Half Equations

1) a) Calculate the oxidation state of each underlined element in the following: [14]

$\underline{S}O_2$	$\underline{S}O_3$	$\underline{S}O_4^{2-}$	$\underline{Cr}_2O_3$	$\underline{Cr}O_3$	$\underline{Mn}O_4^{2-}$	$\underline{Mn}O_4^-$
$\underline{Fe}Cl_4^{2-}$	$\underline{Cu}_2O$	$\underline{Cu}O$	$\underline{N}O_3^-$	$\underline{C}_2O_4^{2-}$	$\underline{C}H_4O_2$	$\underline{C}H_4O$

b) name the IONS in part (a) [6]

2) Write a half equation for each of the following conversions in acidic solution. [10]

a) $H_2 \rightleftharpoons H^+$ b) $Br^- \rightleftharpoons Br_2$ c) $SO_4^{2-} \rightleftharpoons SO_2$

d) $SO_4^{2-} \rightleftharpoons H_2S$ e) $Cr_2O_7^{2-} \rightleftharpoons Cr^{3+}$ f) $MnO_4^- \rightleftharpoons Mn^{2+}$

g) $CH_4O \rightleftharpoons CH_2O_2$ h) $H_2O_2 \rightleftharpoons H_2O$ i) $VO_2^+ \rightleftharpoons VO^{2+}$

j) $S_4O_6^{2-} \rightleftharpoons S_2O_3^{2-}$ k) $H_2O_2 \rightleftharpoons O_2$ l) $NO_3^- \rightleftharpoons NO_2$

3) Using your answers to Q2, combine them to create overall equations for the following reactions: (all in acidic conditions) [10]

a) Oxidation of Fe^{2+} by MnO_4^-
b) Oxidation of Fe^{2+} by O_2
c) Oxidation of H_2O_2 by MnO_4^-
d) Reduction of Br_2 by Fe^{2+}
e) Reduction of $Cr_2O_7^{2-}$ by CH_4O

4) Chlorine reacts differently with sodium hydroxide depending on temperature. [5]
At high temp it forms NaCl and $NaClO_3$ but at low temperatures it forms NaCl and NaOCl.
By considering the oxidation states involved, create balanced equations for both reactions.

5) State whether the following are redox reactions or not, by showing the oxidation numbers of each of the elements involved. If the reaction is a redox reaction state which species have been oxidized and reduced during the reaction.

a) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
b) $CuO + 2HCl \rightarrow CuCl_2 + H_2O$
c) $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + H_2O$
d) $Cl_2 + H_2O \rightarrow HCl + HClO$ [14]

6) A solution of the NO_2^- ion can be reduced to the ion, $N_2O_2^{2-}$. This ion is a strong reducing agent which reacts with MnO_4^- in acidic conditions to form Mn^{2+} ions and a second product that could be NO, NO_3^-, NO_2^-, N_2O or NO_2.

a) State the oxidation number of nitrogen in NO, NO_3^-, NO_2^-, N_2O, NO_2 and $N_2O_2^{2-}$. [6]

b) 8 moles of MnO_4^- react with 5 moles of $N_2O_2^{2-}$.

i) Use this information to identify the second product of the reaction. [1]

ii) Write a balanced equation for the reaction of 8 moles of MnO_4^- react with 5 moles of $N_2O_2^{2-}$. [4]

7) Use oxidation states to create half equations for each of these reactions and use them to help balance the following reactions all in acidic solution [20]

a) $Zn + NO_3^- + H^+ \rightarrow Zn^{2+} + NH_4^+ + H_2O$

b) $UO^{2+} + Cr_2O_7^{2-} \rightarrow UO_2^{2+} + Cr^{3+}$

c) $Mn^{2+} + BiO_3^- \rightarrow MnO_4^- + Bi^{3+}$

d) $Cl^- + Sn + NO_3^- \rightarrow SnCl_6^{2-} + NO_2(g) + H_2O$

e) $MnO_4^- + I^- \rightarrow Mn^{2+} + I_2$

f) $MnO_2 + Cl^- \rightarrow MnCl_2 + Cl_2$

g) $MnO_4^{2-} \rightarrow MnO_4^- + MnO_2$

h) $VO_2^+ + Zn \rightarrow VO^{2+} + Zn$

i) $MnO_4^- + Ni \rightarrow Mn^{2+} + Ni^{2+}$

j) $CrO_4^{2-} + Cr^{2+} \rightarrow Cr^{3+}$