Answers to examination-style questions

Answers	Marks	Examiner's tips
1 (a) (i) loss of electrons	**1**	You must learn the definitions of oxidation and reduction in terms of electrons. When you work out the oxidation states remember that if it is a minus oxidation state you must put this in (you do not need to put the + in).
(ii) oxidation state of nitrogen in NO: +2	**1**	
oxidation state of nitrogen in NH_4^+: –3	**1**	
(iii) I_2	**1**	
(b) (i) $Cl_2 + 2e^- \rightarrow 2Cl^-$	**1**	
(ii) $SO_2 + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2e^-$	**1**	You can put H_2SO_4 on the right if you wish then the equation becomes $H_2SO_4 + 2H^+ + 2Cl^-$ on the right. The last 2 equations here are in the specification so you should learn them if you find it hard to work them out.
(iii) $SO_2 + 2H_2O + Cl_2 \rightarrow SO_4^{2-} + 2Cl^- + 4H^+$	**1**	
2 (a) a reducing agent gives electrons	**1**	This must not refer to electron pairs.
(b) zero	**1**	
(c) (i) (+)3	**1**	You will always need to work out oxidation states so you need to practise them a lot.
(ii) –3	**1**	
(iii) –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.
(ii) $2Cl^- \rightarrow Cl_2 + 2e^-$	**1**	
(iii) $PbO_2 + 4H^+ + 2Cl^- \rightarrow Pb^{2+} + Cl_2 + 2H_2O$	**1**	
3 (a) gains electrons	**1**	An oxidising agent oxidises something else so it must be reduced itself. You can put 'accepts electrons' instead of 'gains electrons' but don't mention electron pairs, as that is wrong.
(b) (i) *oxidising agent*: Ag^+	**1**	
reducing agent: SO_2	**1**	
(ii) $SO_2 + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2e^-$	**1**	You can have $H_2SO_4 + 2H^+ + 2e^-$ on the right-hand side.
(c) (i) $Fe^{2+} \rightarrow Fe^{3+} + e^-$	**1**	
(ii) 5	**1**	
(iii) $ClO_3^- + 6H^+ + 6e^- \rightarrow Cl^- + 3H_2O$	**1**	Check that the atoms on each side balance and the charges too.
(iv) $ClO_3^- + 6H^+ + 6Fe^{2+} \rightarrow Cl^- + 3H_2O + 6Fe^{3+}$	**1**	
(d) *equation*: $Mg + S \rightarrow MgS$	**1**	You could put the equation $FeS + Mg \rightarrow MgS + Fe$ instead
oxidising agent: S	**1**	

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4 (a) gains electrons	**1**	
(b) (i) +4	**1**	
+6	**1**	
(ii) $Br_2 + 2e^- \rightarrow 2Br^-$	**1**	
(iii) $SO_2 + 2H_2O \rightarrow 4H^+ + SO_4^{2-} + 2e^-$	**1**	
(iv) $Br_2 + SO_2 + 2H_2O \rightarrow 2Br^- + 4H^+ + SO_4^{2-}$	**1**	You could have $H_2SO_4 + 2HBr$ on the right.
5 (a) accepts electrons	**1**	
(b) charge on the ion or element or atom	**1**	
(c) +4	**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.)
+5	**1**	
−3	**1**	
(d) (i) $Cu \rightarrow Cu^{2+} + 2e^-$	**1**	
(ii) $NO_3^- + 4H^+ + 3e^- \rightarrow NO + 2H_2O$	**1**	
(iii) $3Cu + 2NO_3^- + 8H^+ \rightarrow 3Cu^{2+} + 2NO + 4H_2O$	**1**	
6 (a) gain of electrons	**1**	
(b) (i) (+)5	**1**	
(+)4	**1**	
(+)2	**1**	
(ii) reduction	**1**	
$4H^+ + NO_3^- + 3e^- \rightarrow NO + 2H_2O$	**1**	
(iii) $2H^+ + NO_3^- + e^- \rightarrow NO_2 + H_2O$	**1**	
(iv) $Cu + 4H^+ + 2NO_3^- \rightarrow Cu^{2+} + 2H_2O + 2NO_2$		
species	**1**	
balanced	**1**	Electrons must not be included in the final overall equation. Make sure you cancel them out on each side.
7 (a) a substance which accepts electrons	**1**	You cannot say removal of electrons because you have not said from where they are removed.
(b) (i) oxidation number of iodine in $IO_3^- = +5$	**1**	
oxidation number of iodine in $I^- = -1$	**1**	
oxidation number of iodine in $I_2 = 0$	**1**	Remember the oxidation state of any element is 0.
(ii) $IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$		
all species present	**1**	
balanced	**1**	You can write an equation using KIO_3 and KI under acidic conditions and as long as all the substances are correct you get one mark. The other mark is for balancing the equation.

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8 (a) +2 +5	**1** **1**	N has variable oxidation states, but oxygen is −2 only.
(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.
(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).
(d) $NO_3^- + 4H^+ + 3Ag \rightarrow NO + 2H_2O + 3Ag^+$	**1**	