CHEM G180: GENERAL CHEMISTRY A

Item	Value
Curriculum Committee Approval Date	12/03/2024
Top Code	190500 - Chemistry, General
Units	5 Total Units
Hours	162 Total Hours (Lecture Hours 54; Lab Hours 108)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	Yes
Basic Skills	Not Basic Skills (N)
Repeatable	No
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S)
Local General Education (GE)	• Area 5 Natural Sciences (GB1)
California General Education Transfer Curriculum (Cal-GETC)	• Cal-GETC 5A Physical Science (5A) • Cal-GETC 5C Laboratory Activity (5C)
Intersegmental General Education Transfer Curriculum (IGETC)	• IGETC 5A Physical Science (5A) • IGETC 5C Laboratory Activity (5C)
California State University General Education Breadth (CSU GE-Breadth)	• CSU B1 Physical Science (B1) • CSU B3 Laboratory Activity (B3)

Course Description

This course is the first in a two-semester general chemistry sequence intended for majors in science and engineering. It examines the composition, properties, and transformations of matter. The laboratory portion of this course provides a hands-on examination of these concepts. PREREQUISITE: Course taught at the level of intermediate algebra or appropriate math placement and CHEM G130 or achieve qualifying score on Chemistry Placement. Transfer Credit: CSU; UC. C-ID: CHEM 110, 120S. **C-ID:** CHEM 110, 120S.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Recall the composition of matter according to the atomic theory.
3. Interpret the properties of matter in terms of its composition according to the atomic theory.
4. Analyze the changes of matter in terms of its composition according to the atomic theory.
5. Demonstrate the use of typical laboratory equipment and the performance of standard laboratory techniques.
6. Interpret experimental results in terms of pertinent chemical theories.
7. Evaluate the uncertainty associated with experimental results.

Course Objectives

- 1. Express measurements and results to the correct number of significant figures and demonstrate the conversion of an amount in one unit to another unit.
- 2. Employ the rules for the systematic naming of chemical compounds.
- 3. Apply the laws of mass conservation, definite proportions, and multiple proportions; and deduce the atomic theory from these laws.
- 4. Demonstrate the balancing of chemical equations and calculate amounts of reactants and products using stoichiometric relations.
- 5. Predict the products of precipitation reactions, deduce the balanced chemical equation for the combination of an acid and a base, demonstrate the balancing of oxidation-reduction reactions, and combine these skills with stoichiometric relations.
- 6. Relate quantized energy levels to the wavelengths of light emitted and absorbed by atoms, memorize the rules governing quantum numbers, recall the shapes of atomic orbitals for specific angular momentum quantum numbers, and use the periodic table to determine the electron configurations of elements.
- 7. Memorize and apply the octet rule; use the periodic table to determine the electron configurations of monatomic ions; explain the observed periodic trends in the properties of elements using electron configurations, effective nuclear charge, and the octet rule; calculate lattice energies using Born-Haber cycles; and identify the importance of lattice energies in the formation of ionic compounds.
- 8. Estimate bond polarities using electronegativity trends, draw Lewis structures for compounds in accordance with the octet rule, calculate formal charges, assess the relative importance of resonance structures of the same molecule or ion, use the VSEPR model to produce three-dimensional drawings of molecules and ions.
- 9. Infer the polarities of molecules and ions, apply valence bond theory theory to explain the bonding in molecules, and use molecular orbital theory to describe the bonding in molecules.
- 10. Memorize and apply the first law of thermodynamics; use calorimetry experiment data, Hess's law, standard heats of formation, and average bond dissociation energies to determine enthalpy changes; and calculate the Gibb's free-energy change and use its value to predict reaction spontaneity.
- 11. Calculate the pressure, volume, temperature, and number of moles for gas samples using the gas laws; combine the gas laws with stoichiometric relations; relate the kinetic-molecular theory of gases to the gas laws; and identify the factors that distinguish real gases from ideal gases.
- 12. Identify the intermolecular forces, use the intermolecular forces to predict the physical properties of pure substances, create phase diagrams for pure substances, and use phase diagrams to determine the physical properties of pure substance.
- 13. Define solutions, calculate solution concentration, use the intermolecular forces to predict solubilities, and calculate colligative properties.

