A Level AQA Chemistry

Chapter 12 – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	Both have outermost electrons in the d-block		1	3.2.5.1 AO1
01.2	Nickel has a stable ion with a partially full d-orbital but zinc only forms 2^+ ions with all filled d-orbitals	Allow correct electron configuration of ions	1	3.2.5.1 AO1
01.3	No space in d orbitals For transition of electrons So no light/photons absorbed		1 1 1	3.2.5.4 AO3
01.4	$[Ni(H_2O)_6]^{2+}(aq) + 2NH_3\ (aq) \rightarrow [Ni(H_2O)_4(OH)_2]\ (s) + 2NH_4^+\ (aq)$ Tetraaqua dihydroxo nickel II		1 1	3.2.5.2 AO1
02.1	The catalyst is a reaction product		1	3.2.5.6 AO1
02.2	Mn^{2+} / Mn^{3+} ion(s)		1	3.2.5.6 AO1
02.3	$4Mn^{2+} + MnO_4^- + 8H^+ \rightarrow 5Mn^{3+} + 4H_2O$ $2Mn^{3+} + C_2O_4^{2-} \rightarrow 2Mn^{2+} + 2CO_2$	Either order Allow multiples	1 1	3.2.5.6 AO1
02.4	Variable / many oxidation states		1	3.2.5.5 AO1
02.5	$V_2O_5 + SO_2 \rightarrow V_2O_4 + SO_3$ $V_2O_4 + ½O_2 \rightarrow V_2O_5$	Either order Allow multiples	1 1	3.2.5.6 AO1
02.6	In a different phase / state from reactants		1	3.2.5.6 AO1
02.7	Impurities poison / deactivate the catalyst / block the active sites		1	3.2.5.6 AO1

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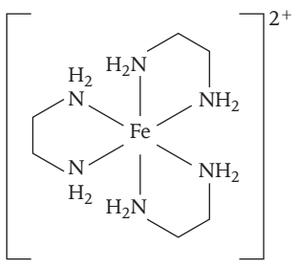
03.1	$[Fe(H_2O)_6]^{2+} + 4Cl^- \rightarrow [FeCl_4]^{2-} + 6H_2O$		1	3.2.5.2 AO1
03.2	Octahedra to Tetrahedral Cl^- ligands are larger So fewer can fit round the ion	Direction of change must be clear	1 1 1 1	3.2.5.3 AO1
03.3		1 mark correct structure 1 mark 2+ charge Accept skeletal or displayed formula	1 1	3.2.5.3 AO1
03.4	increase		1	3.2.5.2 AO1
03.5	Optical		1	3.2.5.3 AO1
04.1	Multidentate – EDTA can form many / six dative bonds with central cation. Ligand – lone pair (on N or O of EDTA) can form dative bond with copper(II) ions.		1 1	3.2.5.2 AO1
04.2	$[Cu(H_2O)_6]^{2+} + EDTA^{4-} \rightarrow [Cu(EDTA)]^{2-} + 6H_2O$ Increase in entropy as more molecules at the end		1 1	3.2.5.2 AO1

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04.3	Calibrate a colorimeter / produce a calibration curve. By testing the colorimeter with solutions of copper-EDTA complex of known concentration. Add excess EDTA salt to the sample.		1 1 1	3.2.5.4 AO3
04.4	Moles Cu = $6.65\times10^{-5} \times 0.025 = 1.662\times10^{-6}$ Vol EDTA = $1.662\times10^{-6} / 1.00\times10^{-3} = 0.0016625\ dm^3$ $1.66\ cm^3$		1 1 1	3.1.2.5 AO2
04.5	$0.05 \times 2 = 0.1$ $(0.1/1.66) \times 100 = 6(.01)$ % Dilute the $EDTA^{4-}$ solution so it increases the volume		1 1 1	3.1.2.5 AO2
05.1	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$		1	3.1.1.3 AO1
05.2	$CoCl_2 + 6H_2O \rightarrow [Cu(H_2O)_6]Cl_2$ Blue to pink	Allow charges/multiples	1 1	3.2.5.2
05.3	Percentage of oxygen is 42.5% Co 13.0 / 58.9 = 0.221, N 18.6 / 14 = 1.329, K 25.9 / 39.1 = 0.662, O 42.5 / 16 = 2.656 $CoN_6K_3O_{12}$	Allow if shown clearly in the calculation. Allow alternative method if chemically correct.	1 1 1	3.1.2.4 AO2
05.4	$[Co(NO_2)_6]^{3-}$		1	3.2.5.2 AO1

