Matter and Motion Winter 2016

We have covered Chapters 12, 13, 14, 15, 17, 18, and 19 in Zumdahl.

Learning Objectives Weeks 11-19

Be able to determine reaction rates from experimental data

Determine the rate law using the method of initial rates

Be able to derive integrated rate laws from differential rate laws

Determine half-life from integrated rate law

Determine reaction order from the relationship between concentration and reaction time.

Be able to relate the rate law for a given reaction to a possible reaction pathway

Describe the function of catalysts, both homogeneous and heterogeneous, in chemical and biological systems

Be able to write equilibrium constant expressions and calculate values for the equilibrium constant from concentrations (K) and pressures (K_p)

Know how to use the reaction quotient and the equilibrium constant to predict the direction in which a system will move to reach equilibrium

Be able to calculate equilibrium concentrations given initial concentrations

Know how to use Le Chatelier's principle to predict the changes that occur when a system at equilibrium is disturbed

Know how acids and bases are defined in the Arrhenius model, Bronsted-Lowry model, and the Lewis model

Be able to write an equilibrium constant expression from the acid/base dissociation reaction

Know how acid/base strength is related to the position of the dissociation equilibrium

Be able to convert between pH, pOH, $[H^+]$, $[OH^-]$, K, and pK

Be able to calculate pH of solutions of strong and weak acids (including polyprotic) and bases

Be able to calculate percent dissociation

Know how to identify conjugate bases and conjugate acids

Be able to explain why certain salts give acidic or basic solutions and calculate the pH of these solutions

Be able to use Lewis structures, bond strength, and polarity to explain acid-base properties and strengths

Explain the characteristics of buffered solutions and in general how to prepare a buffer solutions

Calculate a buffer pH given the concentrations of the buffering chemicals

Be able to apply the concept of buffering capacity to choose the optimal buffer solution at a given pH

Calculate the pH at any point in an acid-base titration

Be able to discuss the function of acid-base indicators and determine the pH at which a color change will occur for a given indicator

Be able to explain the concept of entropy and calculate entropy changes for chemical systems and the surroundings

Know the relationship between ΔS_{surr}, ΔH, and T (K), "free energy" and spontaneity.

Calculate the standard free energy change in a chemical reaction and use it to predict spontaneity

Calculate the pressure dependence of free energy change for a chemical system

Know how equilibrium can be defined in terms of minimum free energy and calculate the value of K from $\Delta G°$.

Be able to relate work done to the change in free energy

Balance redox reactions via the half reaction method

Know the components of an electrochemical cell and distinguish between a galvanic and electrolytic cell

Be able to use the half reactions and standard reduction potential to form the cell reaction and determine the cell potential

Be able to convert between free energy change and the maximum electrochemical cell potential

Understand and apply the Nernst equation to quantify the relationship between concentration and cell potential and to calculate equilibrium constants from cell potentials

Be able to discuss the operation of common batteries and the process of corrosion in terms of half-reactions and standard reduction potentials

Use the stoichiometry of electrolysis reactions to convert between time, amps, and mass produced in a given electrolytic process

Be able to discuss and make predictions of nuclear stability of atoms based on number of neutrons and positions

Be able to identify and write nuclear equations for different types of radioactive decay including fission, fusion, alpha emission, beta emission, gamma emission, positron emission, electron capture

Do kinetics calculations for radioactive decay and associated applications such as carbon dating

Calculate the change of energy associated with nuclear processes

Be familiar with the possible types of radiation damage and methods of prevention