A Level AQA Chemistry

Chapter 13 – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	Can form 2 co-ordinate/dative bonds with metal ion		1 1	3.2.5.1 AO1
01.2	$Fe^{3+}(s) + 3C_2O_4^{2-}(aq) \rightarrow [Fe(C_2O_4)_3]^{-3}(aq)$		1	3.2.6 AO1
01.3	Optical Because the two isomers are not superimposable	 Allow diagrams to explain	1 1	3.2.5.3 AO1
01.4	$[Fe(H_2O)_6]^{3+} + 3NH_3 \rightarrow [Fe(H_2O)_3(OH)_3] + 3NH_4^+$ Purple solution Brown precipitate	Mark 1 for species Mark 2 for charges Allow yellow/brown Allow orange/brown	2 1 1	3.2.6 AO1
01.5	$K_a = \frac{[H^+]^2}{[HA]} / K_a = \frac{[H^+][A^-]}{[HA]}$ $[H^+] = \sqrt{5.4\times10^{-2} \times 1.50} = 0.285$ Diprotic so $[H^+] = 0.285 \times 2 = 0.570$ pH = –log (0.570) = 0.24	Can be awarded from correct calculation	1 1 1 1 1	3.1.12.4 AO2 MS0.1,0.4
02.1	Electron pair acceptor		1	3.2.6 AO1
02.2	$[Al(H_2O)_6]^{3+} + 1½\ CO_3^{2-} \rightarrow [Al(H_2O)_3(OH)_3] + 1½\ CO_2 + 1½\ H_2O$ Colourless solution To white precipitate And effervescence/ fizzing	Allow multiples	1 1 1 1	3.2.6 AO1

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02.3	Three from: Partially filled d-orbital Split due to ligand bonds Electrons absorb light to transition between d orbitals Light absorbed is green / complementary to (brick) red		3	3.2.5.4 AO3
02.4	$4Fe(s) + 6H_2O(g) + 3O_2(g) \rightarrow 4Fe(OH)_3(s)$ State symbols correct	Accept fractions, multiples and equations showing formation of hydrated hydroxide	1 1	3.1.2.5 AO1
02.5	Aluminium (metal) forms an oxide coat (on exposure to air) This coat prevents / inhibits further reaction (by water or oxygen)		1 1	3.2.4 AO1
03.1	$[Cu(H_2O)_6]^{2+}$ hexaaquacopper(II)		1 1	3.2.6 AO1
03.2	$[Cu(H_2O)_6]^{2+} + 2NH_3 \rightarrow [Cu(H_2O)_4(OH)_2] + 2NH_4^+$ Pale blue precipitate		1 1	3.2.6 AO1
03.3	HCl (conc or excess)/ NaCl $[Cu(H_2O)_6]^{2+} + 4Cl^- \rightarrow CuCl_4^{2-} + 6H_2O$		1 1	3.2.5.2 AO1
03.4	$CuCO_3$ Green-blue/green precipitate		1 1	3.2.6 AO1

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04.1	$[VO_2(H_2O)_4]^+$ yellow		1 1	3.2.5.5 AO1
04.2	$[VO(H_2O)_5]^{2+}$ Blue $[V(H_2O)_6]^{3+}$ Green/Dark green $[V(H_2O)_6]^{2+}$ Purple	Must be in correct order	1 1 1 1 1 1	3.2.5.5 AO1
04.3	Equal mix of V and IV/yellow and blue		1	3.2.5.5 AO1
05.1	$[Fe(H_2O)_6]^{2+}$		1	3.2.6 AO1
05.2	Add sodium carbonate / sodium hydroxide Green precipitate forms $[Fe(H_2O)_6]^{2+}(aq) + CO_3^{2-}(aq) \rightarrow FeCO_3(s) + 6H_2O(l)$	 Allow any colour from brown to green 3rd mark equation 4th mark state symbols	1 1 2	3.2.6 AO1
05.3	$K_a = \frac{[H^+]^2}{[HA]} / K_a = \frac{[H^+][A^-]}{[HA]} / [HA] = \frac{[H^+][A^-]}{[K_a]}$ $[H^+] = 10^{-1.62} = 0.023988$ $[HA] = \frac{0.23988^2}{5.76 \times 10^{-3}}$ $= 9.99 = 10.0$ mol dm^{-3}		1 1 1 1	3.1.12.4 AO2

