Chemistry 480A

Study Guide for Exam 3

1. You should know from memory:
   - The components of the kinetic molecular theory of gases model
   - The origin of Boltzmann's constant, \( k \)
   - The symmetry and properties of the one-dimensional velocity distribution function, \( f(v) \)
   - The formula for the rms velocity of molecules in a gas
   - How to write first, second, and third order rate laws
   - The Arrhenius expression for the reaction rate constant
   - The Michaelis-Menten mechanism for enzyme kinetics

2. You should know how to:
   - Calculate averages given the appropriate probability distribution function
   - Normalize an unnormalized probability distribution function
   - Recognize the formula for the one-dimensional velocity distribution function, \( f(v) \)
   - Recognize the formula for the molecular speed distribution function
   - Recognize the formulas for \( \langle v \rangle \) and \( v_{mp} \)
   - Recognize the formula for the number of collisions of gas molecules with a wall
   - Derive a formula for the molecular speed distribution function in various dimensions
   - Calculate the most probable speed given the speed distribution function
   - Recognize the expressions for \( z_{AA}, z_{AB}, \lambda, Z_{AA} \) and \( Z_{AB} \)
   - Write expressions for reaction velocities
   - Tell the order of a reaction from the rate law
   - Integrate first, second and third order rate laws
   - Calculate half-lives from rate laws
   - Use partial fractions to integrate rate laws
   - Recognize a pseudo first order reaction
   - Determine the reaction rate law from half-lives, by the initial rate method, or from a graph
   - Use Arrhenius theory to relate rate constants to temperature and vice versa
   - Write kinetic expressions for elementary reaction steps
   - Derive a rate law from the elementary steps of a reaction mechanism
   - Find \( k_{ref} \) and the relaxation time for a fast reaction using Eigen's relaxation method
   - Find rate constants for fast reactions from relaxation time vs concentration data

3. You should understand:
   - The mechanical origin of the pressure of a gas
   - Knudsen flow
   - Molecular collision diameters and cross-sections
   - The meaning and need for reduced mass
   - The mean free path, \( \lambda \)
   - What is meant by a rate law
   - First order decay
   - The Arrhenius activation energy
   - What is meant by unimolecular, bimolecular, and termolecular
   - The Lindemann mechanism
   - Microscopic reversibility and the principle of detailed balance