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05.5	Cobalt has variable oxidation states (It can act as an intermediate that) lowers the activation energy	Allow exists as Co(II) and Co(III) Allow (alternative route with) lower E_a	1 1	3.2.5.6 AO1
5.6	$CH_3CHO + 2Co^{3+} + H_2O \rightarrow CH_3COOH + 2Co^{2+} + 2H^+$ $O_2 + 2Co^{2+} + 2H^+ \rightarrow 2Co^{3+} + H_2O$	Allow multiples; allow molecular formulae Allow equations with H_3O^+	1 1	3.2.5.6 AO1
06.1	Transport oxygen		1	3.2.5.2 AO1
06.2	Bonds to haemoglobin/iron irreversibly Displaces oxygen / prevents O_2 from bonding	Allow prevents oxygen bonding/ binding	1 1	3.2.5.2 AO1
06.3	$CH_4 + 1½\ O_2 \rightarrow 2H_2O + CO$ / CH_4:CO 1:1 ratio $V = 200 \times 0.01/100 = 0.02\ m^3$ CO $P = 100000$ $T = 298$ $n = \frac{PV}{RT}$ $n = \frac{100000 \times 0.02}{8.31 \times 298}$ $n = 8.076$ mol of CO/CH_4 Mass $CH_4 = 8.076 \times 16 = 129$ g	Can be seen in calculation Or correct workings Allow rounding to 3 s.f.	1 1 1 1 1 1	3.1.2.3 AO2 MS0.0, 2.2, 2.3, 2.4
06.4	$[Fe(H_2O)_6]^{2+}$ (aq) + $2OH^-$ (aq) $\rightarrow$ $[Fe(H_2O)_4(OH)_2]$(s) + H_2O (l) Green solution To green precipitate	 Allow ppt/ppte	1 1 1	3.2.5.2 AO1

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06.5	$[Fe(H_2O)_3(OH)_3](s)$ Brown precipitate	 Allow ppt/ppte	1 1	3.2.5.2 AO1
07.1	(It can act as an intermediate that) lowers the activation energy Is in the same phase as the reactants	Allow provides alt route	1 1	3.2.5.6 AO1
07.2	Variable oxidation states	Allow state accurate oxidation states	1	3.2.5.5 AO1
07.3	Five/5/V		1	3.1.7 AO1
07.4	Fe^{2+} $E^{\ominus}\ VO^{2+}(/\ VO^{2+}) > E^{\ominus}\ Fe^{3+}(/Fe^{2+}) > E^{\ominus}\ VO^{2+}(/V^{3+})$	Accept any Fe(II) compound – correct formula or name If calculations of EMF are provided producing EMFs = 0.23 (V) and −0.43 (V), with a comment, allow 2nd mark allow $E^{\ominus}\ Fe^{3+}\ (/Fe^{2+})$ value of +0.77 is between the $E^{\ominus}$ values for the electrode half-equations containing the V species or wtte	1 1	3.1.11.1 AO3
07.5	$V_2O_5 + SO_2 \rightarrow V_2O_4 + SO_3$ $V_2O_4 + ½\ O2 \rightarrow V_2O_5$		1 1	3.2.5.6 AO1

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08.1	Geometric		1	3.2.5.3 AO1
08.2	Square planar		1	3.2.5.3 AO1
08.3	Both amines will not be able to bond with the double helix of DNA So will not disrupt replication		1 1	3.2.5.3 AO3
08.4	Toxic/Kills normal cells Disrupts DNA of healthy/normal cells	Allow references to hair loss, etc.	1 1	3.2.5.3 AO3

Skills box answers:

1. $\frac{32.40 + 32.45 + 32.50}{3} = 32.45\,\text{cm}^3$

2. $\frac{(20.52 \times 70) + (27.45 \times 72) + (7.76 \times 73) + (36.52 \times 74) + (7.75 \times 70)}{100} = 72.7$

3. $\frac{14.30 + 14.45 + 14.50}{3} = 14.42\,\text{cm}^3$