6.02×10^{23} = 1.71×10^{22} ✓ **3SF** required	3	2.2×3	**ALLOW ECF** Calculator answer = $9.451385117 \times 10^{-3}$ **ALLOW ECF** from incorrect moles of ions. e.g. 0.00945 Common error 5.69×10^{21} no × 3 2 marks

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(c)*	*Refer to marking instructions on page 5 of mark scheme for guidance on marking this question.* **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. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **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. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **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 *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**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.

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	(d)	(i)	$Mg^{2+}(g) + 2Br(g) + 2e^-$ ✓ $Mg(s) + Br_2(l)$ ✓	2	1.2× 2	State symbols required. **CARE:** Liquid state symbol for Br_2
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = –346.5 award 2 marks** --- $2\Delta H$ hyd = – 525 – 186 – (2 x 112) – 148 – 736 – 1450 + (2 x -325) + 1926 **OR** – 525 – 186 – 224 – 148 – 736 – 1450 + 650 + 1926 **OR** = – 693 ✓ ΔH hyd = –346.5 (kJ mol^{-1}) ✓	2	2.2×2	**ALLOW -347** (kJ mol^{-1}) for 2 marks. **ALLOW** for 1 mark **ONE** error with sign **OR** use of 2: –693 (not divided by 2 at the end) 346.5 (wrong sign on answer) **Common errors for 1 mark** –2272.5 (–1926 instead of 1926) -1386 (**2** x -693 instead of -693) –996.5 (–650 instead of 650) –509 (**2** × 325 not used) –290.5 (**2** × 112 not used) –198.5 (148 instead of –148) –160.5 (186 instead of –186) –122.5 (224 instead of –224) 178.5 (525 instead of –525) 389.5 (736 instead of –736) 1103.5 (1450 instead of –1450) **For other answers**, check for a **single** transcription error or calculation error which could merit 1 mark **DO NOT ALLOW** any answer which involves two errors e.g. –453 (**2** × 325 not used **AND 2 x** 112 not used)

Question			Answer	Marks	AO element	Guidance
		(iii)	**Equation:** $Mg^{2+}(g) + 2Br^{-}(g) \rightarrow MgBr_2(s)$ ✓ **CHECK THE ANSWER ON ANSWER LINE** **If answer = –2433 award 2 marks** --- Lattice enthalpy = $\Delta_{hy}H(Mg^{2+}) + 2 \times \Delta_{hy}H(Br^{-}) - \Delta_{sol}H(MgBr_2)$ **OR** -1926 + (2 x -346.5) – (-186) **OR** $\Delta_fH(MgBr_2) - 2\Delta_{at}H(Br) - \Delta_{at}H(Mg)$ – 1st IE(Mg) – 2nd IE(Mg) – $2\Delta_{ea}H(Br)$ **OR** -525 – (2 x 112) – 148 – 736 – 1450 – (2 x -325) ✓ **Lattice enthalpy** = –2433 kJ mol^{-1} ✓	**3**	1.2 2.2 x 2	State symbols required **For other answers**, check for a **single** transcription error or calculation error which could merit 1 mark **DO NOT ALLOW** any answer which involves two errors **ALLOW ECF** from incorrect answer to d(ii)
			Total	**18**		