

Chemistry C2407, Fall 1999

Outline of Course content

Instructor: George Flynn

Meeting Time: TTh, 1:10 p.m.

All information contained in this handout can be found at the C2407 course website:

<http://www.columbia.edu/itc/chemistry/chem-C2407/>

I) Kinetic Theory of Gases

- 1) An Observation about gases
- 2) Review of physics of kinematics
- 3) A simplified Kinetic Theory Model
- 4) Kinetic energy and absolute temperature
- 5) Typical molecular speeds
- 6) Effusion
- 7) Heat Capacity
- 8) Definition of work at constant pressure
- 9) Collisions between molecules
- 10) Mean free path
- 11) Boltzmann speed distribution
- 12) Various definitions of average speeds

II) Binary Collision Model for Chemical Reactions

- 1) Reactions occur during collisions
- 2) Collision frequency/kinetic rate constant
- 3) Relative speed
- 4) Energy requirements/reaction

barriers

- 5) All or nothing activated state model
- 6) Arrhenius reaction model
- 7) Temperature Dependence of rate constant
- 8) Orientation effect

III) Chemical Kinetics

- 1) Definitions: reaction rate and reaction order
- 2) First order kinetics
- 3) Half time for first order reactions
- 4) Second order kinetics
- 5) Half life for second order reactions
- 6) Initial rates method
- 7) Mechanisms and elementary reactions
- 8) Unimolecular decompositions
 - a) The Lindemann Mechanism
 - b) The steady state approximation
 - c) Results for limiting cases
- 9) Catalysis
 - a) Enzyme kinetics
 - b) Michaelis-Menten Model

- 10) Temperature dependence of rate constants
- 11) Relationship between rate constant and equilibrium constant

- 5) The first law of thermodynamics
- 6) Definition of Enthalpy, H
- 7) Standard Enthalpy
- 8) Enthalpy of formation and reaction
- 9) Enthalpy and heat capacity
- 10) Temperature dependence of ΔH

IV) Acid-Base Equilibria

- 1) Definitions of acid/base properties
- 2) The acid and base ionization constants
- 3) The ion product of water
- 4) Weak acids and weak bases
- 5) Hydrolysis
- 6) Buffers
- 7) Titrations of acids with bases
- 8) Indicators

V) Thermodynamics (I)

- 1) State functions
- 2) Properties independent of path
- 3) Work and heat
- 4) Work under variable pressure conditions

VI) Thermodynamics (II)

- 1) Entropy exists
- 2) Reversible and irreversible work
- 3) Definition of Entropy
- 4) The second law of thermodynamics
- 5) Properties of Entropy S (temperature dependence)
- 6) Third law of thermodynamics
- 7) Definition of free energy, G, and work function, A

- 8) Spontaneous processes and ΔG
- 9) Pressure dependence of ΔG for an ideal gas
- 10) Standard free energy
- 11) Relationship between standard free energy and equilibrium constant

VII) Chemical Bonding in Polyatomic

Molecules

- 1) Delocalized Molecular orbitals
- 2) Hybridization of atomic orbitals/localized molecular orbitals
- 3) Hybridization and shape: VSEPR model
- 4) Multiple bonds in carbon compounds
- 5) Pi bonds: ethylene
- 6) Delocalized molecular orbitals: polyenes
- 7) Triple bonds: acetylene
- 8) Delocalized Pi bonds: benzene
- 9) Generalized delocalization: solids