THINGS TO KNOW FOR EXAM 1 Reich Chem 343
October 6, 2005

Electronic configuration of atoms, e.g. Oxygen $1s^2$ $2s^2$ $2p^4$, six valence electrons
Shape of s and p orbitals
Electronegativity trends in the periodic table
Ionic compounds
Covalent compounds
Drawing Lewis structures, octet rule, formal charge
Lewis structures of common acids: H_2SO_4, H_2SO_3, HNO_3, HNO_2, H_2CO_3, H_3PO_4, $HClO_4$
Acid-base reactions
Drawing resonance structures, stability
Hybridization of atoms in molecules: sp^3, sp^2, sp, geometry, angles, shape of orbitals
Drawing structures in 3-dimensions with lines, wedges and dashes
Converting complete structures to skeletal structures and the reverse
Dipole moments
Bond polarity
Definitions: Bronsted-Lowry and Lewis acids and bases
Estimating relative acid and base strength from the periodic table
Acidity constant, pKa
Inductive effects
Functional groups: alkanes (ethane), alkenes (ethylene), alkynes (acetylene), benzene (chlorobenzene), alkyl halides (isopropyl bromide), alcohols (ethanol), ethers (diethyl ether), amines (methylamine), aldehydes (acetaldehyde), ketones (acetone), carboxylic acids (acetic acid), esters (ethyl acetate), amides (N-methylacetamide), nitriles (acetonitrile).
IR spectroscopy, trends
Names of alkanes, C_1-C_{10}
Meaning of iso-, tert-, sec-
Meaning of phenyl-, benzy, allyl-, vinyl-
Primary, secondary and tertiary carbons, hydrogens and functional groups
Drawing isomers
Combustion of alkanes, heat of combustion
IUPAC nomenclature
Cis-trans isomerism in cycloalkanes
Rotational conformers: staggered, anti, gauche, eclipsed
Newman projection and sawhorse drawings
Rotational energy diagrams
Strain: angle, torsional (eclipsing), steric
Conformations of cycloalkanes
Strain in cycloalkanes, torsional, angle
Drawing chair cyclohexane with axial and equatorial H's properly oriented
Drawing chair interconversion (ring flip)
Calculation of conformer ratio from ΔG^o and the reverse, $\Delta G^o = - 2.303RT\log K_{eq}$
Conformational analysis of substituted cyclohexanes
Higher energy conformations of cyclohexane: twist-boat, boat
Cis- and trans-decalins
Electrophiles and nucleophiles
Difference between rates and equilibria: kinetics and thermodynamics
Progress of Reaction vs. Energy diagram ΔG^o, $\Delta G^{\ddagger}$ and transition states
Hammond-Leffler Postulate
R/S designation, Cahn-Ingold-Prelog priority rules

Multi-step synthesis and retro-synthetic analysis
Polarity of alcohols, H-bonding
Nucleophilic substitution mechanisms: S_N2 and S_N1
S_N2: 2nd order; $1^o>2^o>3^o$ won't work; inversion; high concentration of good nucleophile; polar aprotic solvent
S_N1: 1st order; $3^o>2^o>1^o$; racemization; polar, ionizing protic solvent
Good nucleophiles: good bases, ^-OH, ^-CN; better down vertical rows of periodic table, e.g., I^-, $^-SCH_3$, in protic solvents. In aprotic solvents: $F^->Cl^->Br^->I^-$
Leaving group ability: ROTos>RI>RBr>RCl~H_2O; conjugate bases of strong acids (weak bases)
Groups which won't leave: ^-OH, $^-OCH_3$, $^-NH_2$, ^-CN, ^-F; strong bases
Effect of protic and aprotic solvents on S_N2 reaction, + ion solvation
Effect of polar, ionizing, protic solvents on S_N1, dielectric constant
Stabilty of cations including allyl, benzyl, vinyl, aryl
Elimination E2: strong base, $3^o>2^o>1^o$, stereochemistry-anti
Elimination and cyclohexane conformation: trans diaxial
Elimination E1: weak base or nonbasic solvent, side reaction of S_N1