



South Central College

CHEM 121 Principles of Chemistry II

Course Outcome Summary

Course Information

Description	Principles of Chemistry II is the second in a series of Chemistry courses designed for students who plan to major in a scientific or health related field. Topics include kinetics, chemical equilibria, acids and bases, buffers, precipitation reactions, thermodynamics, and electrochemistry. 4 hour lecture plus 2 hour lab. Lab topics reinforce lecture concepts. MNTC goal area 3. Prerequisite: Chem 120.
Total Credits	5
Total Hours	96

Types of Instruction

Instruction Type

Credits/Hours

Classroom Presentation

On-Campus Lab

Pre/Corequisites

Chem 120

Institutional Core Competencies

Critical and Creative Thinking - Students will be able to demonstrate purposeful thinking with the goal of using a creative process for developing and building upon ideas and/or the goal of using a critical process for the analyzing and evaluating of ideas.

Course Competencies

1. Demonstrate understanding of chemical kinetics.

Learning Objectives

Describe factors that affect the rate of chemical reactions.

Given time and concentration, determine the rate of a chemical reaction.

Given the balanced equation for a reaction, relate the rate of formation of products and the rate of disappearance of reactants.

Determine the rate law and rate constant for a reaction from a series of experiments given the measured rates for various concentrations of reactants.

Determine the concentration of a reactant at a given time using the integrated form of a rate law.

Predict a rate law for a reaction having a multistep mechanism given the individual steps in the mechanism.

2. Describe the effects of catalysts and activation energies.

Learning Objectives

Explain how activation energy affects a rate.

Use the Arrhenius Equation to demonstrate the relationship between rate constant and temperature.

3. Use equilibrium constant expressions in problem solving.

Learning Objectives

Write the equilibrium constant expression for a heterogeneous reaction.

Calculate an equilibrium constant from concentration measurements.

4. Calculate equilibrium concentrations.

Learning Objectives

Calculate equilibrium concentrations given the equilibrium constant and the concentrations of reactants and products.

Use an appropriate approximation method to calculate the equilibrium constant when the quadratic formula is insufficient.

5. Demonstrate understanding of changes in equilibrium.

Learning Objectives

Predict the direction of a reaction given the equilibrium constant and the concentrations of reactants and products.

Describe the effects of changing concentrations, volume, or temperature on an equilibrium system.

6. Demonstrate knowledge of acid/base reactions.

Learning Objectives

Define and identify Arrhenius acids and bases.

Define and identify Bronsted-Lowry acids and bases.

Identify conjugate acid-base pairs.

Define and identify Lewis acids and bases.

Predict whether an aqueous solution of a salt will be acidic, basic, or neutral.

Write balanced chemical equations for acid/base reactions.

7. Demonstrate understanding of acid/base strength.

Learning Objectives

Relate the strength of an acid to the strength of its conjugate base.

Use the ion-product constant for water to describe concentration of $[H_3O^+]$ and $[OH^-]$.

Predict the relative strength of a series of acids from their molecular structures.

8. Calculate pH.

Learning Objectives

Calculate pH of a solution given $[H_3O^+]$ or $[OH^-]$.

Calculate the pH of a strong acid or base given its concentration.

Calculate the pH of a weak acid or weak base or its percent ionization given its concentration and K_a or K_b .

9. Perform calculations using K_a and K_b .

Learning Objectives

Calculate K_a or K_b for a weak acid or weak base given its concentration and the pH of the solution.

Calculate K_b for a weak base given K_a of its conjugate acid.

Calculate K_a for a weak acid given K_b of its conjugate base.

10. Demonstrate understanding of buffers.

Learning Objectives

Describe the common-ion effect.

Explain how a buffer functions.

Calculate the pH of a buffer solution.

Calculate the pH of a buffer after the addition of small amounts of a strong acid or a strong base.

11. Demonstrate understanding of titrations.

Learning Objectives

Identify differences between titration curves for a strong acid - strong base titration and those when either acid or base is weak.

Calculate the pH at any point in an acid-base titration of a strong acid and a strong base.

Calculate the pH at any point in a titration of a weak acid with a strong base or a weak base with a strong acid.

12. Apply knowledge of solubility to problem solving situations.

Learning Objectives

Calculate K_{sp} from molar solubility and molar solubility from K_{sp} .

Calculate molar solubility in the presence of a common ion.

Predict the effect of pH on solubility.

Calculate the ion concentrations required to begin precipitation.

Explain the effect of complex-ion formation on solubility.

13. Describe green chemistry processes and their impact on the environment.

Learning Objectives

List the major principles of green chemistry.

Describe a process in which green chemistry has been used in industry.

14. Demonstrate understanding of chemical thermodynamics.

Learning Objectives

Define spontaneous process, reversible process, irreversible process, and isothermal process.

State the second law of thermodynamics.

Predict the sign of ΔS for physical and chemical processes.

State the third law of thermodynamics.

Calculate standard entropy changes for a system from standard molar entropies.

Calculate entropy changes in the surroundings for isothermal processes.

Calculate the Gibbs free energy from the enthalpy change and entropy change at a given temperature.

Use free energy changes to predict whether reactions are spontaneous.

Predict the effect of temperature on spontaneity given ΔH and ΔS .

Calculate ΔG under nonstandard conditions.

Relate standard free energy change and equilibrium constant.

15. Use electrochemistry to relate electricity and chemical reactions.

Learning Objectives

Identify oxidation, reduction, oxidizing agent, and reducing agent in a chemical reaction.

Complete and balance redox equations using the method of half-reactions.

Sketch a voltaic cell and identify its cathode, anode, and the directions that electrons and ions move.

Calculate standard emfs from standard reduction potentials.

Predict whether a reaction is spontaneous based on reduction potentials.

Calculate emf under nonstandard conditions.

Relate amounts of reactants and products in redox reactions to electrical charge.

Describe the reactions in electrolytic cells.

16. Perform chemical experiments in a laboratory setting using proper laboratory techniques and procedures.

Learning Objectives

Use equipment safely and appropriately.

Form a hypothesis.

Develop a procedure.

Collect data in a laboratory notebook and analyze data.

Write a conclusion based on collected and analyzed data.

Analyze sources of error.

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