



**Cowley College
& Area Vocational Technical School**

COURSE PROCEDURE FOR

CHEMISTRY II
CHM4230 5 Credit Hours

Student Level:

This course is open to students on the college level in either the freshman or sophomore year.

Catalog Description of the Course:

CHM4230 - CHEMISTRY II (N) (5 hrs)

[KRSN CHM 1020/1021/1022]

A continuation of CHM4220 Chemistry I. A presentation of the properties of solutions, chemical kinetics, equilibrium, acid-base theory, thermodynamics, coordination chemistry, organic and biochemistry, and electrochemistry. Includes laboratory experimentation.

Prerequisite:

CHM 4220 Chemistry I and MTH 4420 College Algebra, with a C or better within the past five years.

Controlling Purpose:

This course is the continuation of the study of inorganic chemistry. The course will give students a functional knowledge of the principles and concepts of chemistry which are needed for advanced study in chemistry or other areas of science.

Unit Outcomes and Clock Hours of Instruction for Core Curriculum:

The following outline defines the minimum core content and does not include the final examination period. Instructors may add other material as time allows.

Units Outcomes and Criterion Based Evaluation Key for Core Content:

The following defines the minimum core content not including the final examination period. Instructors may add other content as time allows.

Evaluation Key:

- A = All major and minor goals have been achieved and the achievement level is considerably above the minimum required for doing more advanced work in the same field.
- B = All major goals have been achieved, but the student has failed to achieve some of the less important goals. However, the student has progressed to the point where the goals of work at the next level can be easily achieved.
- C = All major goals have been achieved, but many of the minor goals have not been achieved. In this grade range, the minimum level of proficiency represents a person who has achieved the major goals to the minimum amount of preparation necessary for taking more advanced work in the same field, but without any major handicap of inadequacy in his background.

- D = A few of the major goals have been achieved, but the student's achievement is so limited that he is not well prepared to work at a more advanced level in the same field.
- F = Failing, will be computed in GPA and hours attempted.
- N = No instruction or training in this area.

UNIT 1: STATES OF MATTER; LIQUIDS & SOLIDS

Outcomes: The student will develop concepts necessary to understand solid liquid and gas phase properties of substances.

						Specific Competencies
A	B	C	D	F	N	Demonstrate the ability to:
						Identify intermolecular forces, given the molecular structure.
						Determine the relative vapor pressure on the basis of intermolecular attraction.
						Identify the types of solids using the knowledge of bonding.
						Arrange substances in order of increasing melting point based on the type of structure.
						Find the number of atoms per unit cell, given the description of a unit cell.

UNIT 2: SOLUTIONS AND COLLIGATIVE PROPERTIES

Outcomes: The student will understand and utilize concepts of mixtures and concentrations of solutions and the colligative properties of substances.

						Specific Competencies
A	B	C	D	F	N	Demonstrate the ability to:
						Distinguish among saturated, unsaturated and supersaturated solutions.
						Apply Henry's law to find the solubility of a gas at a given pressure.
						Explain factors that affect solubility.
						Explain how to calculate mole fraction.
						Distinguish between molarity and molality, and determine how each can be obtained from the other.
						Explain and calculate vapor pressure using Raoult's Law.
						Calculate the boiling-point elevation and freezing -point depression from the molality of a nonvolatile, undissociated solute.

UNIT 2: SOLUTIONS AND COLLIGATIVE PROPERTIES

Outcomes: The student will understand and utilize concepts of mixtures and concentrations of solutions and the colligative properties of substances.

						Specific Competencies
A	B	C	D	F	N	Demonstrate the ability to:
						Find the molecular weight of a solute from the mass of the solvent, molality, freezing-point depression, and K_f .
						Calculate the osmotic pressure given molarity and temperature of a solution.
						Determine the colligative properties of ionic solutions

UNIT 3: RATES OF REACTION/CHEMICAL KINETICS

Outcomes: The student will develop theoretical and practical understanding of chemical reaction rates and reaction mechanisms for application to other concepts.

						Specific Competencies
A	B	C	D	F	N	Demonstrate the ability to :
						Discuss the meaning of the rate of a reaction.
						Explain the factors that affect reaction rates.
						Use the initial rate method to determine reaction order from experimental data.
						Describe the relationship between order of reaction and molecularity.
						Use experimental data to determine the rate law for a reaction.
						Compare first and second order rate reactions.
						Discuss the collision theory of a reaction rate.
						Use the Arrhenius equation to illustrate the relationship between energy of activation and rate law constant.
						Describe the relationships among the mechanism, the overall reaction and elementary steps.
						Draw and interpret energy diagrams and illustrate the affect of a catalyst on the energy diagram.

UNIT 4: CHEMICAL EQUILIBRIUM; GASEOUS REACTION

Outcomes: The student will apply chemical kinetic concepts to applications of chemical equilibria.

A	B	C	D	F	N	Specific Competencies
						Demonstrate the ability to :
						Apply stoichiometry to an equilibrium mixture.
						Write equilibrium-constant expressions, including those for heterogeneous equilibria.
						Determine K_c or K_p from the reaction composition.
						Predict the direction of reaction given the concentrations of substances in a reaction mixture.
						Solve for equilibrium concentrations of reactants and products from an initial set of conditions.
						Apply Le Chatelier's principle to determine the effects on the equilibrium position when changes in temperature, pressure, volume or concentration occur.

