**Exam 1 Review Guide:**

**Basic Chemistry**

- Be able to predict from the electronic structure of atoms the number of bonds the atom can form, or the charge on an ion.
- Be able to identify the following functional groups in a molecule, and state the properties of the functional group (non-polar, polar, potentially charged).
  - i) hydrocarbon
  - ii) alcohol
  - iii) carboxylate
  - iv) carbonyl
  - v) benzyl (phenyl)
  - vi) amino
  - vii) amide
- Know the relationship between hybrid orbitals and molecular geometry for $sp^2$ and $sp^3$ hybrid orbitals.
- Identify chiral centers on molecules, and discuss implications of chiral centers on drug activity.
- Identify hydrogen bond donors and acceptors.
- Be able to discuss role of pH in drug transport across membranes and binding to targets
- Be able to predict whether a group will be largely protonated or deprotonated, given pKa and pH. State the charge on each species (be able to do this for either carboxyl or amino groups).
- Predict the relative solubility of compounds
- Understand the fundamental molecular basis for:
  i) electrostatic interactions
  ii) van der Waals interactions
  iii) hydrophobic effect.
- Know that the overall energy change depends on both enthalpic and entropic terms
- Predict whether reactants or products will be favored given $\Delta G^o$ for the reaction.

**Protein structure – important characteristics of each level:**

1. Primary structure:
   - Know how amino acids are linked together by peptide bonds to form proteins, given the structure of two amino acids, could you draw the correct structure after they are joined?
   - Nomenclature – sequence begins at the amino terminus.
   - Distinguish mainchain from sidechain atoms.
   - Know that order (sequence) of amino acids defines folded structure, defines activity.
2. Secondary structure
   - conformation of the mainchain
   - only two that can be stabilized by hydrogen bonds are $\alpha$-helix and $\beta$-sheet.
   - know structural properties (location of H-bonds, sidechains)
3. Tertiary structure
   - Relate structure to energetic terms:
     - Folded form destabilized by high entropy of the unfolded form.
     - Folded form stabilized by burial of hydrophobic groups, therefore core is composed of non-polar amino acids.
     - Folded form stabilized by van der Waals interaction in the core – therefore core is well packed.
     - Folded form stabilized by mainchain hydrogen bonds (same one that stabilize secondary structure) and sidechain hydrogen bonds.
   - All polar and charged residues are on the surface
   - Significant number of non-polar residues are on the surface.
4. Quaternary Structure
   - Structure with multiple chains.

**Enzymes**

- Catalysts – make reactions go faster without being changed by the reaction.
- Active site – part of the enzyme that has amino acid residues that recognize substrate and facilitate chemistry on the substrate, converting it to product.
- Increase in rate occurs because enzyme decrease the energy of the high energy transition state
- Decrease in the energy of the transition state is due to the fact that reactants are pre-ordered in enzymatic reactions, so no unfavorable decrease in entropy
- Rate of product formation as a function of substrate – initially linear, but eventually becomes constant at high substrate because all of the enzymes have substrate bound – saturated.

**Competitive inhibitors:**

- Similar in structure to the substrate
- Bind at the active site, prevent (compete for substrate binding)
- Therefore, substrate can't bind – no product formed.

**Allosteric Inhibitors:**

- Bind to the enzyme at a different site than the active site
- Cause a change in the shape or conformation of the enzyme, so that it is no longer active.