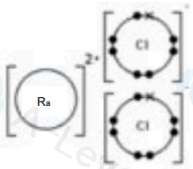
Question	Answer	Marks
2(a)	giant ionic	1
2(b)	Ra^{2+} and 2 x Cl^- 0 electrons surrounding 2Ra **AND** 8 electrons surrounding Cl 	1
2(c)(i)	$Ra + 2H_2O \rightarrow Ra(OH)_2 + H_2$	1
2(c)(ii)	Ra – more bubbles per unit time **OR** With Ra solid disappears more quickly **OR** Ra is the first to stop fizzing **ora**	1

Question	Answer	Marks
2(c)(iii)	**option 1** *suggest why these* reactions *occur at different rates (collision theory)* **M1** difference in activation energy / ionisation energy **M2** affects the frequency of effective collisions (between particles / molecules) **OR** affects the proportion of particles with energy greater than activation energy **option 2** *suggest why the elements have different reactivity in terms of atomic structure (which results in a different rate)* **M1** ionisation energies are different **M2** a decrease in nuclear attraction due to **EITHER** increase in shielding **OR** increase in distance of outer electron from nucleus **OR** increase in number of shells of electrons **ora**	2
2(c)(iv)	**M1** • pH value (or values) for each solution must be greater > 7 **AND** • pH value (or range values) identified for solution made from Ra must be greater than pH values (or range of values) stated for Ca **M2** *any one from:* • solubility of group 2 hydroxides increases down the group • $Ra(OH)_2$ is more soluble • greater concentration of OH^-(aq) in the solution involving Ra • more OH^- (aq) in the solution involving Ra	2

Question	Answer	Marks
2(d)		3

step	method	observation with $CaCl_2$	observation with $CaBr_2$	observation with CaI_2
step **1**	$AgNO_3$(aq) ($+HNO_3$(aq)	white ppt	cream **OR** off-white ppt	(pale) yellow ppt
step **2**	NH_3 (aq)	(ppt) dissolves / (completely) soluble (in dilute or conc) OR (forms) colourless solution	(ppt) partly soluble / slightly soluble (in dilute or conc) **ALLOW** (ppt) dissolves in excess (in dilute or conc) **ALLOW** (ppt) soluble in **conc.**NH_3	(ppt) insoluble / solid remains (in dilute or concentrated)

M1 step **1** $AgNO_3$(aq) / silver nitrate solution **AND** step **2** NH_3(aq) / ammonia solution / dilute NH_3 / concentrated NH_3

M2 ALL solid / precipitate **AND** correct colours described in row 1

M3 correct observations on addition of ammonia

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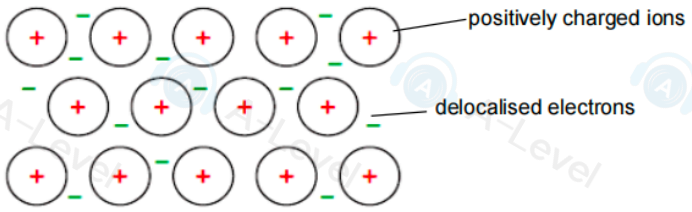
Question	Answer	Marks
1(a)	<table><tr><td>Mg^{2+}</td><td>24</td><td>12</td><td>10</td></tr><tr><td>Al^{3+}</td><td>27</td><td>13</td><td>10</td></tr></table> 4 correct = 2 marks 2 or 3 correct = 1 mark 0 or 1 correct = 0 marks	2
1(b)	**M1** it / Al^{3+} is smaller (compared to Mg^{2+}) **M2** greater nuclear attraction for remaining electrons **M3** same shielding effect AND greater nuclear charge	3
1(c)	 labelled diagram shows: • regular arrangement of minimum of 2 × 2 circles containing + for positive ions • **AND** surrounded by (sea of) delocalised electrons	1
1(d)(i)	large amount of energy required to break bonds in giant covalent structure	1

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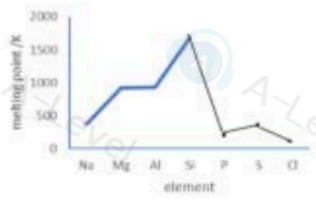
Question	Answer	Marks
1(d)(ii)	 **M1** all 3 melting points lower than Mg **M2** show melting point Cl < P < S	2
1(e)(i)	<table><tr><td>Na</td><td>solid</td><td>10–14</td></tr><tr><td>S</td><td>gas</td><td>0–4</td></tr></table> 4 correct = 2 marks 2 or 3 correct = 1 mark 0 or 1 correct = 0 marks	2
1(e)(ii)	acid–base **OR** neutralisation	1
1(e)(iii)	$P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$	1
1(f)(i)	reacts with both acids and bases **OR** shows both acidic and basic behaviour	1
1(f)(ii)	$Al(OH)_3 + NaOH \rightarrow NaAl(OH)_4$	1

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Question	Answer	Marks
1(a)	$O(g) \rightarrow O^+(g) + e^-$	1
1(b)(i)	increase across period **AND** increased nuclear attraction **for** (valence / outer) **electrons** [1] increase in (positive) nuclear charge / number of protons (in the nucleus) [1] similar shielding (of outer electrons) [1]	3
1(b)(ii)	spin-pair repulsion (of electrons) in (2)p orbital [1] outweighs increased nuclear charge [1]	2
1(c)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$ [1] greatest jump between 3rd and 4th ionisations [1] indicates three electrons in outer shell [1]	3