Unit 8, Lesson 04: Balancing Redox Reactions in Basic Conditions

These youtube videos by Tyler DeWitt are excellent. Before reading the notes, please watch:

1. How to Balance Redox Equations in Basic Solution
2. How to Balance Redox Equations in Basic Solution Example Problem

The main trick is to remember to add OH^{1-} ions **TO BOTH SIDES** of the chemical equation that was balanced in acidic conditions.

Let's take the reactions that we balanced in acid conditions from the last lesson and balance them in basic conditions:

Example #1, balanced in acidic conditions:

$$5\ HSO_3^{1-} + 2\ IO_3^{1-} \rightarrow 5\ SO_4^{2-} + I_2 + 3\ H^{1+} + H_2O$$

Step 1: Recopy the reaction and add 3 OH^{1-} ions TO BOTH SIDES to neutralize the 3 H^{1+}

$$3\ OH^{1-} + 5\ HSO_3^{1-} + 2\ IO_3^{1-} \rightarrow 5\ SO_4^{2-} + I_2 + 3\ H^{1+} + H_2O + 3\ OH^{1-}$$

Step 2: the 3 H^{1+} and 3 OH^{1-} on the product side will combine to make 3 H_2O. These 3 water molecules add to the water molecule that is already there to make a total of 4 H_2O. The reaction is now balanced in basic conditions. Re-write the simplified equation and draw a box around it:

$$3\ OH^{1-} + 5\ HSO_3^{1-} + 2\ IO_3^{1-} \rightarrow 5\ SO_4^{2-} + I_2 + 4\ H_2O$$

Step 3: Double-check!!!

8 (H)	8 (H)
5 (S)	5 (S)
24 (O)	24 (O)
2 (I)	2 (I)
charge: –10	charge: –10

Example #2, balanced in acidic conditions (this is the slow oxidation of ethanal to ethanoic acid):

$$8\ H^{1+} + Cr_2O_7^{2-} + 3\ C_2H_4O \rightarrow 3\ HC_2H_3O_2 + 2\ Cr^{3+} + 4\ H_2O$$

Step 1: Recopy the reaction and add 8 OH^{1-} ions TO BOTH SIDES to neutralize the 3 H^{1+}

$$8\ OH^{1-} + 8\ H^{1+} + Cr_2O_7^{2-} + 3\ C_2H_4O \rightarrow 3\ HC_2H_3O_2 + 2\ Cr^{3+} + 4\ H_2O + 8\ OH^{1-}$$

Step 2: the 8 H^{1+} and 8 OH^{1-} on the reactant side will combine to make 8 H_2O. These 8 water molecules will cancel out the 4 H_2O molecules on the product side, leaving 4 H_2O on the reactant side. The reaction is balanced in basic conditions. Re-write the simplified equation, drawing a box around it:

$$4\ H_2O + Cr_2O_7^{2-} + 3\ C_2H_4O \rightarrow 3\ HC_2H_3O_2 + 2\ Cr^{3+} + 8\ OH^{1-}$$

Step 3: Double-check!!! Both sides have 20 (H), 14 (O), 2 (Cr), 6 (C) and a total charge of –2