# CHEM 421: Biochemistry Review Concepts

Algebra
    Solving for a single variable
Electronegativity
Enthalpy
Entropy
Equilibrium constants
Eukaryotes
Fischer projections
Fractions
Free energy
Functional groups
Hydrophilicity
Hydrophobicity
Intermolecular interactions
    -van der Waals
    -hydrogen bonding
Line drawings
Logarithms
    -natural logarithm (ln)
    -base 10 (log)
    -generally how to work with them (+,-,/,*)
Mechanisms
    -how you write them (equilibrium arrows, nonequilibrium arrows, drawing arrows from electrons to the atom where they are going)
    -$S_N2$
    -hydrolysis
    -aldol condensation
    -carbonyl chemistry
    -acid-base chemistry
pH
pKa
Polarity of chemical bonds and molecules
Polyprotic acids
Prokaryotes
Titration curves
VSPER theory

# Some Specific Review Concepts

**Electronegativity**

Electronegativity is a measure of the ability of an atom in a molecule to accept electron density. The larger the electronegativity value, the greater the ability an atom has to attract electron density. Specific electronegativity values were defined by Pauling. Electronegativity values increase from left to right across the periodic table and from the bottom up.

Example: 0 is more electronegative than C
F is more electronegative than Cl

**Polarity**

The degree of polarity in a bond, or the difference in electron density between the atoms, can be determined from the difference in electronegativity values.

Example: polarity of bond: C-H< C-O < C-F

**Intermolecular Forces**

1) van der Waals forces
   a. dipole-dipole interactions
      - exist between neutral polar molecules
   b. London dispersion forces
      - exist between neutral nonpolar molecules
      - relies on the polarizability of electron density

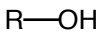
      Example: $CH_3(CH_2)_3CH_3$ and $C_6H_6$

2) hydrogen bonding
   - exists between a hydrogen atom in a polar molecule and a lone pair in an electronegative atom
   - need a hydrogen-bond donor (two atoms; one electronegative and one H)
   - need a hydrogen-bond acceptor (an electronegative atom with a lone pair)
   - electronegative atoms involved in H-bonding: O, N, F, sometimes Cl
   - a dotted line indicates a H-bond

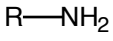
   Examples: N—H----O, O—H---N, O----H—F
3) ion-dipole interactions
   - occurs between an ion and a polar portion of a molecule

   Example: C=O and $Na^+$

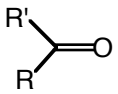
## Functional Groups/Classes of Compounds



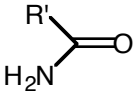
hydroxyl group/ alcohol



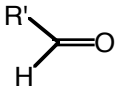
amine



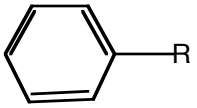
carbonyl/ ketone



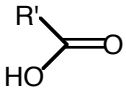
amide



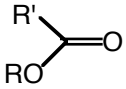
aldehyde



phenyl group



carboxylic acid



ester

## Logarithms

$\log_b x = a$

$\log_{10} x = \log x = a$

$10^a = x$

$\log xy = \log(x * y) = \log x + \log y$

$\log \frac{x}{y} = \log(\frac{x}{y}) = \log x - \log y$

## Acid/Base Chemistry

pH

- pH=—log [$H^+$]
- pH is a measure of the acidity or # of $H^+$ ions in solution
- pH<7 acidic pH=7, neutral pH>7 basic

$pK_a$

- $pK_a$ =—log $K_a$
- When pH=pKa, one-half of the species are protonated and one half are not.
- Example: If pKa=5 and there are 10 molecules, then at pH=5 there are 5 molecules with the $H^+$ and 5 without

**Dr. Nagan's informal rules to writing mechanisms**

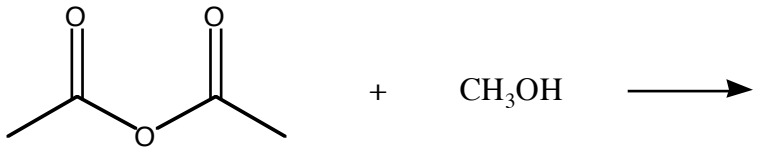
1) Negative things attack positive things
2) Start from the most negative atom (look for a nucleophile or base)
3) Electrons move in the direction of the arrow
4) Follow your arrows to see what happens next
5) If you added something, you usually have to have something leave or rearrange
    - The best leaving group is very stable after it has left
6) Make sure formal charges and valencies of atoms are correct

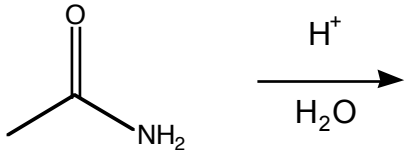
Mechanism Problems

For each of the reactions, below:

a) draw the product(s).
b) write the mechanism.

1.) $(CH_3)_3COH + HBr \rightarrow$

2.) 


3.) 


*Note:* the answers for all of these problems are in Wade.

Additional Problems

Problems from your book are posted online at the class website.