Lesson 2 – Redox. Writing oxidation and reduction half equations for more complex oxidants and reductants.

Simple oxidants such as $Ag^+$ are somewhat easy to write a balanced half equation for.

$$Ag^+(aq) + e \rightarrow Ag(s)$$

$$Sn^{4+}(aq) + 4e \rightarrow Sn(s)$$

$$Pb(s) \rightarrow Pb^{2+}(aq) + 2e$$

Electrons always added to the most positive side

$Cr_2O_7^{-2}$/ $Cr^{3+}$

To write a balanced half equation follow the steps

1. Balance for all elements other than O or H

$$Cr_2O_7^{-2} \rightarrow 2Cr^{3+}$$

2. balance for oxygen by adding water to the side with least number of oxygens

$$Cr_2O_7^{-2} \rightarrow 2Cr^{3+} + 7H_2O$$

3. balance for hydogens by adding $H^+(aq)$ to the side with least hydrogens

$$14H^+(aq) + Cr_2O_7^{-2} \rightarrow 2Cr^{3+} + 7H_2O$$

4. balance for charge by adding electrons to the most positive side

$$6e + 14H^+(aq) + Cr_2O_7^{-2} \rightarrow 2Cr^{3+} + 7H_2O$$

1. Use the steps outlined above to give a balanced half equation, states not included, for the reaction of the the following conjugate pairs. Indicate if the reaction is an oxidation or a reduction.
   Keep in mind : Reduction – electrons appear on the left
   Oxidation – electrons appear on the right

*a.* $MnO_4^-$ / $Mn^{2+}$
*$5e + 8H^+ + MnO_4^- \rightarrow Mn^{2+} + 4H_2O$ -- reduction*

*b.* $BiO_4^{-3}$ / $Bi^{3+}$
*$2e + 8H^+ + BiO_4^{-3} \rightarrow Bi^{3+} + 4H_2O$ -- reduction*

c. $SO_3^{-2}$ / $SO_4^{-2}$
*$H_2O + SO_3^{-2} \rightarrow SO_4^{-2} + 2H^+ + 2e$ – oxidation*

d. $NO_3^-$ / $NO_2$
*$e + 2H^+ + NO_3^- \rightarrow NO_2 + H_2O$ – reduction*

e. $C_2O_4^{-2}$ / $CO_2$
*$C_2O_4^{-2} \rightarrow 2CO_2 + 2e$ -- oxidation*

f. $H_5IO_6$ / $IO_3^-$
*$2e + H^+ + H_5IO_6 \rightarrow IO_3^- + 3H_2O$ -- reduction*

g. $BrO_3^{-3}$ / $Br^-$
*$4e + 6H^+ + BrO_3^{-3} \rightarrow Br^- + 3H_2O$ -- reduction*

h. $MnO_2$ / $Mn_2O_3$
*$2e + 2H^+ + 2MnO_2 \rightarrow Mn_2O_3 + H_2O$ -- reduction*

i. $HClO_4$ / $HCl$
*$8e + 8H^+ + HClO_4 \rightarrow HCl + 4H_2O$ -- reduction*

j. $P_4H_{10}$ / $P_2O_5$
*$P_4H_{10} + 10H_2O \rightarrow 2P_2O_5 + 30H^+ + 30e$ -- oxidation*

k. $P_4$ / $PO_4^{-3}$
*$16H_2O + P_4 \rightarrow 4PO_4^{-3} + 32H^+ + 20e$ -- oxidation*