El Camino College

COURSE OUTLINE OF RECORD - Official

I. GENERAL COURSE INFORMATION

Subject and Number: Chemistry 1A
Descriptive Title: General Chemistry I

Course Disciplines: Chemistry

Division: Natural Sciences

Catalog Description: This course details fundamental theory and principles of atomic and molecular structure, physical states and chemical reactions. Included is the study of elements, compounds, periodic relationships, bonding, acids and bases, oxidation-reduction, energy, solutions, electrolytes and chemical equations. Descriptive chemistry of water and selected nonmetals including hydrogen, oxygen and carbon is presented.

Conditions of Enrollment:

Prerequisite

Chemistry 4
with a minimum grade of C
or

Chemistry 4H or

1 year of high school chemistry

AND

qualification by testing (El Camino College Chemistry Placement Test) and assessment;

AND

eligibility for Mathematics 170 or qualification by testing (El Camino College Mathematics Placement Test) and assessment.

Recommended Preparation

eligibility for English 1A

Course Length: [X] **Full Term** [ ] **Other (Specify number of weeks):**
Hours Lecture: **5.00 hours per week** [ ] **TBA**
Hours Laboratory: **4.00 hours per week** [ ] **TBA**
Course Units: **5.00**

Grading Method:	**Letter**
Credit Status	**Associate Degree Credit**

Transfer CSU:	[X] **Effective Date: Prior to July 1992**
Transfer UC:	[X] **Effective Date: Prior to July 1992**

General Education:

El Camino College:	**1 – Natural Sciences**	
	Term:	Other:
CSU GE:	**B1 - Physical Science**	
	Term:	Other: Approved
	B3 - Laboratory Sciences	
	Term:	Other: Approved
IGETC:	**5A - Physical Science with Lab**	
	Term:	Other:
	5C - Science Laboratory	
	Term:	Other:

II. OUTCOMES AND OBJECTIVES

A. COURSE STUDENT LEARNING OUTCOMES (The course student learning outcomes are listed below, along with a representative assessment method for each. Student learning outcomes are not subject to review, revision or approval by the College Curriculum Committee)

1. On a written exercise, given the names of chemical compounds, students will be able to write the correct reactant formulas, states of matter (when required), identify reaction type, predict the product formulas and balance the chemical equation.
2. Students will be able to create (via molecular models or drawings) accurate representations of compounds. The representations will contain appropriate bonds, lone pairs, and geometry.
3. Students will adhere to safety protocol in the laboratory regarding eye protection. Students will follow the proper procedure regarding wearing goggles in the laboratory, and keeping them on to protect their eyes.

The above SLOs were the most recent available SLOs at the time of course review. For the most current SLO statements, visit the El Camino College SLO webpage at http://www.elcamino.edu/academics/slo/.

B. Course Student Learning Objectives (The major learning objective for students enrolled in this course are listed below, along with a representative assessment method for each)

1. The student will be more proficient in
   a. the use of scientific terminology.
   b. the naming and writing of chemical formulas for inorganic compounds: binary nonmetal compounds, salts, acids and bases.
   c. writing and classifying chemical equations for elementary chemical reactions.
   d. performing stoichiometric calculations involving chemical reactions.

Objective Exams

2. Structure: The student will
   a. provide a historical picture of the development of atomic theory.
   b. be able to state the fundamentals of quantum theory; assign quantum numbers and construct orbital diagrams.
   c. predict and explain periodic trends of elements in terms of electronic configurations.
   d. describe and illustrate the structure and bonding of molecules by constructing Lewis structures, sketching and labeling the molecular geometries of a molecule, describing the hybridization of the atoms involved, and determining polarity.
   e. predict and explain properties of molecules in terms of structure and bonding.
   f. predict and explain properties of conductors, semiconductors and insulators in terms of structure and bonding.

   Essay exams

3. States of Matter: The student will
   a. use the Kinetic Molecular Theory to explain the behavior of gases.
   b. compare and contrast various gas laws.
   c. perform gas law calculations.
   d. relate intermolecular forces to observed properties of solids, liquids and gases.
   e. interpret phase diagrams.
   f. describe basic crystal systems.

   Objective Exams

4. Aqueous solutions: The student will
   a. explain solubility in terms of properties of both solute and solvent.
   b. determine concentrations of solutions quantitatively and experimentally.
   c. give qualitative and quantitative descriptions of solution properties as a function of solute type and solute concentration.
   d. classify solutes as strong, weak, or nonelectrolytes.
   e. write net ionic equations for chemical reactions.

   Laboratory reports

5. Acids and bases: The student will
   a. define and identify acids and bases.
   b. write and classify acid-base reactions.

