Oxidation – Reduction (aka Redox) Reactions

One or more electrons are transferred in a redox reaction

Examples: photosynthesis, oxidation of sugars, fats, and proteins, and combustion reactions

To keep track of the electrons transferred in a redox reaction, we assign oxidation states.

Oxidation State – arbitrary charge assigned to an atom

The Oxidation State of…	**Summary**	**Examples**
An atom in an element is zero	Element: 0	Na(s), O_2(g), Hg(l)
A monatomic ion is the same as its charge	Monatomic ion: charge of ion	Na^+, Cl^-
Fluorine is -1 in its compounds	Fluorine: -1	HF, PF_3
Oxygen is -2 in its compounds *Exception: oxygen is -1 in peroxides (O_2^{-2})	Oxygen: -2 *Except in peroxides: O is -1	H_2O, CO_2 *Exception: H_2O_2
Hydrogen is +1 in its covalent compounds	Hydrogen: +1	H_2O, HCl, NH_3
Hydrogen is -1 in binary metal hydrides	Hydrogen: -1	NaH, MgH_2

Neutral Compounds: sum of all oxidation states must equal zero

Examples: H_2O is neutral: each H is +1 and O is -2; SUM = 2(+1) + (-2) = 0

NaCl is neutral: Na is +1 and Cl is -1; SUM = (+1) + (-1) = 0

Ionic species: sum of all oxidation states must equal charge of the ion

Examples: NO_3^- has charge of -1; each O is -2 and SUM = -1

N + 3(-2) = -1

N = +5

$Cr_2O_7^{2-}$ has charge of -2; each O is -2 and SUM = -2

2(Cr) + 7(-2) = -2

Cr = +6

Practice: Assign oxidation states to each element.

1. $CaBr_2$
2. N_2
3. Na_2CO_3
4. ClO_3^-
5. $KMnO_4$
6. SF_6
7. Fe_3O_4
8. CH_3F
9. P_4
10. Al_2O_3
11. LiH
12. SO_4^{2-}

***LEO says GER**

Oxidation – oxidation number increases, loss of electrons

Reduction – oxidation number decreases, gain of electrons

Balancing Redox Equations

Balance the following REDOX reactions (cr = crystalline solid).

All reactions take place in an acidic solution unless otherwise indicated.

1. $Cr\ (cr) + Sn^{4+}\ (aq) \longrightarrow Cr^{3+}\ (aq) + Sn^{2+}\ (aq)$

2. $Al\ (cr) + H^{+}\ (aq) \longrightarrow Al^{3+}\ (aq) + H_2\ (g)$

3. $MnO_4^{-}\ (aq) + S^{2-}\ (aq) \longrightarrow Mn^{2+}\ (aq) + S\ (cr)$

4. $Cu\ (cr) + SO_4^{2-}\ (aq) \longrightarrow Cu^{2+}\ (aq) + SO_2\ (g)$

5. $Fe^{2+}\ (aq) + MnO_4^{-}\ (aq) \longrightarrow Mn^{2+}\ (aq) + Fe^{3+}\ (aq)$

6. $NO_3^{-}\ (aq) + S\ (cr) \longrightarrow NO_2\ (g) + H_2SO_{4\ (aq)}$

7. $Cu\ (cr) + NO_3^{-}\ (aq) \longrightarrow Cu^{2+}\ (aq) + NO\ (g)$

8. $Zn\ (cr) + Ag^{+}\ (aq) \longrightarrow Zn^{2+}\ (aq) + Ag\ (cr)$

9. $CuS\ (cr) + NO_3^{-}\ (aq) \longrightarrow Cu^{2+}\ (aq) + NO_2\ (g) + S\ (cr)$

10. $NO_2\ (g) + ClO^{-}\ (aq) \longrightarrow NO_3^{-}\ (aq) + Cl^{-}\ (aq)$ **BASIC**

11. $Fe^{2+}\ (aq) + Cr_2O_7^{2-}\ (aq) \longrightarrow Cr^{3+}\ (aq) + Fe^{3+}\ (aq)$

12. $MnO_4^{-}\ (aq) + Cl^{-}\ (aq) \longrightarrow Mn^{2+}\ (aq) + Cl_2\ (cr)$

13. $IO_3^{-}\ (aq) + H_2S\ (g) \longrightarrow I_2\ (g) + SO_3^{2-}\ (aq)$ **BASIC**

14. $H_2SeO_3\ (aq) + Br^{-}\ (aq) \longrightarrow Se\ (cr) + Se\ (cr) + Br_2\ (g)$

15. $BrO_3^{-}\ (aq) + MnO_2\ (cr) \longrightarrow Br^{-}\ (aq) + MnO_4^{-}\ (aq)$ **BASIC**

16. $H_2S\ (g) + NO_3^{-}\ (aq) \longrightarrow S\ (cr) + NO\ (g)$

17. $Br_2\ (l) + SO_3^{2-}\ (aq) \longrightarrow Br^{-}\ (aq) + SO_4^{2-}\ (aq)$ **BASIC**

Solution Stoichiometry w/ REDOX

(*use the balanced equations you determined from the front)*

1. What mass of chromium solid is needed to react completely with 20.0 mL of a 1.00 M tin (IV) nitrate solution?

2. What mass of aluminum solid is needed to react completely with 40.0 mL of a 1.00 M hydrochloric acid solution?

3. What volume of a 1.00 M potassium permanganate solution is needed to react completely with 30.0 mL of a 2.00 M sodium sulfide solution?

4. What volume of a 0.100 M potassium sulfate solution is needed to react completely 10.0 g of copper solid?

5. What volume of a 0.300 M iron (II) nitrate is needed to react completely with 50.0 mL of a 0.200 M potassium permanganate solution?

6. What volume of a 0.300 M potassium nitrate solution is needed to react completely 20.0 g of sulfur solid?

7. What is the molarity if 50.0 mL of sodium nitrate solution is needed to react completely with 15.0 g of copper solid?

8. What mass of zinc solid is needed to react completely with 30.0 mL of 0.400 M silver nitrate solution?

9. What mass of copper (II) sulfide solid is needed to react completely with 10.0 mL of a 0.800 M potassium nitrate solution?

10. What volume of a 1.000 M sodium hypochlorite is needed to react completely with 30.00 grams of nitrogen dioxide gas?

11. What is the molarity if 20.0 mL of iron (II) nitrate is needed to react completely with 50.0 mL of a 0.200 M potassium dichromate solution?

12. What is the molarity if 15.0 mL of potassium dichromate solution is needed to react completely with 30.0 mL of a 1.00 M sodium chloride solution?

13. What volume of a 0.500 M sodium iodate is needed to react completely with 12.00 grams of hydrogen sulfide gas?