7 Oxidation, reduction, and redox reactions
Answers to practice questions

Question number	Answer	Marks	Guidance
1 (a)	a reducing agent gives electrons	1	This must not refer to electron pairs.
1 (b)	Zero	1	
1 (c) (i)	(+)3	1	You will always need to work out oxidation states so you need to practise them a lot.
1 (c) (ii)	–3	1	
1 (c) (iii)	–1	1	
1 (d) (i)	$PbO_2 + 4H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O$	1	When you balance these equations and they are not familiar always check that the numbers of atoms on each side are the same and then go back and check that the net charge on each side is the same.
1 (d) (ii)	$2Cl^- \rightarrow Cl_2 + 2e^-$	1	
1 (d) (iii)	$PbO_2 + 4H^+ + 2Cl^- \rightarrow Pb^{2+} + Cl_2 + 2H_2O$	1	
2 (a)	gains electrons	1	
2 (b) (i)	4 +6	1 1	
2 (b) (ii)	$Br_2 + 2e^- \rightarrow 2Br^-$	1	
2 (b) (iii)	$SO_2 + 2H_2O \rightarrow 4H^+ + SO_4^{2-} + 2e^-$	1	
2 (b) (iv)	$Br_2 + SO_2 + 2H_2O \rightarrow 2Br^- + 4H^+ + SO_4^{2-}$	1	You could have $H_2SO_4 + 2HBr$ on the right.
3 (a)	accepts electrons	1	
3 (b)	charge on the ion or element or atom	1	
3 (c)	+4 +5 -3	1 1 1	Remember to learn the oxidation states of the elements using the periodic table to help you. Mg in Group 2 is always +2, O in Group 6 is –2, etc. (The elements that have variable oxidation states are often the ones asked for.)
3 (d) (i)	$Cu \rightarrow Cu^{2+} + 2e^-$	1	
3 (d) (ii)	$NO^{3-} + 4H^+ + 3e^- \rightarrow NO + 2H_2O$	1	
3 (d) (iii)	$3Cu + 2NO^{3-} + 8H^+ \rightarrow 3Cu^{2+} + 2NO + 4H_2O$	1	

4 (a)	+2 +5	1 1	N has variable oxidation states, but oxygen is −2 only.
4 (b)	$NO^{3-} + 4H^+ + 3e^- \rightarrow NO + 2H_2O$	1	When the question says 'in acid solution' just put H+ ions in on the left and balance them up at the end.
4 (c)	$Ag \rightarrow Ag^+ + e^-$	1	Even in this simple equation check that the charge on each side balances (in this case it is 0).
4 (d)	$NO^{3-} + 4H^+ + 3Ag \rightarrow NO + 2H_2O + 3Ag^+$	1	
5 (a) (i)	**M1 0** **M2 (+) 5**	2	Accept Roman V for M2
5 (a) (ii)	$I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$	1	Accept multiples
5 (b)	**M1** $IO_3^- + 6H^+ + 5I^- \rightarrow 3I_2 + 3H_2O$ **M2** $NaIO_3$ **OR** IO_3^- **OR** iodate ions **OR** iodate(V) ions etc Accept "the iodine in iodate ions" but NOT "iodine" alone	2	For M1, ignore state symbols Credit multiples Accept $2½I_2 + ½I_2$ as alternative to $3I_2$ Electrons must be cancelled For M2 Do not penalise an incorrect name for the correct oxidising agent that is written in addition to the formula. Accept "the iodine / I in iodate ions" but NOT "iodine" alone
5 (c) (i)	Iodine **OR** I_2	1	Insist on correct name or formula
5 (c) (ii)	$H_2SO_4 + 6H^+ 6e^- \rightarrow S + 4H_2O$ $SO_4^{2-} + 8H^+ + 6e^- \rightarrow S + 4H_2O$	1	Ignore state symbols Credit multiples Do not penalise absence of charge on the electron
5 (d)	hydrogen sulfide **OR** H_2S **OR** hydrogen sulphide	1	

5 (e) (i)	$Ag^+ + I^- \rightarrow AgI$ ONLY	1	Ignore state symbols No multiples
5 (e) (ii)	The (yellow) precipitate / solid / it does not dissolve / is insoluble **OR** turns to a white solid **OR** stays the same **OR** no (visible/ observable) change **OR** no effect / no reaction	1	Ignore "nothing (happens)" Ignore "no observation
5 (e) (iii)	The silver nitrate is acidified to • react with / remove <u>(an)ions that would interfere</u> with the test • prevent the formation of <u>other silver precipitates / insoluble silver compounds</u> that would interfere with the test • remove (other) <u>ions that react with the silver nitrate</u> • react with / remove carbonate / hydroxide / sulfite (ions)	1	Ignore reference to "false positive" Do not penalise an incorrect formula for an ion that is written in addition to the name. If only the formula of the ion is given, it must be correct
5 (f) (i)	An <u>electron donor</u> **OR** (readily) <u>donates / loses / releases / gives (away) electron(s)</u>	1	Penalise "electron pair donor" Penalise "loss of electrons" alone Accept "electron donator"
5 (f) (ii)	$Cl_2 + 2e^- \rightarrow 2Cl^-$	1	Ignore state symbols Do not penalise absence of charge on electron Credit $Cl_2 \rightarrow 2Cl^- - 2e^-$ Credit multiples
5 (f) (iii)	For M1 and M2, iodide ions are stronger reducing agents than chloride ions, because **M1 Relative size of <u>ions</u>** Iodide ions / they are <u>larger</u> / have <u>more electron levels(shells)</u> (than chloride ions) / <u>larger atomic / ionic radius</u> **OR** <u>electron to be lost/outer shell/level</u> (of the iodide ion) is further the nucleus **OR** <u>iodide ion</u>(s) / they have <u>greater / more shielding</u> **OR** converse for <u>chloride ion</u>	2	Ignore <u>general statements</u> about Group VII trends or about halogen molecules or atoms. Answers must be specific CE=0 for the clip if "iodine ions / chlorine ions **QoL** CE=0 for the clip if "iodide ions are bigger molecules / atoms" **QoL** Insist on <u>iodide</u> ions in M1 and M2 or the use of it / they / them, in the correct context (or <u>chloride</u>

	M2 Strength of attraction for electron(s) The electron(s) lost / outer shell / level electron from (an) iodide ion(s) less strongly held by the nucleus compared with that lost from a chloride ion **OR** converse for a chloride ion		ions in the converse argument) Must be comparative in both M1 and M2