

## Major Learning Objectives for General Chemistry II

After completing General Chemistry II, students will be expected to:

1. Describe properties of liquids and solids. Understand phase changes and the energy terms associated with them.
2. Discuss the factors that affect the rates of chemical reactions, determine rate laws and carry out calculations involving concentration, time data.
3. Write equations, equilibrium expressions and carry out calculations for various equilibria. Describe how changes in concentration and temperature affect equilibrium reactions.
4. Describe the process of solution formation and the properties of solutions. Calculate the concentration of solutions in a variety of units. Carry out calculations involving the colligative properties of solution.
5. Characterize acids, bases and salts by Arrhenius or Bronsted-Lowry definitions. Carry out pH calculations. Relate the properties of acids to their structure.
6. Identify and describe the properties of buffer solutions. Carry out calculations involving buffer solutions. Carry out calculations with solutions of slightly soluble salts and describe the factors that affect their solubility.
7. Discuss the relationship between enthalpy, entropy and free energy and their relationship to spontaneity. Carry out calculations of enthalpy, entropy and free energy.
8. Describe voltaic and electrolytic cells. Write equations for oxidation-reduction reactions and calculate cell potentials for these reactions.
9. Describe nuclear reactions, the uses of radioisotopes and the properties of alpha, beta and gamma radiation.

## General Chemistry II Course Objectives by Chapter

### Chapter 11 - Liquids, Solids and Materials

1. Know the properties of liquids, including viscosity & surface tension. Include special properties of water.
2. Describe and understand the energy terms associated with phase changes, including vapor pressure, boiling and melting points.
3. Interpret phase diagrams.
4. Describe solids as crystalline, metallic, molecular, network and amorphous.

### Chapter 13 - Chemical Kinetics

1. Know the factors that affect the rate of a chemical reaction.
2. Relate the rate of disappearance of a reactant with the rate of appearance of a product.
3. Determine the rate law of a reaction.
4. Carry out calculations using the integrated rate laws.
5. Discuss the relationship between rate law, stoichiometry and mechanism.
6. Compare and contrast Collision Theory and Transition State Theory
7. Label and interpret a potential energy diagram of a reaction.

### Chapter 14 – Chemical Equilibrium

1. Write equilibrium constant expressions for chemical reactions based on balanced chemical equations.
2. Discuss factors that affect the position of equilibrium in homogeneous and heterogeneous equilibria.
3. Carry out calculations involving the equilibrium constant.
4. Be able to predict shifts in equilibria due to changes in the concentration of a reactant or product, temperature changes and volume/pressure changes.

### Chapter 15 – The Chemistry of Solutes and Solutions

1. Discuss solution formation include energy terms and intermolecular forces.
2. Discuss the effects of temperature and pressure on solubility.
3. Calculate the concentration of solutions in terms of molarity, molality, percent concentration by mass and mole fraction.
4. Understand the concepts and carry out calculations involving the colligative properties vapor pressure reduction, boiling point elevation, freezing point depression and osmosis.

### Chapter 16 – Acids & Bases

1. Characterize acids and bases according to the Arrhenius and Bronsted-Lowry definitions.
2. Write equations that show the ionization of acids and bases in water, identify conjugate acid base pairs.
3. Carry out calculations involving ionization of strong and weak acids and bases.
4. Relate pH to hydronium ion and hydroxide ion concentration.
5. Discuss the strength of acids as related to their  $K_a$  values and structures.
6. Predict whether a salt is acidic, basic or neutral and carry out pH calculations.

### Chapter 17 – Additional Aqueous Equilibria

1. Discuss the common ion effect and carry out calculations involving common ions.
2. Carry out calculations involving buffer solutions.
3. Qualitatively discuss and interpret titration curves.
4. Write solubility product expressions for slightly soluble salts.
5. Carry out calculations involving solubility of slightly soluble salts.
6. Predict whether or not precipitation occurs based on ion concentrations.
7. Discuss the effect of common ion, complex ion and pH on the solubility of a slightly soluble salt.

### Chapter 18 – Thermodynamics

1. Discuss how enthalpy and entropy affect the spontaneity of reactions.
2. Calculate  $\Delta G^\circ$  from  $\Delta H^\circ$  and  $\Delta S^\circ$ .
3. Predict the sign of entropy change for a reaction.
4. Determine the spontaneity of a reaction from the sign of  $\Delta G$ .

### Chapter 19 – Electrochemistry

1. Write and balance oxidation-reduction reactions.
2. Sketch, label and discuss applications of a voltaic cell.
3. Calculate the cell potential from standard cell potentials, and predict how cell potential is changed by changes in concentration.
4. Use standard cell potentials to determine the spontaneity of a reaction and to rank oxidizing and reducing strengths.
5. Describe and discuss applications of electrolytic cells.
6. Discuss corrosion.

### Chapter 20 – Nuclear Chemistry

1. Write and balance nuclear reactions.
2. Describe fission and fusion reactions and their applications.
3. Describe alpha, beta and gamma emissions, their detection and health effects.
4. Discuss conservation of mass and energy in relation to nuclear reactions.
5. Describe uses of radioactive isotopes.