   Quizzes

6. Oxidation-Reduction: The student will
   a. determine oxidation numbers.
   b. balance oxidation-reduction equations.
   c. identify oxidizing and reducing agents.

   Laboratory reports

7. Energy: The student will
   a. apply the First Law of Thermodynamics.
   b. relate ΔU to ΔH.
   c. calculate ΔH through calorimetry, Hess' Law, enthalpy of formation, and bond energies.

   Homework Problems

8. Nonmetals: The student will
   a. compare and contrast properties and reactions within a family of compounds.
   b. describe the role of nonmetals and nonmetal compounds in pollution.
   c. draw Lewis structures and name simple organic compounds.
   d. identify the classes of organic compounds.

   Objective Exams

9. Laboratory: The student will
   a. learn fundamental chemistry techniques such as gravimetric analysis, spectral analysis, titration.
   b. become proficient in the use of the following laboratory equipment: analytical

balance, spectrophotometer, burets, pipets, volumetric flasks.
c. illustrate basic principles of gases, solutions, acids and bases, and oxidizing and reducing agents through experimental setups.

Laboratory reports

III. OUTLINE OF SUBJECT MATTER (Topics are detailed enough to enable a qualified instructor to determine the major areas that should be covered as well as ensure consistency from instructor to instructor and semester to semester.)

Lecture or Lab	Approximate Hours	Topic Number	Major Topic
Lecture	7	I	I. Introduction and Nomenclature A. Introduction to chemistry B. Problem solving 1. Units and measurements 2. Dimensional analysis 3. Significant figures C. Matter 1. Physical and chemical properties 2. Mixtures 3. Elements 4. Historical development through Rutherford D. Nomenclature 1. Binary nonmetal compounds 2. Salts 3. Acids and bases 4. Organic compounds: simple alkanes, alcohols and carboxylic acid
Lecture	7	II	II. Chemical Calculations A. Mole concept, empirical and molecular formulas B. Chemical equations 1. Balancing 2. Classifying 3. Writing C. Stoichiometry 1. Percent yield 2. Limiting reagents 3. Analysis of mixtures D. Solutions 1. Molarity 2. Solution stoichiometry including titrations
Lecture	8	III	III. Thermochemistry A. First Law of Thermodynamics B. ΔU, q and w C. Calorimetry D. Enthalpy changes, ΔH 1. Standard molar enthalpy of formation 2. Heat of reaction E. Hess' Law
Lecture	8	IV	IV. Atomic Structure A. Nature of light B. Atomic spectra 1. Rydberg equation 2. Bohr atom

			C. Quantum mechanics 1. DeBroglie equation 2. Heisenberg uncertainty principle 3. Schroedinger equation 4. Quantum numbers 5. Atomic Orbitals i. cross-section and boundary diagrams ii. radial probability distributions D. Electronic configurations 1. Use of periodic table 2. Explanation of trends
Lecture	6	V	V. Periodicity A. Periodic table B. Trends 1. Atomic radius 2. Ionization energy 3. Electron affinity 4. Electronegativity
Lecture	9	VI	VI. Chemical Bonding A. Ionic Bonding 1. Ionic radii 2. Born-Haber cycle B. Covalent Bonding 1. Polar and nonpolar bonds 2. Dipole moment and percent ionic character 3. Bond energies and their use to estimate ΔH 4. Lewis structure a. Octet rule b. Formal charge c. Multiple bonds d. Resonance e. Exceptions to the octet rule f. Structural isomers
Lecture	7	VII	VII. Bonding Theories and Molecular Geometry A. Valence Shell Electron Pair Repulsion model B. Valence Bond Theory 1. Hybrid orbitals 2. Multiple bonding C. Molecular orbitial theory and energy diagrams D. Band theory and metallic bonding
Lecture	7	VIII	VIII. Gases A. Properties B. Gas Laws: Boyle, Charles, Avogadro, Gay-Lussac, Combined and ideal 1. Partial pressures 2. Gas Stoichiometry c. Kinetic Molecular Theory D. Real Gases E. Air Pollution
Lecture	6	IX	IX. Liquids and Solids A. Properties B. Intermolecular forces C. Dynamic equilibrium D. Types of crystalline solids E. Energy and Phase Changes F. Crystal types and properties