UNIT 5: ACID BASE EQUILIBRIUM

Outcomes: The student will apply concepts of equilibrium to acid-base reactions and other acid-base concepts including pH, titration, and common ion effects.

A	B	C	D	F	N	Specific Competencies
						Demonstrate the ability to :
						Describe and recognize Bronsted-Lowry, Lewis and Arrhenius acids and bases.
						Calculate the hydrogen-ion and hydroxide-ion concentrations.
						Find the pH and pOH from the hydrogen-ion concentration or hydroxide-ion.
						Determine the K_a or K_b from the pH of a solution.
						Solve for the concentrations of species in a weak acid solution using K_a .
						Solve for the concentrations of species in a weak base solution using K_b .
						Predict whether a salt solution is acidic, basic or neutral.

UNIT 5: ACID BASE EQUILIBRIUM

Outcomes: The student will apply concepts of equilibrium to acid-base reactions and other acid-base concepts including pH, titration, and common ion effects.

A	B	C	D	F	N	Specific Competencies
						Demonstrate the ability to :
						Describe the ionization of a polyprotic acid in a aqueous solution.
						Describe the properties and components of a buffer.
						Apply the Henderson-Hasselbach equation to calculate the concentrations of species in a buffer.
						Calculate the pH of a buffer, a strong acid, and a weak acid.
						Identify titration curves for strong, weak and polyfunctional acids and bases.
						Read a titration curve and determine the pH at equivalence point.

UNIT 6: SOLUBILITY AND COMPLEX - ION EQUILIBRIA

Outcomes: The student will gain understanding of the solubility equilibria and complex ion formation of chemical reactions.

A	B	C	D	F	N	Specific Competencies
						Demonstrate the ability to:
						Write the solubility product expression for a given ionic compound.
						Calculate the solubility from K_{sp} or K_{sp} from solubility.
						Predict whether precipitation will occur when two solutions are mixed, using solubility constants.
						Calculate the affect of a common ion on the molar solubility of a salt.

UNIT 7: THERMODYNAMICS AND EQUILIBRIUM

Outcomes: The student will understand the theoretical applications of thermodynamic properties of systems to chemical reactions, and to utilize predictive thermodynamic indicators.

A	B	C	D	F	N	Specific Competencies
						Demonstrate the ability to:
						Explain similarities/differences between enthalpy, entropy and free energy.
						Explain how the 1st, 2nd and 3rd laws of Thermodynamics apply to chemical and physical processes.
						Predict the sign of the entropy change of a reaction or a phase change.
						Relate the entropy of a reaction to the standard entropies of reactants and products.
						Calculate ΔG , ΔH and ΔS from data tables.
						Determine the spontaneity of a reaction using the standard free-energy change.
						Explain how ΔH , ΔS and ΔG are related to reaction spontaneity.
						Describe the relationship between K and the standard free energy change.
						Examine the effects of temperature on ΔG and K .

UNIT 8: ELECTROCHEMISTRY

Outcomes: The student will gain an understanding of electrochemical principles and will apply those principles to electrochemical processes.

						Specific Competencies
A	B	C	D	F	N	Demonstrate the ability to:
						Describe galvanic and electrolytic cells and their operation.
						Calculate cell potentials and determine spontaneity of oxidation/reduction reactions.
						Understand and use Faraday's Law.
						Understand and apply the relationship of thermodynamics to electrochemistry.
						Understand and use the Nernst equation.
						Give examples of natural and/or commercial applications of electrochemical processes.
						Use the activity series of metals.

Projects Required:

Laboratory Notebook

Textbook:

Contact the Bookstore for current textbook.

Materials/Equipment Required:

composition notebook, calculator

Major Pieces of Equipment:

pH meters

electronic balances

analytical balances

spectrophotometers

PC computers

Attendance Policy:

Students should adhere to the attendance policy outlined by the instructor in the course syllabus.

Grading Policy:

The grading policy will be outlined by the instructor in the course syllabus.

Maximum class size:

Based on classroom occupancy.

Course Time Frame:

The U.S. Department of Education, Higher Learning Commission and the Kansas Board of Regents define credit hour and have specific regulations that the college must follow when developing, teaching and assessing the educational aspects of the college. A credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally-established equivalency that reasonably approximates not less than one hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work for approximately fifteen weeks for one semester hour of credit or an equivalent amount of work over a different amount of time, The number of semester hours of credit allowed for each distance education or blended hybrid courses shall be assigned by the college based on the amount of time needed to achieve the same course outcomes in a purely face-to-face format.

Learner Outcomes: Upon completion of this course, students will be able to read technical information in the field of chemistry and apply mathematics to chemical principles and concepts. The students will be able to use laboratory equipment to gather data and interpret data to write laboratory reports.

The learning outcomes and competencies detailed in this course meet, or exceed the learning outcomes and competencies specified by the Kansas Core Outcomes Project for this course, as sanctioned by the Kansas Board of regents.

Refer to the following policies:

[402.00 Academic Code of Conduct](#)

[263.00 Student Appeal of Course Grades](#)

[403.00 Student Code of Conduct](#)

Disability Services Program:

Cowley College, in recognition of state and federal laws, will accommodate a student with a documented disability. If a student has a disability which may impact work in this class which requires accommodations, contact the Disability Services Coordinator.