Question	Expected answers	Marks
1 (a)	Number of outer shell electrons increases (by one) / uses (one) more outer electron in bonding / (maximum) oxidation number increases (by one) (1)	1
(b)	Bonding NaCl and $MgCl_2$ – ionic $AlCl_3$ and $SiCl_4$ – covalent Structure NaCl and $MgCl_2$ – giant $AlCl_3$ and $SiCl_4$ – simple	4
(c)	Sodium chloride has a **higher** melting point than silicon(IV) chloride / sodium chloride has a high melting point and silicon(IV) chloride a low melting point (1); **And** **Any three from** Silicon(IV) chloride has intermolecular forces / van der Waals forces of attraction / induced dipole-induced dipole attractions (1); these forces are weak (1); NaCl has attraction between positive ion and negative ion / NaCl has electrostatic attraction between ions (1); these attractions are strong (1)	4
(d)	**Any six from** Sodium chloride dissolves in water / $NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$ / NaCl dissociates in water (1); Gives a colourless solution (1); With a pH of 7 (1); Silicon(IV) chloride is hydrolysed / vigorous reaction (1); Gives a mixture with a pH of between 0 and 6 (1); White precipitate formed / steamy fumes (1); $SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl$ / $SiCl_4 + 4H_2O \rightarrow Si(OH)_4 + 4HCl$ (1)	6
		Total = 15

Question	Expected answers	Marks
2 (a)	$MgCO_3 \rightarrow MgO + CO_2$ (1)	1
(b)	Moles of $MgCO_3$ = 0.0050 / 0.00498 (1); So mass of $BaCO_3$ = 0.98 / 0.99 (1)	2
(c)	More (inner) shielding (shells) / more shells (1)	1
(d)	Charge density decreases from Mg^{2+} to Ba^{2+} (1); As the rate of decomposition (as shown from the slope of graph) decreases from $MgCO_3$ to $BaCO_3$ / $MgCO_3$ produces more carbon dioxide (1)	2
(e)	Anion is polarised by the positive ion / carbonate is polarised by the cation / electron cloud around carbonate ion is distorted by cation / covalent bonds within the carbonate ion are weakened (1); Polarising ability of cation decreases from Mg^{2+} to Ba^{2+} / ora (1);	2
		Total = 8

Question	Expected answers	Marks
3 (a)	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$ (1); (Iron is a transition element since this ion has an) incomplete set of 3d electrons / aw (1)	2
(b)	Iron in the Haber process / Iron to catalyse reaction of nitrogen and hydrogen / iron in the synthesis of ammonia (1)	1
(c) (i)	Calculation of moles / mole ratio (1) Na = 1.21, Fe = 0.603 and O = 2.41; Divide by smallest to give correct molar ratio (1) **OR** Calculation of relative formula mass (1); Working out to get the same percentage compositions (1)	2
(ii)	+6 (1)	1
(d) (i)	$2I^- \rightarrow I_2 + 2e^-$ (1)	1
(ii)	$FeO_4^{2-} + 8H^+ + 4I^- \rightarrow Fe^{2+} + 4H_2O + 2I_2$ Correct reactants and products (1); Balancing (1)	2
(iii)	Colour after is orange / yellow / brown (solution) (1)	1
		Total = 10

Question	Expected answers	Marks
4	**Any eleven from** **Bonding and shape** Dative / coordinate bonding – this must be stated in words (1); Water is an electron pair donor / ligand is an electron pair donor / lone pair on oxygen (1); Metal ion accepts electron pair (1); Octahedral / drawing of octahedral complex (1) **Water** In both cases central oxygen is surrounded by four electron pairs (1); In gaseous water (2 bond pairs and) 2 lone-pairs (1); In gaseous water lone pair-lone pair repulsion is greater than other electron pair repulsions (1); Bond angle is 104° – 105° (1); In complex one dative bond is more like a bond pair / water has only one lone pair (1); So less repulsion from the lone pairs (1); bond angle in complex is 106° – 108° / bond angle is slightly bigger than 104° (1) **Distinguishing** Reagent (1) e.g. aqueous sodium hydroxide / add aqueous ammonium thiocyanate / aqueous ammonia; Result of test with Fe^{2+} (1) e.g. green ppt with Fe^{2+} and NH_3 or NaOH and no reaction with SCN^-; Result with Fe^{3+} (1) e.g. orange ppt with Fe^{3+} and NH_3 or NaOH and blood red with SCN-; Suitable equations (2) e.g. $Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$ or $[Fe(H_2O)_6]^{3+} + SCN^- \rightarrow [Fe(SCN)(H_2O)_5]^{2+} + H_2O$ **And** QWC – award one mark for answers using the correct scientific terminology (1)	12
		Total = 12