$MnO_{2(s)} + 4H^+ + 2e \rightarrow Mn^{2+}_{(aq)} + 2H_2O$ + 1.23

$MnO_4^-{}_{(aq)} + 2H_2O + 3e^- \rightarrow MnO_{2(s)} + 4OH^-$ + 0.60

4 (e)

Stawa Set 19

1. Calculate the standard cell voltages and write the overall chemical reactions for cells which consist of the following half-cells
   (a) Zn^{2+} / Zn and Sn^{2+} /Sn
   (b) Cr^{3+}/Cr and Ag^+/Ag
   (c) Hg^{2+}/Hg and Cu^{2+}/Cu
   (d) Mg^{2+}/Mg and Cu^{2+}/Cu
   (e) Mg^{2+}/Mg and Ag^+/Ag
   (f) Fe^{3+}/Fe^{2+} and $Cr_2O_7^{2-}$/Cr^{3+} ($Cr_2O_7^{2-}$ is acidified)
   (g) Cl_2/Cl^- and I_2/I^-

$Hg^{2+}_{(aq)} + 2e^- \rightarrow Hg_{(l)}$ E° +0.85V

$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$ E° +0.77V

2. Predict whether the following reactions could occur under standard conditions:

   (a) $2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$
   (b) $Sn^{4+} + H_2O_2 \rightarrow Sn^{2+} + 2H^+ + O_2$
   (c) $Cr_2O_7^{2-} + 6F^- + 14H^+ \rightarrow 2Cr^{3+} + 3F_2 + 7H_2O$
   (d) $Cu + 2H^+ \rightarrow Cu^{2+} + H_2$
   (e) $2Fe^{3+} + Sn^{2+} \rightarrow 2Fe^{2+} + Sn^{4+}$

$Sn^{4+}_{(aq)} + 2e^- \rightarrow Sn^{2+}_{(aq)}$ E° +0.15V

3. (a) Which of the following species could react with 1 mol L^{-1} HCl to form hydrogen gas?
      (i) Cu
      (ii) Mg
      (iii) Hg
      (iv) Ag
      (v) Sn
      (vi) Zn

   (b) From the table of reduction potentials supplied, identify
      (i) a reducing agent which could convert Pb^{2+} to Pb, but not Co^{2+} to Co.
      (ii) an oxidising agent which could convert Cl^- to Cl_2, but not F^- to F_2.
      (iii) a reductant which could convert H^+ to H_2, but not H_2O to H_2.
      (iv) an oxidant which could convert Ag to Ag^+, but not Hg to Hg^{2+}.
      (v) a reductant which could convert acidified MnO_4^- to Mn^{2+}, but not acidified $Cr_2O_7^{2-}$ to Cr^{3+}.

4. Predict whether the following disproportionation reactions could occur in aqueous solution:

$Cu^{2+} + e^- \rightarrow Cu^+$ +0.15V

$Cu^+ + e^- \rightarrow Cu$ +0.52V.

   (a) copper(I) ion to copper(II) ion and copper metal
   (b) Iron(II) ion to iron(III) ion and iron metal
   (c) hydrogen peroxide to water and oxygen gas
   (d) chlorine to hypochlorous acid and chloride ion
   (e) manganese dioxide to permanganate ion and manganese(II) ion

HClO - hypochlorous acid *

5. Predict whether reactions could occur in each of the following. Assume standard conditions.

   (a) Chlorine gas is bubbled through potassium bromide solution.
   (b) Iron(II) nitrate is mixed with sodium iodide.
   (c) Aluminium is added to hydrochloric acid.
   (d) An iron nail is placed in a tin(II) chloride solution.
   (e) An iron(II) sulfate solution is placed in a nickel container.
   (f) Hydrogen sulfide is bubbled through an acidified potassium dichromate solution.
   (g) Chlorine gas is bubbled through an acidified solution of barium nitrate.
   (h) Chlorine gas is bubbled through an acidified solution of iron(II) bromide.

STAWA SET 19 : SOLUTIONS

Set 19

1. (a) $Zn + Sn^{2+} \rightarrow Zn^{2+} + Sn$, +0.62V
   (b) $3Ag^{+} + Cr \rightarrow 3Ag + Cr^{3+}$, +1.54V
   (c) $Hg^{2+} + Cu \rightarrow Hg + Cu^{2+}$, +0.51V
   (d) $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$, +2.70V
   (e) $Mg + 2Ag^{+} \rightarrow Mg^{2+} + 2Ag$, +3.16V
   (f) $Cr_2O_7^{2-} + 14H^{+} + 6Fe^{2+} \rightarrow 2Cr^{3+} + 7H_2O + 6Fe^{3+}$, +0.56V
   (g) $Cl_2 + 2I^{-} \rightarrow 2Cl^{-} + I_2$, +0.82V

2. (a) Yes, +0.99V
   (b) No, - 0.53V
   (c) No, -1.54V
   (d) No, -0.34V
   (e) Yes, +0.62V

3. (a) Mg, Sn, Zn
   (b) (i) Sn or Ni
   (ii) H_2O_2 or MnO_4^{-} (these are common oxidants, both must be acidified)
   (iii) Pb, Sn, Ni, Co , Cd , Fe, Cr , Zn
   (iv) $O_2/4H^{+}$
   (v) Au, Cl^{-}/H_2O, Cl^{-}

4. (a) Yes, +0.37V
   (b) No, -1.21V
   (c) Yes, +1.10V
   (d) No, -0.27V
   (e) Yes, +0.63V

5. (a) $Cl_2 + 2Br^{-} \rightarrow 2Cl^{-} + Br_2$, +0.27V
   (b) No reaction
   (c) $2Al + 6H^{+} \rightarrow 2Al^{3+} + 3H_2$, +1.66V
   (d) $Fe + Sn^{2+} \rightarrow Fe^{2+} + Sn$, +0.30V
   (e) No reaction
   (f) $Cr_2O_7^{2-} + 3H_2S + 8H^{+} \rightarrow 2Cr^{3+} + 3S + 7H_2O$, +1.19V
   (g) No reaction
   (h) Both Br^{-} and Fe^{2+} are oxidised