CHEMICAL REACTIONS TOOLBOX

Redox Reactions: ***When a problem mentions an acidic or basic solution, it is probably a redox reaction.***

Common oxidizing agents	Products formed		Common reducing agents	Products formed
MnO_4^- in acidic solution	Mn^{2+}		Halide ions	Free halogen
MnO_2 in acidic solution	Mn^{2+}		Free metals	Metal ions
MnO_4^- in neutral or basic solution	$MnO_{2(s)}$		Sulfite ions or SO_2	Sulfate ions
$Cr_2O_7^{2-}$ in acidic solution	Cr^{3+}		Nitrite ions	Nitrate ions
HNO_3, concentrated	NO_2		Free halogens, dilute basic solution	Hypohalite ions
HNO_3, dilute	NO		Free halogens, conc. basic solution	Halite ions
H_2SO_4, hot, concentrated	SO_2		Lower charge metal ions	Higher charge metal ions
Higher charge metal ions (ex: Fe^{3+})	Lower charge metal ions (ex: Fe^{2+})		H_2O_2	O_2
Free halogens	Halide ions		$C_2O_4^{2-}$ (oxalate ion)	CO_2
Na_2O_2	NaOH			
$HClO_4$	Cl^-			
H_2O_2	H2O			

Balancing Redox Reactions by the Ion-Electron Method

1. Write the skeletal equation containing the oxidizing and reducing agents and the products in ionic form. Assign oxidation numbers to each atom.

2. Separate the equation into two half-reactions.

3. Balance the atoms (except the O and H) in each half reaction separately. This is called *mass balance*.

4a. For reactions in *acidic* medium, add H_2O to balance the oxygen atoms and H^+ to balance the hydrogen atoms.

4b. For reactions in *basic* medium, first balance the atoms as you would for an acidic solution. Then, for each H^+ ion, add OH^- ion to both sides of the half-reaction. Whenever H^+ and OH^- appear on the same side, combine them to make H_2O.

5. Add electrons to one side of each half-reaction to equalize the charges. Electrons are added to the reactant side of a reduction half-reaction and to the product side of an oxidation half-reaction. The number of electrons added to the one side of the half-reaction should make the total charge of that side equal to the charge on the other side. This procedure is called a *charge balance*.

6. Multiply the half-reactions through by the appropriate coefficients to balance the number of electrons as needed.

7. Add the two half-reactions, and check the final equation by inspection. Reduce the balanced equation to lowest terms (coefficients).