Lecture Content

Matter and Measurement Units of, and uncertainty in, measurements Dimensional analysis Temperature Density Classification of matter Atoms, Molecules, and Ions History of chemistry Modern view of atomic structure The periodic table Nomenclature Stoichiometry Balancing chemical equations The mole concept Computing compositions and formulas of compounds Conservation of mass and stoichiometric calculations Reactions in Aqueous Solution The nature of aqueous solutions Precipitation reactions Acid-base reactions Acid-base titrations Oxidation-reduction reactions Gases The gas laws Stoichiometry and the gas laws Dalton's law of partial pressures The kinetic-molecular theory of gases Effusion and diffusion Real gases Thermochemistry The nature of energy Enthalpy Calorimetry Hess' law Standard heats of formation Average bond dissociation energies An introduction to entropy and free-energy Atomic Structure Electromagnetic radiation The nature of matter The Bohr model of the atom The quantum mechanical model of the atom Electron configurations, condensed electron configurations, and orbital filling diagrams Trends in the Periodic Table Electron configurations of ions Trends in atomic radii Trends in ionic radii Trends in ionization energy Trends in electron affinity The octet rule Ionic Bonding Ionic bonds Lattice energies Born -Haber cycles Covalent Bonding A comparison of ionic and covalent bonds Electronegativity and bond polarity Lewis structures Resonance Molecular shape (VSEPR model) Description of Covalent Bonds Valence bond theory Hybridization of atomic orbitals Molecular orbitals Delocalized electrons Properties of Solids and Liquids Intermolecular forces The liquid state of matter Types of crystalline solids Metallic Ionic Molecular Covalent network Phase diagrams Phase changes Properties of Solutions Defining solution composition Factors affecting solubility Colligative properties

Lab Content

Techniques will be required to: Separate suspensions using gravity filtration, suction filtration, and centrifugation followed by decantation. Qualitative separation of a solution by paper chromatography and thin-layer chromatography. Measurements will be taken to: Obtain the masses of objects on pan balances to varying degrees of resolution. Measure the volumes of liquids, quantitatively, using burets and graduated cylinders. Determine the melting points of solids using thermometers to a resolution of 0.1 oC. Determine the densities of solids and liquids. Statistical analysis of data will be used to measure: Rejection quotient, Q, for a data set. Absolute and relative deviations. Absolute standard and relative standard deviations. Volumetric titrations will be required to quantitatively determine the composition of samples. Descriptive chemistry experiments will be required to decide whether reactions occur by observing color changes, formation of a gas or a precipitate, or the evolution of heat. Graphing and the use of linear regression will be required on the computer for data compiled in several laboratories, including pressure-volume data, equilibrium vapor pressure versus temperature measurements, and dissolved oxygen versus temperature data. Gas laws will be experimentally tested. These include Boyle s Law and Amonton s Law. Calorimetry will be used for one or more of the following: Measure the specific heat of an unknown metal. Calculate the heat of solution for an unknown solid. Test the validity of Hess s Law. Measure the heat of solution of a metal oxide of unknown identity. Atomic spectra will be observed and wavelengths measured using spectros copes. Spectra will be related to atomic theory and used for analysis of a substance of unknown identity. A quantitative analysis will be performed to obtain the percent sulfate in a sulfate containing sample of unknown identity. Molecular models will be constructed to enable students to determine the three-dimensional geometry, connectivity, and molecular polarity of molecules. In a separate experiment, students will build crystal structures for metallic and ionic compounds and then observe coordination numbers so they can be compared to radial parameters.

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- DE Online Lecture (02X)
- Lab (04)
- DE Live Online Lab (04S)
- DE Online Lab (04X)

Reading Assignments

Daily reading of text material to supplement lecture presentations. Twice weekly reading of laboratory manual as preparation for laboratory experiments. Periodic reading of supplemental materials to reinforce key concepts.

Writing Assignments

Writing definitions, explaining concepts, and describing the proper use of laboratory equipment.

Out-of-class Assignments

Homework assignments to reinforce key concepts and develop problem solving techniques. Twice weekly completion of prelaboratory and postlaboratory assignments.

Demonstration of Critical Thinking

Combining the application of several chemistry concepts to the solution of a problem. Drawing conclusions about the properties and transformations of matter from experimental observations.

Required Writing, Problem Solving, Skills Demonstration

Writing definitions of chemistry terms, explaining chemistry concepts, and solving numerical chemistry problems. Demonstrating the ability to properly use chemistry laboratory equipment, safe practices in the chemistry laboratory, and proper analysis of data from chemistry experiments.

Eligible Disciplines

Chemistry: Master's degree in chemistry OR bachelor's degree in chemistry or biochemistry AND master's degree in biochemistry, chemical engineering, chemical physics, physics, molecular biology, or geochemistry OR the equivalent. Master's degree required.

Textbooks Resources

1. Required Robinson, J., McMurry, J., Fay, R. Chemistry, 8th ed. Prentice Hall, 2020 2. Required Almy, J., Grimes, C., and Souto, M. Golden West College Laboratory Manual, 7th ed. Golden West College, 2021 Rationale: -