			G. Base crystal systems of metals and binary salts
Lecture	8	X	X. Solutions A. Concentration units B. Factors affecting solubility 1. Energy 2. Temperature and pressure 3. Henry's Law C. Colligative properties 1. Raoult's Law of vapor pressure, non-volatile solutes and two-component systems 2. Freezing and boiling points 3. Osmotic pressure 4. Effect of electrolytes including van't Hoff factor
Lecture	3	XI	XI. Acids and Bases A. Arrhenius theory 1. Definitions 2. Solution properties B. Bronsted-Lowry theory 1. Definitions 2. Bronsted-Lowry reactions
Lecture	9	XII	XII. Reactions in Aqueous Solutions A. Electrolytes B. Net Ionic Equations 1. Precipitation 2. Acid-base 3. Dissolving C. Oxidation-Reduction 1. Oxidation numbers 2. Balancing redox equations by half-reaction method 3. Oxidizing and reducing agents
Lecture	5	XIII	XIII. Selected topics of nonmetals A. Hydrogen, oxygen, halogens, noble gases, nitrogen, phosphorus, and sulfur 1. Properties 2. Occurrence and preparation 3. Compounds and reactions 4. Uses
Lab	72	XIV	Laboratory Experiments. Starred Experiments are Mandatory. (Number of Lab Periods needed) Gravimetric and Volumetric Equipment and Introduction to Uncertainty in Measurements and Propagation of Error* (1) Computer Graphing (1) Molecular Modeling (1) Gravimetric Determination of Sulfate Ion* (3) Calorimetry: Hess' Law* (1) Atomic Spectra and Energy Levels (1) Determination of Solution Concentration by Spectrophotometry* (2) Analysis of $KClO_3$/KCl Mixture by Thermal Decomposition to Measurable Volume of Oxygen* (1) Determination of the Molar Mass of Gaseous Carbon Dioxide (1) Lewis Structures* (1) Model Making: Geometry* (1)

			Model Making: Carbon Compounds (1) Metallic and Ionic Crystal Lattices* (2) Acid/Base Titrations* (2) Part I: Standardization of sodium Hydroxide Solution Part II: Determination of the Molar Mass of an Acid Ions in Solution* (1) Oxidation-Reduction* (2) Redox Titration: Analysis of Liquid Bleach (2)
Total Lecture Hours	90		
Total Laboratory Hours	72		
Total Hours	162		

IV. PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS

A. **PRIMARY METHOD OF EVALUATION:**

Problem solving demonstrations (computational or non-computational)

B. **TYPICAL ASSIGNMENT USING PRIMARY METHOD OF EVALUATION:**

Use the heat of vaporization of water and the normal boiling point to calculate the vapor pressure of water at 25 °C.

C. **COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:**

1. The electrolyte in a lead storage battery must be between 4.8 M and 5.3 M sulfuric acid if the battery is to be most effective. If a 5.00 mL sample of battery acid requires 49.74 mL of 0.935 M NaOH for its complete neutralization, determine if the concentration of the acid falls within the desired range. Show your work in the space provided.
2. Below is schematic of an experiment which contributed to our current understanding of atomic structure. Describe how this setup was important to modern atomic theory**.** Your description should include the name of the scientist, his observations and conclusions, and how his work supported and/or changed what was understood at the time about atomic structure.

D. **OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:**

Essay exams

Other exams

Quizzes

Written homework

Laboratory reports

Homework Problems

Multiple Choice

Completion

Matching Items

True/False

V. INSTRUCTIONAL METHODS

Demonstration
Discussion
Laboratory
Lecture
Multimedia presentations

Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.

VI. WORK OUTSIDE OF CLASS

Study
Answer questions
Skill practice
Required reading
Problem solving activities
Written work

Estimated Independent Study Hours per Week: 8

VII. TEXTS AND MATERIALS

A. **UP-TO-DATE REPRESENTATIVE TEXTBOOKS**
Scroggins, ECC Faculty. Chemistry 1A Supplement. ECC Reproduction Center, 2012.
Petrucci, et al. General Chemistry: Principles and Modern Applications. 11 ed. Pearson, 2016.

B. **ALTERNATIVE TEXTBOOKS**

C. **REQUIRED SUPPLEMENTARY READINGS**

D. **OTHER REQUIRED MATERIALS**
Scientific Calculator
Department-Approved Safety Goggles

VIII. CONDITIONS OF ENROLLMENT

A. Requisites (Course and Non-Course Prerequisites and Corequisites)

Requisites	Category and Justification
Course Prerequisite Chemistry-4 or	Sequential
Course Prerequisite Chemistry-4H or	Sequential
Non-Course Prerequisite AND	The Chem 1A curriculum demands that the entering student has a solid foundation in introductory chemistry. Upon starting the course, the student is expected to be able to use the periodic table and the symbols of the elements; solve introductory chemistry problems including equation writing and quantitative analysis; express answers with the correct number of significant figures; identify types of chemical reactions; identify different types of chemical bonds; and be able to determine electron configurations and draw Lewis structures.
Non-Course Prerequisite AND	The Chem 1A curriculum demands that the entering student has a solid foundation in introductory chemistry. Upon starting the course, the student is expected to be able to use the periodic table and the symbols of the elements; solve introductory chemistry problems including equation writing and quantitative analysis; express answers with the correct number of significant figures; identify types of chemical reactions; identify different types of chemical bonds; and be able to determine electron configurations and draw Lewis structures.
Non-Course Prerequisite	Incoming Chem 1A students are required to solve basic math and algebra problems.

