HONORS CHEMISTRY

STUDY GUIDE FOR CHAPTERS 14, 15, 17, 18, 19, 20

HOW TO USE THIS STUDY GUIDE:

This is only a summary of the important points of each chapter.
Use each point to remind you of other concepts in each section. Make sure you understand all terms.
Anything marked with an asterisk (*) involves equations that you should know how to use.
Give yourself practice in these, using old homeworks and quizzes.

Ch.17. Kinetics -

Collision theory refers to the assumption that reactions happen when particles collide with sufficient energy and in proper orientation. Rates are explained with reference to this theory.

* First-order reactions: rate is proportional to the concentration of a reactant: rate = $k[A]^1$.
  Decay is exponential, $[A] = e^{-kT}$, $[A]/[A_0] = (1/2)^{T/H}$, where $H = t_{1/2}$ = half-life
* Second-order reactions: rate = $k[A]^2$. Each half-life gets longer.

Zero-order reactions: rate is constant, does not depend on [A].

* Method of initial rates:
  Zero order: Doubling or tripling the initial concentration has no effect on the rate.
  First order: Doubling the initial concentration doubles the rate; tripling it triples the rate.
  Second order: Doubling the initial concentration quadruples the rate; tripling it multiplies x9

Catalysts speed up reactions by reducing activation energy, but they do not get used up in reactions.

Ch.18. Equilibrium chemistry -

An equlibrium is a dynamic state in which no net change occurs because opposite rates are balanced

* "Law of mass action": If $aA + bB \rightleftharpoons cC + dD$ then

$$k_{eq} = \frac{[C]^c\ [D]^d}{[A]^a\ [B]^b}$$

* Heterogeneous equilibria:
  Include only gases (g) and aqueous solutions (aq); ignore solids (s) and pure liquids (l)
* LeChâtelier's principle: If a change (or a "stress") is made to a system at equilibrium, the equilibrium will shift in whatever direction undoes the change (or reduces the "stress").

Ch. 14-15. Acids, Bases, and pH -

Arrhenius' theory: acids produce H^+ ions in solution; bases produce OH^- ions in solution.

Brønsted & Lowry: acids are proton (H^+) donors; bases take protons away (recipients).

* Be sure you can pick out proton donors and recipients in any reaction.

Lewis: bases donate lone pairs of electrons; acids accept lone pairs and bone with them.

Anything that can act as either an acid or a base is called amphiprotic. Water is amphiprotic:

$H_2O + H_2O \longrightarrow H_3O^+ + OH^-$ (proton donor becomes OH^-; recipient becomes H_3O^+)

*Review all past quizes and homeworks; make sure you can do problems using these equations.

CONTINUED ON THE REVERSE SIDE

Ch. 14-15. Acids, Bases, and pH (continued)**-**

A strong acid ionizes completely in solution. HCl, HBr, HNO_3, and H_2SO_4 are strong acids.

Most other acids are weak acids; they ionize only partially in solution.

Similarly, strong bases (like NaOH and KOH) ionize completely, weak bases only partly.

In aqueous solutions: acids and bases neutralize each other to produce water and a salt.

* $pH = -\log[H^+]$; $pH = 7$ if $[H^+] = 10^{-7}$ (neutral)

Acidic solutions have $pH < 7$; basic solutions have $pH > 7$.

$pOH = -\log[OH^-]$; $k_w = [H^+][OH^-] = 10^{-14}$; so $pH + pOH = 14$

Buffers are solutions that resist a change in pH.

Most buffers are a combination of a weak acid and its congugate base.

Ch. 19-20. Oxidation and Reduction -

* Oxidation numbers are conventional quantities to describe oxidation state (pretended charge):

Uncombined elements have an oxidation number of 0.

Charged ions (incl. polyatomic) have an oxidation number equal to their charge.

Oxygen in compounds has an oxidation number of -2. Halogens are usually -1.

Hydrogen and group I metals usually have oxidation numbers of +1.

Most other oxidation numbers can be figured by making molecules add up to zero.

* <u>Oxidation</u> is an increase in oxidation number, or a loss of electrons.

* <u>Reduction</u> is a reduction (decrease) in oxidation number, or a gain of electrons.

LEO says GER: Loss of Electrons is Oxidation; Gain of Electrons is Reduction.

"REDOX" (reduction & oxidation) reactions always have electrons lost = electrons gained.

* Balancing redox reactions by the half-reaction method:

Separate oxidation and reduction half-reactions; balance them separately:

Balance metals, halogens, and miscellaneous ions first;

Balance O by adding H_2O as needed.

Balance H by adding H^+ ions as needed. Remember: "O, H, 'charge!' "

Balance charge by adding electrons as needed.

Combine half-reactions together, multiplying by constants to make electrons gained = lost

"Disproportionation" means that the same substance is both oxidized and reduced.

An <u>oxidizing agent</u> always oxidizes something else; it undergoes <u>reduction</u>.

A <u>reducing agent</u> always reduces something else; it undergoes <u>oxidation</u>.

Electrochemistry: a Voltaic cell converts chemical energy into electrical energy.

ANode is always the site of OXidation (remember: AN OX)

CAThode is always the site of REDuction (remember: RED CAT)

Electrolysis: passing electricity through a chemical solution results in oxidation & reduction:

OXidation at the ANode and REDuction at the CAThode.

* Be sure you can write oxidation & reduction half-reactions at both anode and cathode.

*Review all past quizes and homeworks; make sure you can do problems using these equations.