**CHE 171**
**Fall, 2005**
**Specific Objectives for Final Exam**

1. **Regarding Molecular Structure:**
   By now you should be proficient at drawing and interpreting organic structures in a variety of ways (Lewis structures, condensed structures, bond-line or skeletal structures) with correct bond angles (where applicable) and formal charges (where applicable); you should also be able to determine if a molecule can be represented by more than one resonance structure (and be able to draw the different, contributing resonance structures); you should be an expert at drawing cyclohexane chair conformations with axial and equatorial bonds clearly shown; you should be able to assess the relative stabilities of the two chair conformations of a given substituted cyclohexane; you should be able to recognize, draw, and determine the configuration of stereogenic centers; you should be able to determine whether or not a molecule is chiral; you should be able to recognize stereoisomeric relationships (are two compounds enantiomers, diastereomers, constitutional isomers, completely different compounds?); you should know what a meso compound is; you should know the difference between *cis* and *trans* isomers for cyclic compounds and alkenes; you should be able to name (IUPAC and/or common names) alkanes, alkyl halides, alcohols, ethers and epoxides, and be able to draw structures given the name; be able to classify carbon atoms as 1°, 2°, 3°, or 4°; be able to classify hydrogen atoms as 1°, 2°, or 3°; you should be able to classify a given alkene as mono-, di-, tri-, or tetra-substituted and know how substitution affects stability of alkenes.

2. **Regarding Chemical and Physical Properties of Molecules:**
   You should also be able to determine whether or not a molecule is polar, predict what types of intermolecular forces (IMFs) a given molecule will experience, and assess how those IMFs will affect the compounds physical properties; know what p$K_a$ is and how p$K_a$ values correspond to relative acid strength; know the relationship between acid strength and conjugate base strength (which is favored at equilibrium?); know how to recognize Lewis acids (electrophiles) and Lewis bases (nucleophiles); know what constitutes a good nucleophile and be able to assess relative nucleophile strength; know what constitutes a strong base; know what a bulky (non-nucleophilic) base is; know what constitutes a good leaving group; know the difference between polar protic and polar aprotic solvents;

3. **Regarding Reactivity:**
   Be able to recognize and classify acid-base or proton transfer, reduction, oxidation, substitution and elimination reactions; know what a mechanism is and how to show a mechanism using curved arrows to represent electron flow; know the two ways that a covalent bond can break or form (heterolytically or homolytically) and be able to show each using the proper curved-arrow notation; Know what constitutes a reaction intermediate and a transition state and the difference between the two; . Be able to read, interpret (is the reaction endo- or

exothermic? is it fast or slow?), and/or draw energy level diagrams for a given reaction; Know that thermodynamics tell us whether or not a reaction CAN occur, but kinetics tell us whether or not it will occur (at a reasonable rate) and that these are two independent considerations; i.e. a reaction may be thermodynamically favored ($-\Delta H°$) but not kinetically favored (very large $E_a$); Be able to write a rate equation for a given reaction and assess whether the reaction is first order (unimolecular) or second order (bimolecular).

4. **Regarding Specific Reactions (Substitution and Elimination of Alkyl Halides and Alcohols):**
Know the two mechanisms by which substitution reactions occur ($S_N2$ and $S_N1$) and the two mechanisms by which elimination reactions occur (E2 and E1); be able to predict the product(s) that will form for a given reaction (sometimes mixtures are possible)—i.e., will a substitution or elimination (or both) reaction occur and by which mechanism(s) (don't forget about regioselectivity and stereoselectivity); know two ways to convert alcohols to alkenes (dehydration with sulfuric acid or with $POCl_3$ and pyridine); know three ways to convert alcohols to alkyl halides (with HX, with $SOCl_2$, or with $PX_3$); know how to convert an alcohol to a tosylate (TsCl and pyridine) and know that tosylates undergo substitution with strong nucleophiles ($S_N2$) and elimination when treated with strong bases (E2); be able to predict the product(s) that will form when an epoxide is treated with a strong nucleophile; be able to predict the product(s) that will form when an epoxide is treated with "HZ"; be able to show how you could synthesize a given target compound using reactions that you know.