

Chemistry Notes 10/4/13

Warm Up

1. What is the oxidation number on C in the compound CO_2 ?
 - a. +4 ($\text{C}^{+4} + 2\text{O}^{-2}$)

Balancing Redox Reactions

- $\text{Ag}^+_{(aq)} + \text{Cu}_{(s)} \rightarrow \text{Cu}^{2+}_{(aq)} + \text{Ag}_{(s)}$
 - o The silver is in solution in the reactant side, and Copper is in solution on the product
 - o In order for a reaction to be Redox, electrons have to be transferred
 - $\text{Ag}^{+1} \rightarrow \text{Ag}^0$ $\text{Cu}^0 \rightarrow \text{Cu}^{+2}$
 - Copper is oxidized
 - Silver is reduced
 - o What is the oxidizing reagent (causes oxidation)?
 - Ag^{+1}
 - o What is the reducing reagent (causes reduction)?
 - Cu^0

Rules for Balancing Redox Reactions:

1. Recognize that it is a redox reaction
 - a. Assign oxidation numbers
 - b. $\text{Ag}^+_{(aq)} + \text{Cu}_{(s)} \rightarrow \text{Cu}^{2+}_{(aq)} + \text{Ag}_{(s)}$
2. Break the process into 2 "half-reactions" (Oxidation and Reduction)
 - a. Reduction: $\text{Ag}^{+1} \rightarrow \text{Ag}^0$
 - b. Oxidation: $\text{Cu}^0 \rightarrow \text{Cu}^{+2}$
3. Balance all atoms **other than H and O**
4. Achieve a charge balance by adding electrons
 - a. Charge Balance: Same charge on both side of the reaction
 - b. $\text{Ag}^{+1} + 1\text{e}^{-1} \rightarrow \text{Ag}^0$
 - c. $\text{Cu}^0 \rightarrow \text{Cu}^{+2} + 2\text{e}^{-1}$
 - i. The electrons are lost in the reaction, so they are placed on the product side
5. Multiply the half reactions by appropriate factors so that the same number of electrons are lost and gained
 - a. $2\text{Ag}^{+1} + 2\text{e}^{-1} \rightarrow 2\text{Ag}^0$
 - b. $\text{Cu}^0 \rightarrow \text{Cu}^{+2} + 2\text{e}^{-1}$
6. $2\text{Ag}^{+1} + \text{Cu} \rightarrow 2\text{Ag} + \text{Cu}^{+2}$

When balancing in aqueous solution; water (in H_2O), hydronium ions (H^+), or hydroxide ions (OH^-) may be present

Acids: H^+ and/or H_2O

Bases: OH⁻ and/or H₂O aq

1. Balance in an acid: $\text{MnO}_4^- (\text{aq}) + \text{H}_2\text{C}_2\text{O}_4 (\text{aq}) \rightarrow \text{Mn}^{2+} (\text{aq}) + \text{CO}_2 (\text{g})$
- $\text{Mn}^{+7}\text{O}_4^{-2} + \text{H}_2^{+3}\text{C}_2^{+3}\text{O}_4^{-2} \rightarrow \text{Mn}^{+2} + \text{C}^{+4}\text{O}_2^{-2}$
 - Carbon and Manganese changed their charges
 - $\text{MnO}_4^- \rightarrow \text{Mn}$
 - $\text{H}_2\text{C}_2\text{O}_4 \rightarrow \text{CO}_2$
 - $\text{H}_2\text{C}_2\text{O}_4 \rightarrow 2\text{CO}_2$
 - Do not balance the hydrogen and oxygen atoms
 - Add H₂O to balance O; and add H⁺ to balance H
 - $\text{MnO}_4^- \rightarrow \text{Mn} + 4\text{H}_2\text{O}$
 - $\text{MnO}_4^- + 8\text{H}^+ \rightarrow \text{Mn} + 4\text{H}_2\text{O}$
 - $\text{H}_2\text{C}_2\text{O}_4 \rightarrow 2\text{CO}_2 + 2\text{H}^+$
 - $\text{MnO}_4^- + 8\text{H}^+ \rightarrow \text{Mn} + 4\text{H}_2\text{O}$
 - $+7 \rightarrow +2$
 - $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn} + 4\text{H}_2\text{O}$
 - $+2 \rightarrow +2$
 - $\text{H}_2\text{C}_2\text{O}_4 \rightarrow 2\text{CO}_2 + 2\text{H}^+$
 - $0 \rightarrow +2$
 - $\text{H}_2\text{C}_2\text{O}_4 \rightarrow 2\text{CO}_2 + 2\text{H}^+ + 2\text{e}^-$
 - $0 \rightarrow 0$
 - Balance the electrons
 - $2(\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn} + 4\text{H}_2\text{O})$
 - $2\text{MnO}_4^- + 16\text{H}^+ + 10\text{e}^- \rightarrow 2\text{Mn} + 8\text{H}_2\text{O}$
 - $5(\text{H}_2\text{C}_2\text{O}_4 \rightarrow 2\text{CO}_2 + 2\text{H}^+ + 2\text{e}^-)$
 - $5\text{H}_2\text{C}_2\text{O}_4 \rightarrow 10\text{CO}_2 + 10\text{H}^+ + 10\text{e}^-$
 - $16\text{H}^+ + 2\text{MnO}_4^- + 5\text{H}_2\text{C}_2\text{O}_4 \rightarrow 2\text{Mn}^{2+} + 8\text{H}_2\text{O} + 10\text{CO}_2 + 10\text{H}^+$
 - $6\text{H}^+ + 2\text{MnO}_4^- + 5\text{H}_2\text{C}_2\text{O}_4 \rightarrow 2\text{Mn}^{2+} + 8\text{H}_2\text{O} + 10\text{CO}_2$

2. In an acid: $\text{Cr}_2\text{O}_7^{2-} + \text{Cl}^- \rightarrow \text{Cr}^{+3} + \text{Cl}_2$
- $\text{Cr}_2^{+6}\text{O}_7^{-2} + \text{Cl}^- \rightarrow \text{Cr}^{+3} + \text{Cl}_2^0$
 - $\text{Cr}_2^{+6}\text{O}_7^{-2} + 14\text{H}^+ \rightarrow 2\text{Cr}^{+3} + 7\text{H}_2\text{O}$
 - $+12 \rightarrow +6$
 - $\text{Cr}_2^{+6}\text{O}_7^{-2} + 14\text{H}^+ + 6\text{e}^- \rightarrow 2\text{Cr}^{+3} + 7\text{H}_2\text{O}$
 - $\text{Cl}^- \rightarrow \text{Cl}_2^0$
 - $-1 \rightarrow 0$
 - $\text{Cl}^- \rightarrow \text{Cl}^0 + \text{e}^-$

