CHE 171
Fall, 2005
Specific Objectives for Exam 2

1. Know the three types of alkanes we discussed in class: straight chain, branched and cyclic and they're corresponding empirical molecular formulas.

2. Be able to classify carbon atoms as 1°, 2°, 3°, or 4°; be able to classify hydrogen atoms as 1°, 2°, or 3°.

3. Know the IUPAC names for the straight chain alkanes with 1 to 11 carbon atoms (and the corresponding alkyl groups, e.g. methyl, ethyl, propyl, etc.).

4. Be able to name all kinds of alkanes using the IUPAC system.

5. Know the following common names: isopropyl, tert-butyl, sec-butyl.

6. Understand the trends associated with physical properties of alkanes (BP, MP, solubility).

7. Be able to draw and interpret Newman projections sighting down particular bonds of a molecule.

8. Be able to draw a diagram of and explain the energetics associated with rotation around σ bonds of a molecule (butane and other straight-chain or branched alkanes, for example).

9. Understand and be able to explain or define the following terms as they apply to conformational analysis: staggered, eclipsed, anti, gauche, torsional strain, steric strain, angle strain, energy barrier, "ring flipping," puckered, chair, boat.

10. Be able to accurately draw cyclohexane chair conformations with axial and equatorial substituents, and assess the relative energies of these. Understand why the cyclohexane chair conformation is so stable (low in energy).

11. Understand the differences between *cis* and *trans* isomers of di-substituted ring systems.

12. Be able to draw and understand the conformational analysis associated with di-substituted cyclohexanes [*cis*- or *trans*-(1,2); *cis*- or *trans*-(1,3); *cis*- or *trans*-(1,4)].

13. Know what a stereogenic center is and be able to identify them in a molecule.

14. Be able to determine whether or not a molecule is chiral (look for the presence of stereocenter(s) and the absence of any planes of symmetry).

15. Be able to determine the absolute configuration (R or S) of a stereogenic center.

16. Know what it means for a molecule to be optically active and how optical activity is measured.

17. Know how to calculate the specific rotation $[\alpha]$ of a sample given its observed rotation, concentration, and the path-length of the sample tube.

18. Be able to calculate optical purity (enantiomeric excess or ee) of an optically active sample and determine how much of each enantiomer is present in a mixture.

19. Be able to draw all of the possible stereoisomers for a given molecule (maximum possible stereoisomers = 2^n, where n = # of stereocenters.

20. Be able to recognize the relationship between two stereoisomers as enantiomeric or diastereomeric.

21. Know what a meso compound is and be able to recognize one.

22. Be able to recognize and classify the following types of organic reactions: (a) acid-base or proton transfer; (b) reduction; (c) oxidation; (d) substitution; (e) elimination; (f) addition.

23. Know the difference between a concerted mechanism and one that is step-wise.

24. 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.

25. Know what constitutes a reaction intermediate and a transition state and the difference between the two.

26. Know what is meant by "bond dissociation energy," and be able to asses the strength of a bond given its $\Delta H°$ value.

27. Be able to calculate $\Delta H°$ for a reaction in which several bonds are being broken and formed.

28. Know what the Gibbs free energy ($\Delta G°$) of a reaction is and be aware that for many organic reactions $\Delta G° \sim \Delta H°$.

29. Know that a -$\Delta G°$ and a -$\Delta H°$ correspond to an exothermic reaction (products are lower in energy than reactants and equilibrium is shifted towards product); be aware that the reverse is also true.

30. Know that for a reaction to be practical, it must be thermodynamically favorable (equilibrium favors products) AND kinetically favorable (product is formed at a reasonable rate).

31. Be aware that a -$\Delta G°$ and a -$\Delta H°$ correspond to a $K_{eq} > 1$ and that a a +$\Delta G°$ and a +$\Delta H°$ correspond to a $K_{eq} < 1$.

32. Know that small changes in energy correspond to large changes in the ratio or reactants:products at equilibrium.

33. 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).

34. 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.

35. Know what the activation energy (E_a) of a reaction is and that the greater the activation energy the slower the reaction.

36. Know that kinetics is the study of reaction rates, and know what a reaction rate is and how it is expressed.

37. Be able to write a rate equation for a given reaction and asses whether the reaction is first order (unimolecular) or second order (bimolecular).

38. Know what factors can affect a reaction rate and to what extent.

39. Know what a catalyst is and how a catalyst affects the rate of a reaction.