Lesson 3 – an overall redox reaction from two half reactions (oxidation and reduction half reactions).

An overall balanced redox equation must balance for elements and charge. Electrons do not appear in an overall reaction. Number of electrons produced in oxidation equals the number of electrons used in reduction.

Derive the balanced overall equation given the two conjugate pairs. (Make sure electrons balance)

Eg. $Cr_2O_7^{2-}(aq)$/ $Cr^{3+}(aq)$ and $NO(aq)$ / $NO_3^-(aq)$

Step 1 write the balanced oxidation and reduction half equations

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

$2H_2O + NO \rightarrow NO_3^- + 4H^+ + 3e$ – oxidation

Step 2 Number of electrons produced in oxidation should equal the number of electrons used in reduction.

Multiply the oxidation reaction by 2

$(2H_2O + NO \rightarrow NO_3^- + 4H^+ + 3e)$ X 2 – oxidation

$\Rightarrow 4H_2O + 2NO \rightarrow 2NO_3^- + 8H^+ + 6e$ – oxidation

Step 3 Add the oxidation and reduction reactions

$4H_2O + 2NO \rightarrow 2NO_3^- + 8H^+ + 6e$

+

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

$\Rightarrow 6e + 14H^+ + Cr_2O_7^{2-} + 4H_2O + 2NO \rightarrow 2NO_3^- + 8H^+ + 6e + 2Cr^{3+} + 7H_2O$

***Step 4** Eliminate electrons and species that appear on both sides.*

$\Rightarrow 6H(aq)^+ + Cr_2O_7^{2}(aq)^- + 2NO(aq) \rightarrow 2NO_3^-(aq) + 2Cr^{3+}(aq) + 3H_2O(l)$

a. $MnO_4^-(aq)$ / $MnO(s)$ and $Cu(s)$ / $Cu^{2+}(aq)$

b. $S(s)$ / $H_2S(g)$ and $Al(s)$ /$Al^{3+}(aq)$

c. $K(s)/K^+(aq)$ and $Cl_2(g)/Cl^-(aq)$

d. $Cr_2O_7^{2-}(aq)$ / $Cr^{3+}(aq)$ and $CH_3OH(aq)$ / $COOH(aq)$

e. $H^+(aq)$ /$H_2(g)$ and $Al(s)$ / $Al^{3+}(aq)$