Topics for the second midterm: Chem142A (Kahn, Summer 2006)

You are expected to know all the material that was covered in the lecture. The following list, organized by textbook chapters, list concepts that I think are especially important.

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
- Biological function of vitamin C in formation of collagen
- How are membraneous 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
- Oxygen-heme interactions
- Myoglobin: structure and function
- Hemoglobin: structure and function
- 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$_2$ 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:

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/)
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 $V_{\text{max}}$ 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

Chapter 7. Please know the names or structures of monosaccharides other than D-glyceraldehyde, 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
Physical and optical properties of saccharides
Chemical reactions of saccharides
Basic structure of disaccharides (e.g. compare maltose with trehalose)
Structure of polysaccharides starch, glycogen, cellulose, and chitin
General structure and function of peptidoglycan
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
Exhaustive methylation with methyl iodide in analysis of di- and oligosaccharides
Mass spectrometry in analysis of oligosaccharides
Experimental approaches to study the sequence and structure of complex carbohydrates