B. Requisite Skills

Requisite Skills
Write symbols for chemical elements given the names, and vice versa. CHEM 4H - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations. CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations.
Introductory knowledge of problem solving and dimensional analysis. CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations. CHEM 4 - Analyze and solve quantitative problems, including stoichiometry, percent yield, energy and change of temperature, gas laws, the ideal gas equation, Dalton's law of partial pressures, percent abundance of isotopes, density, solution concentration, and colligative properties. CHEM 4 - Solve problems and express answers in scientific and decimal notation with correct units and significant figures. Use logarithms to convert among pH, pOH, $[H^+]$, and $[OH^-]$.
Basic knowledge of inorganic chemical nomenclature. CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations. CHEM 4 - Given one or the other, generate names or formulas for elements, ions, and compounds.
Fundamentals knowlege of basic types of chemical reactions. CHEM 4 - Differentiate between five reaction types: combination, decomposition, single replacement, double replacement, and complete oxidation. Given a set of reactants, diagnose the reaction type and predict the products.
Identify the oxidation number of an atom in a simple compound or ion. CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations. CHEM 4 - Given one or the other, generate names or formulas for elements, ions, and compounds.
Basic knowledge of groups, periods, and areas of the periodic table. CHEM 4 -

Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations.
Basic knowledge of equation writing and reaction stoichiometry. CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations. CHEM 4 - Analyze and solve quantitative problems, including stoichiometry, percent yield, energy and change of temperature, gas laws, the ideal gas equation, Dalton's law of partial pressures, percent abundance of isotopes, density, solution concentration, and colligative properties. CHEM 4 - Differentiate between five reaction types: combination, decomposition, single replacement, double replacement, and complete oxidation. Given a set of reactants, diagnose the reaction type and predict the products.
Experience writing simple electron configurations. CHEM 4 - Utilize the language of chemistry, including vocabulary, symbols, formulas, and equations.
Basic understanding of states of matter and their transitions. CHEM 4 - Compare and contrast physical properties, physical changes, chemical properties, and chemical changes.
Write simple Lewis structures and deduce simple molecular geometries. CHEM 4 - Compare and contrast ionic and covalent compounds. Evaluate bonding based on the chemical formula, and then correlate compound properties with the structure and types of bonding present.
Use the Ideal Gas Law in simple calculations. CHEM 4 - Analyze and solve quantitative problems, including stoichiometry, percent yield, energy and change of temperature, gas laws, the ideal gas equation, Dalton's law of partial pressures, percent abundance of isotopes, density, solution concentration, and colligative properties.
Knowlege of significant figures and relative error. CHEM 4 - Solve problems and express answers in scientific and decimal notation with correct units and significant figures. Use logarithms to convert among pH, pOH, $[H^+]$, and $[OH^-]$. CHEM 4 - Evaluate volumetric laboratory glassware for the correct significant place to be read and record volumes correctly. Evaluate quantitative experimental data, and infer the presence or absence of specific ions in an unknown mixture.
Construct simple lab set-ups and a basic understanding of lab operations and safety. CHEM 4 - Demonstrate basic laboratory skills, including making, recording, and evaluating observations of chemical systems. CHEM 4 - Evaluate volumetric laboratory glassware for the correct significant place to be read and record volumes correctly. Evaluate quantitative experimental data, and infer the presence or absence of specific ions in an unknown mixture.

C. Recommended Preparations (Course and Non-Course)

Recommended Preparation	Category and Justification
Non-Course Recommended Preparation eligibility for English 1A	In order to succeed in the course, students must be able to read a college level textbook and answer essay questions explaining chemistry concepts and principles.

D. Recommended Skills

Recommended Skills
Answer essay questions explaining chemical concepts and principles. ENGL A - Read and apply critical thinking skills to college-level expository prose for the purposes of writing and discussion. ENGL 84 -

Select and employ reading strategies to interpret the content of a college-level textbook, with special focus on constructing a thesis statement and providing valid support.

E. Enrollment Limitations

Enrollment Limitations and Category	Enrollment Limitations Impact

Course created by Warren Ford on 02/01/1965.

BOARD APPROVAL DATE:

LAST BOARD APPROVAL DATE:

Last Reviewed and/or Revised by Soshanna Potter on 10/26/2016

19777