**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 atomic ion.
* Distinguish between non-polar and polar bonds/molecules
* 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 sp2 and sp3 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 ΔGo 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 -helix and β-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.