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06.1	Al: colourless (solution) gives a white ppt $[Al(H_2O)_6]^{3+} + 3NH_3 \rightarrow Al(H_2O)_3(OH)_3 + 3NH_4^+$ Ag: colourless (solution) remains a colourless solution / no visible change $[Ag(H_2O)_2]^+ + 2NH_3 \rightarrow [Ag(NH_3)_2]^+ + 2H_2O$		1 1 1 1	3.2.6 AO1
06.2	Iron(II): green (solution) gives a green precipitate $[Fe(H_2O)_6]^{2+} + 2OH^- \rightarrow Fe(H_2O)_4(OH)_2 + 2H_2O$ Al: colourless (solution) gives a white ppt $[Al(H_2O)_6]^{3+} + 3OH^- \rightarrow Al(H_2O)_3(OH)_3 + 3H_2O^+$		1 1 1 1	3.2.6 AO1
06.3	Iron(II): green (solution) gives a green precipitate $[Fe(H_2O)_6]^{2+} + CO_3^{2-} \rightarrow FeCO_3 + 6H_2O$ Iron(III): violet (solution) gives a brown precipitate Effervescence / gas / bubbles $2[Fe(H_2O)_6]^{3+} + 3CO_3^{2-} \rightarrow 2[Fe(H_2O)_3(OH)_3] + 3CO_2 + 3H_2O$	Not blue-green ppt.	1 1 1 1 1	3.2.6 AO1
07.1	Has a stable ion with a partially filled d orbital		1	3.2.5.1 AO1
07.2	Linear 180°	Accept accurate diagram	1 1	3.2.5.3 AO1
07.3	$[Ag(H_2O)_2]^+(aq) + I^-(aq) \rightarrow AgI(s) + 2H_2O\ (l)$ Yellow precipitate	$Ag^+ + I^- \rightarrow AgI$ Do not allow cream	1 1	3.2.3.2 / 3.2.5.2 AO1
07.4	$2[Ag(H_2O)_2]^+(aq) + CO_3^{2-}\ (aq) \rightarrow Ag_2CO_3(s) + 4H_2O\ (l)$ Add nitric acid (to halide before silver)	Allow other strong acid but not HCl	1 1	3.2.6 AO1
07.5	Place a sample of each in a new boiling/test tube with tollens reagent Warm/Place in water bath Silver mirror should form with propanal but not propanone		1 1 1	3.2.5.5 AO3

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08.1	Electron pair acceptor		1	3.2.6 AO1
08.2	Aluminium is a small highly charged ion Electrons in coordinate/dative bonds from ligands are attracted strongly Polarised water ligand loses a proton/H^+	Allow high charge density	1 1 1	3.2.6 AO1
08.3	$[Al(H_2O)_6]^{3+}(aq) + 3OH^- \rightarrow Al(H_2O)_3(OH)_3(s) + 3H_2O(l)$ Colourless solution to white precipitate $Al(H_2O)_3(OH)_3(s) + OH^-(aq) \rightarrow [Al(OH)_4]^-(aq) + 3H_2O(l)$ White precipitate dissolves/ colourless solution forms		1 1 1 1	3.2.6 AO1
08.4	Can react as an acid and a base $3HCl + Al(OH)_3 \rightarrow AlCl_3 + 3H_2O$ $Al(OH)_3 + NaOH \rightarrow Al(OH)_4^- + Na^+$	Allow other acid and ionic equation	1 1 1	3.2.6 AO1

Skills box answers

1. Fe^{3+} / Fe(III)
2. $[Fe(H_2O)_6]^{3+}(aq) + 3NH_3(aq) \rightarrow [Fe(OH)_3(H_2O)_3](s) + 3NH_4^+(aq)$
3. No change
4. Add Na_2CO_3 solution. If bubbles (of CO_2) form then it is a 3+ ion, if not then it is a 2+ ion.