Exam 1 will focus on chapters 11 and 9.

We have looked at the theory and use of $^1$H and $^{13}$C NMR spectroscopy for the determination of structure in organic molecules. Other methods (IR, MS, UV), learned in Organic I, remain important. Be aware of the type of information each method can provide, and be prepared to use spectral data to solve structural problems. Here, the key to success lies in working problems. In addition to the problems at the end of the chapters, additional problems (with solutions) are available from our class web site (see "Related Links").

In addition, the characteristics, properties and reactivity of aromatic systems are important, as is a knowledge of the spectroscopy of aromatic systems. A clear understanding of these areas can only be obtained if you understand that factors that contribute to the special stability associated with these compounds. For reactions, repetition is the best way to remember. Work the problems at the end of the chapters, make flash cards, etc. You will be expected to both identify what specific reagents do (e.g. predict products) as well as choose reagents to complete various transformations. In addition, you may be asked to apply your knowledge to the solution of multistep synthetic problems.

Don't forget about reaction mechanisms. Note that many of the reactions we've learned share strong mechanistic similarities (electrophilic aromatic substitution), and an understanding of these similarities will make the mechanisms easier to recall. In writing mechanisms, you must be able to identify/follow the flow of electrons, and to keep track of charges. Remember (!) arrows point in the direction of electron flow; (e.g. from negative to positive). Simple inspection of bond polarity can often add immediate insight to a probable mechanistic pathway.

Some topics that stand out when looking over the material covered to date include the following:

**Ch 11: Structure Determination: Nuclear Magnetic Resonance Spectroscopy**

$^1$H NMR Spectroscopy
- properties of magnetic nuclei
- chemical shift
  - shielding/deshielding
  - chemical equivalence
- integration
- multiplicity (splitting)
  - expectations
  - basis for splitting patterns (simple spectra)
  - coupling constants ($J$)
  - characteristic patterns (ethyl, isopropyl, para disubstituted aromatics)
- solving structural problems

$^{13}$C NMR Spectroscopy
- chemical shift
- shielding/deshielding
- chemical equivalence
- differences between $^1$H and $^{13}$C NMR
- DEPT
- use in determining molecular symmetry

Using Spectral Data to Solve Structural Problems
- don’t forget IR, MS, UV in this context

(over →)
Ch 9: Aromatic Compounds

Nomenclature
Structure, reactivity, & properties
Aromaticity
  benzene structure and stability
  features of aromatic compounds
  Hückels rule
  identification of aromatic, non-aromatic, and antiaromatic compounds, including heterocycles
drawing orbital pictures (as in class)
Spectroscopy of aromatic compounds (IR, $^{1}$H NMR, $^{13}$C NMR, UV, MS)

Electrophilic Aromatic Substitution (reactions & mechanisms)
bromination
chlorination
iodination
nitration
  reduction (NO$_2$ $\rightarrow$ NH$_2$)
sulfonation
  alkalai fusion (SO$_3$H $\rightarrow$ OH)
alkylation
  Friedel-Crafts reaction (and limitations)
  reaction with alcohols
  reaction with alkenes
acylation
  Friedel-Crafts acylation
    comparison to Friedel-Crafts Reaction
Substituent effects
  ortho/para directors
  meta directors
  activating/deactivating groups
    inductive effects
    resonance effects
  mechanistic rationale
Trisubstituted benzene derivatives
  substituent effects
Reactions of aromatic side chains
  oxidation
  bromination
  reduction (hydrogenation)
Synthesis of substituted benzene derivatives

Nucleophilic Aromatic Substitution
  addition/elimination
  benzyne