

Electron Transfer Processes

CHEM-4685

Spring '07

Purpose: This course is aimed at understanding the transfer of charge, or electron migration with molecular systems! About two thirds of all chemical reactions, both thermal and photo processes, can be viewed as electron transfer processes; hence, the importance of understanding such phenomena is of considerable fundamental to the profession of chemists. In this course we will investigate and apply thermodynamic (e.g. Gibbs Free Energy, Equilibrium, Nernst Equation), kinetic (Arrhenius Equation and Transition State Theory), and Quantum Mechanical (wave mechanically) models that predict and account for a broad range of chemical reactions.

Learning Outcomes: Each student will acquire a basic understanding of the thermodynamic, kinetic, and quantum mechanical view of electron transfer processes. Hence, the student will be able to qualitative predict and justify electron transfer reactions using a wave-mechanical description of the molecular systems. The quantum mechanical approach will be used to account for the thermodynamic (spontaneous nature of the reaction) and kinetic interpretation (rate and molecular mechanism of the reaction).

Instructor:	Professor Spencer Slattery
Phone:	(678) 839-6550
Email:	sslatt@westga.edu
Office Hours:	<i>Mon & Wed (11:00 am – noon)</i>
Class Meetings:	<i>Tues. & Thurs. (11:00 am – 2:00 pm):</i>
Location:	<i>TLC Building (Room 2105)</i>
Text:	No text; however, read below.
Note:	<i>General Chemistry, Inorganic, and Physical Chemistry texts will be necessary for understanding the topics in this course.</i>

Evaluation: Your *course grade* will be computed as shown below.

A (90 - 100%); B (80 – 89%); C (70 – 79%); D (60 – 69%)	Percent of Total
Homework	(+/- or 0)
Exam #1	20%
Exam #2	20%
Exam #3	20%
Exam #4	20%
Formal Report	20%
Total	100%

Topics to be covered!

I. Introduction:

***A. Review of Reduction/Oxidation (redox) Processes:
-thermodynamic-quantitative approach-***

- 1. Assigning Oxidation Charges***
- 2. Balancing Redox Processes (aqueous & non-aqueous systems)***
- 3. Electromotive Force (emf)***
- 4. Standard vs non-Standard Conditions***
- 5. Electrical work, Nernst equation, and Equilibria***
- 6. Electrochemical Cells***

II. Beyond the Introduction:

A. Quantum Mechanical Model of Electron Transfer Processes

- 1. Atomic Structure***
- 2. Molecular Structure***
- 3. Electron Transfer Processes (thermodynamic and kinetic factors)***
 - a. Thermally driven processes***
 - i. Frank-Condon Principle***
 - ii. Adiabatic vs Non-Adiabatic electron transfer***
 - iii. Self Exchange***
 - iv. inter-molecular versus intra-molecular electron transfer***
 - b. Photo-driven processes***
 - i. Frank-Condon Principle***
 - ii. Marcus Theory***

B. Band Theory

- 1. Metallic Conductors***
- 2. Insulators***
- 3. Semi-Conductors***
 - a. intrinsic semi-conductors***
 - b. extrinsic semi-conductors***
 - i. n-type charge carriers***
 - ii p-type charge carriers***
 - iii. p-n junctions***