

## Topics for the second midterm: Chem142A (Kahn, Fall 2007)

You are expected to know all the material that was covered in the lecture. Most importantly:

**Chapter 4.** The few important topics that we covered after the first midterm are:

- Structure and function of fibrous proteins  $\alpha$ -keratin, collagen, and silk fibroin
- Structure of proline, recognize hydroxylated prolines
- Biological function of vitamin C in formation of collagen
- How are membrane proteins unique
- Distinction about tertiary and quaternary structure in globular proteins
- Symmetry in oligomeric proteins
- The concept of protein motifs (but not all the structures / names)
- Protein folding and denaturation
- Assisted folding (chaperones, chaperonins)
- Basic steps and main bottlenecks in NMR and X-ray crystallography

**Chapter 5.** Please read pg 157-174 to reinforce the concepts on protein function. You need to have an understanding of the immune system to the extent we covered in the lecture. The function of motor proteins will be covered; note that we were more detailed in the lecture than textbook is. You are expected to know:

- Key concepts: ligand, binding site, etc
- General themes: interactions and protein flexibility
- Quantitative measures of interaction; binding thermodynamics
- Oxygen-heme interactions
- Myoglobin: structure and function
- Hemoglobin: structure and function
- Oxygen binding to myoglobin
- Cooperativity in oxygen binding to hemoglobin
- T and R state in hemoglobin
- Role of F-helix in cooperativity of hemoglobin
- Two models for cooperativity (no math)
- Heterotropic cooperativity, Bohr effect, 2,3-bisphosphoglycerate
- Transport of CO<sub>2</sub> by hemoglobin
- Molecular origin of sickle cell anemia
- Task of the immune system
- Humoral and cellular immune system
- Antigens and antigen presentation, MHC I and MHC II
- Different types of T cells
- B-lymphocytes
- General structure of antibodies: constant and variable regions
- Generation of soluble antibodies during humoral immune response
- Examples of roles of motor proteins
- Role of kinesin, dynein, and microtubules in trafficking
- Structure and protein composition of the muscle tissue
- Molecular mechanism of the muscle contraction
- Role and general work mechanism of ATP synthase

**Chapter 6.** All the material will be covered. I might ask on the exam about:

- Chemical structures of amino acids histidine and arginine
- What enzymes are and why we need them
- How enzymes work
- Acid-base catalysis (e.g. general ester hydrolysis)
- Covalent catalysis (e.g. lysozyme)
- Role of metal ions in catalysis (e.g. alcohol dehydrogenase)
- Importance of proximity and good orientation of reactants (e.g. chorismate mutase)
- Transition state stabilization; transition state analogs
- Induced fit (e.g. hexokinase; see also [http://www.chem.ucsb.edu/~molvisual/ABLE/induced\\_fit/](http://www.chem.ucsb.edu/~molvisual/ABLE/induced_fit/))
- Mechanism of chymotrypsin
- Mechanism of haloalkane dehalogenase
- Mechanism of ketosteroid isomerase
- How to measure reaction rates: special focus on spectrophotometric and radiometric methods
- Michaelis–Menten (steady state) kinetics, basic principles on how to derive kinetic equations
- The meaning of  $V_{\max}$  and  $K_m$  in a simple one-substrate mechanism: equilibrium model
- Two-substrate enzymes, sequential vs. Ping–Pong mechanism
- Regulation of enzyme activity, allosteric enzymes
- Reversible and irreversible enzyme inhibition
- Mechanisms of action of cholinesterase inhibitors
- Competitive inhibition
- Uncompetitive inhibition
- Mixed inhibition
- Experimental determination of kinetic mechanisms and modes of inhibition

**Chapter 7.** Please know the names or structures of monosaccharides D-glyceraldehyde, D-dihydroxyacetone, ribose, glucose, galactose, mannose, and fructose; be able to recognize functional groups in various derivatives of carbohydrates. Some areas of special interest include:

- Differences between aldoses and ketoses
- Open chain and ring structures of monosaccharides
- Isomerism, D,L nomenclature, epimers and anomers
- Recognize enantiomeric and diastereomeric pairs (e.g. erythrose and threose)
- Physical and optical properties of saccharides
- Biologically important chemical reactions of saccharides
- Basic structure of disaccharides (e.g. compare maltose with trehalose)
- Structure of polysaccharides starch, glycogen, cellulose, and chitin
- Glucogen's role as a source of rapid energy source in animals
- General structure and function of peptidoglycan
- Biological role of lysozyme in animals
- How glycosylaminoglycans differ from simple polysaccharides
- Different types of glycoconjugates
- General structure of proteoglycan and proteoglycan aggregates
- Extracellular matrix and processes involving its degradation
- Biosynthesis and degradation of proteoglycans
- Functions of saccharides in living organisms
- Experimental approaches to study the sequence and structure of complex carbohydrates
  - How to determine the composition of a complex carbohydrate
  - How to determine which atoms form the glycosidic bonds in oligosaccharides