Midterm I Preparation Guide (Chem 111, Spring 2008)

The first midterm will test your knowledge and understanding of topics and techniques that we have covered so far. Some of the important topics that you should know are:

1) Introductory topics
    a. The importance of kinetics in technology and everyday life
    b. The role of kinetics in understanding reaction mechanisms
    c. The goal and scope of kinetic studies
2) Rate laws, reaction order and reaction mechanisms
    a. The definition of reaction rate as the rate of change of concentrations with time
    b. Differential and integrated forms of rate laws
    c. Differential and integral methods for determination of reaction order
    d. Initial rates method: advantages and issues
    e. Elementary and complex reactions
    f. Reaction molecularity and reaction order
3) Traditional ways to measure rates of not very fast reactions
    a. Sample the reaction in time: Separate and quantitate approaches
    b. Continuous detection as the reaction proceeds: Optical methods
    c. Calculation of concentrations from absorbance in two-component system
4) Stopped-flow, continuous flow, and quenched flow for fast reactions in solution
    a. Design features of rapid-mixing systems with optical detection
    b. Application of rapid-mixing methods in chemistry and biochemistry
5) Characteristic features of the irreversible first-order unimolecular reaction
    a. Differential and integral forms of the rate law
    b. Single-exponential decay of the reactant to zero, half-life
6) Characteristic features of the reversible first-order unimolecular reaction
    a. Differential and integral forms of the rate law
    b. Single-exponential decay of the reactant to equilibrium
    c. Relationship between the observed and intrinsic rate coefficients
    d. Relationship between the rate coefficients and the equilibrium constant
    e. A need to measure both [A] and [B] if B is initially present
7) Temperature dependence of rate coefficients
    a. Activation free energy: Eyring equation
    b. Activation enthalpy: Arrhenius equation
    c. Sources of non-linearity in Arrhenius plot
8) Temperature and pressure dependence of equilibrium constants
    a. Differential equations for d lnK / dT and d lnK /dP
    b. Le Chatelier Principle
    c. Heat capacity and temperature dependence of reaction enthalpy
    d. Heat capacity and temperature dependence of reaction entropy
    e. Linear and non-linear van't Hoff plots
    f. Effects of temperature and pressure of protein folding equilibrium
9) Relaxation methods: principles and applications
    a. How to achieve temperature and pressure jumps
    b. Relaxation methods in studies of protein folding
    c. Detection methods for relaxation methods
    d. Kinetic analysis of relaxation data
10) Paper by Jacob et al on protein folding studies: posted discussion questions

The Midterm I has two parts. The first, one-hour in-class part tests your knowledge of the material. The second, at-home part tests your ability to analyze data and solve practical problems in kinetics. You are allowed to use any existing literature or Internet source, and software of your choice when answering "at-home" questions. However, students should abide by ethical standards of conduct, including individual work without substantial help from other students in the class or other individuals not associated with the course.