SCH4U

Electrochemistry

10.3 Balancing Half Reactions

Steps to balancing redox equations. NO shortcuts. This format must be followed in the given sequence.

Step 1 Write separate equations for the oxidation and reduction half-reactions.

Step 2 For each half reaction:

a) Balance all the elements except hydrogen and oxygen
b) Balance oxygen using H_2O.
c) Balance hydrogen using H^+ .
d) Balance the charge using electrons.

Step 3 If necessary, multiply one or both balanced half-reactions by an integer to equalize the number of electrons transferred in the two half-reactions. # electrons lost = # electrons gained.

Step 4 Add the half-reactions, and cancel identical species.

Step 5 Check that the elements and charges are balanced.

If the redox reaction is occurring in **a basic solution** continue on.

Step 6 To both sides of the equation obtained above, add a number of OH^- ions that is equal to the number of H^+ ions. (one wants to eliminate H^+ by forming water.)

Step 7 Form H_2O on the side containing H^+ and OH^- ions, and eliminate the number of H_2O molecules that appear on both sides of the equation.

Step 8 Check that the elements and charges are balanced.

Let's try an example:

In acidic solution, balance the equation $ClO_4^- + NO_2 \dashrightarrow Cl^- + NO_3^-$

Assign oxidation numbers.

Is it a redox?

Which was Oxidized?

Which was Reduced?

Write the half reactions separately.

OXIDIZED **REDUCED**

Balance other atoms

Balance with H_2O

Balance with H^+

Balance with e^-

$8NO_2 + ClO_4^- + H_2O \dashrightarrow 8NO_3^- + 8H^+ + Cl^-$

REDOX WORKSHEET

Balance the following redox reactions. Assume all are in acidic solutions unless otherwise indicated.

1. $NO_3^- + Cu \rightarrow NO_2 + Cu^+$

2. $IO_3^- + AsO_3^{3-} \rightarrow I^- + AsO_4^{3-}$

3. $SO_4^{2-} + Zn \rightarrow Zn^{2+} + SO_2$

4. $NO_3^{1-} + Zn \rightarrow NH_4^+ + Zn^{2+}$

5. $Cr^{3+} + BiO_3^{1-} \rightarrow Cr_2O_7^{2-} + Bi^{3+}$

6. $I_2 + OCl^{1-} \rightarrow IO_3^{1-} + Cl^{1-}$

7. $Mn^{2}+ + BiO_3^{1-} \rightarrow MnO_4^{1-} + Bi^{3}+$

8. $MnO_4^{1}- + C_2O_4^{2-} \rightarrow CO_2 + MnO_2$ (basic)

9. $ClO_3^{1}- + N_2H_4 \rightarrow NO + Cl^{1-}$

10. $NiO_2 + Mn(OH)_2 \rightarrow Mn_2O_3 + Ni(OH)_2$

11. $SO_3^{2-} + CrO_4^{2-} \rightarrow SO_4^{2-} + CrO_2^{1-}$ (basic)

12. $Au + CN^{1-} + O_2 \rightarrow Au(CN)_4^{1-} + OH^{1-}$ (basic)