CHEM R120: GENERAL CHEMISTRY I

Originator
atoypalmer

College
Oxnard College

Discipline (CB01A)
CHEM - Chemistry

Course Number (CB01B)
R120

Course Title (CB02)
General Chemistry I

Banner/Short Title
General Chemistry I

Credit Type
Credit

Start Term
Fall 2021

Catalog Course Description
This course introduces fundamental principles and theories of chemistry with special emphasis on calculations of solution chemistry, stoichiometry, chemical equilibrium and oxidation-reduction; includes discussion of quantum mechanical model of the atom, kinetic-molecular theory, and periodic table. The lab is designed to develop quantitative relationships through experiments, and to introduce inorganic preparative procedures and computer analysis of data. C-ID: CHEM 110.

Taxonomy of Programs (TOP) Code (CB03)
1905.00 - Chemistry, General

Course Credit Status (CB04)
D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)
A (Transferable to both UC and CSU)

Course Basic Skills Status (CB08)
N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)
E - Non-Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
Y - Not Applicable (Funding Not Used)

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
May be required

Grading method
Letter Graded

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture
Minimum Contact/In-Class Lecture Hours
52.5
Maximum Contact/In-Class Lecture Hours
52.5

Activity

Laboratory
Minimum Contact/In-Class Laboratory Hours
105
Maximum Contact/In-Class Laboratory Hours
105

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
157.5
Total Maximum Contact/In-Class Hours
157.5

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
105
Maximum Outside-of-Class Hours
105

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
262.5
Total Maximum Student Learning Hours
262.5

Minimum Units (CB07)
5
Maximum Units (CB06)
5

Prerequisites
CHEM R110 and MATH R005 or MATH R015

Entrance Skills

Entrance Skills

Describe and quantitate properties of matter from subatomic particles to compounds, name and provide chemical formulas for elements and compounds, and perform calculations and conversions between metric measurements and chemical equations

Prerequisite Course Objectives

CHEM R110-Analyze the fundamental features of chemistry including measurement, mathematical conversion of measured physical properties such as mass, volume, density, pressure, temperature, solutions, concentrations, and dilutions.
CHEM R110-Perform conversions using the technique of dimensional analysis and memorized metric conversion factors.
CHEM R110-Give the names and symbols of the common elements.
CHEM R110-Name or give the formulas of simple inorganic compounds.
CHEM R110-Identify and give general physical properties of the three states of matter. Describe phase-change between the three states.
CHEM R110-Differentiate clearly between chemical and physical changes, and among elements, compounds and mixtures.
CHEM R110-Write and evaluate chemical reactions and balance chemical equations.
CHEM R110-Perform stoichiometric calculations using the mole concept to determine weight percent composition, empirical formula, molecular formula, combining weight, theoretical yield, and limiting reactants.
CHEM R110-Describe atomic structure in terms of protons, neutrons, and electrons using the Bohr model.
CHEM R110-Relate electron configuration to the periodic table, and use the table to predict or explain variations in size, ionization energy, electronegativity, and metallic or non-metallic character.
CHEM R110-Describe covalent and ionic bonding in simple terms. Predict molecular shapes and polarities by VSEPR (Valence Shell Electron Pair Repulsion) Theory.
CHEM R110-Describe and explain the properties of gases in terms of KMT (Kinetic Molecular Theory). Calculate gas properties from the gas laws.
CHEM R110-Categorize the properties of solutions and describe the solution process on a molecular level.
CHEM R110-Give common concentration units and use them to perform calculations involving solutions.

Entrance Skills

Graph and interpret collected data, write and solve algebraic equations and rational expressions

Prerequisite Course Objectives

MATH R005-Simplify algebraic expressions
MATH R005-Solve linear equations.
MATH R005-Graph linear equations by plotting points and using intercepts.
MATH R005-Simplify rational expressions and solve rational equations.
MATH R005-Solve quadratic equations and their applications using multiple methods.
MATH R005-Graph and evaluate elementary functions.

Entrance Skills

Graph and interpret collected data, write and solve algebraic equations and rational expressions

Prerequisite Course Objectives

MATH R014-Graph linear functions and write using function notation.
MATH R014-Solve and graph (on a number line) absolute value equations and inequalities.
MATH R014-Simplify radical expressions including those with rational exponents.
MATH R014-Solve radical equations and applications.
MATH R014-Solve quadratic equations and related applications.
MATH R014-Solve exponential and logarithmic equations and related applications.

Entrance Skills

Graph and interpret collected data, write and solve algebraic equations and rational expressions

Prerequisite Course Objectives

MATH R015-Evaluate and simplify algebraic expressions.
MATH R015-Solve linear equations.
MATH R015-Simplify expressions with positive and negative exponents.
MATH R015-Solve quadratic equations by factoring, the square root method, and the quadratic formula.
MATH R015-Add, subtract, multiply, divide and simplify rational expressions.
MATH R015-Solve rational equations.
MATH R015-Graph linear functions and write using function notation.
MATH R015-Simplify radical expressions including those with rational exponents.
MATH R015-Solve radical equations and applications.
MATH R015-Solve elementary exponential and logarithmic equations.

Entrance Skills

Graph and interpret collected data, write and solve algebraic equations and rational expressions

Prerequisite Course Objectives

MATH R033-Solve problems that can be modeled by exponential and logarithmic equations.
MATH R033-Apply basic formulas for basic sequences and series

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Requisite Justification

Requisite Type

Prerequisite

Requisite

CHEM R110

Requisite Description

Course in a sequence

Level of Scrutiny/Justification

Closely related lecture/laboratory course

Requisite Type

Prerequisite

Requisite
MATH R005

Requisite Description
Course not in a sequence

Level of Scrutiny/Justification
Required communication/computation skill

Requisite Type
Prerequisite

Requisite
MATH R015

Requisite Description
Course not in a sequence

Level of Scrutiny/Justification
Required communication/computation skill

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	Use the ideal gas equation to calculate volume, pressure, temperature, or quantity of a gas when data are given or collected.
2	Perform thermodynamic calculations involving calorimetry, Hess's Law, and heat information. Students will become proficient at using the table of thermodynamic values, specifically heats of formation.
3	Describe covalent and ionic bonding in terms of Lewis Dot Structure, Valence Bond Hybridization, and VSEPR (Valence Shell Electron Pair Repulsion) Theory. Relate chemical and physical properties to bonding and structure.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	Perform conversions in the metric system using memorized conversions and the technique of dimensional analysis.
2	Write the names and symbols of common elements. Name or give the formulas of simple inorganic compounds.
3	Write and balance chemical equations including net-ionic equations.
4	Perform stoichiometric calculations based on chemical formulas and balanced chemical equations.
5	Describe the structure of the atom according to Rutherford's Experiment and Bohr's Theory. Give the modern wave mechanical view of the atom in terms of electronic orbitals.
6	Relate periodic properties to electronic configurations of the elements.
7	Give the four quantum numbers of an electron in a particular atomic orbital, and their role in describing the location and energy of the electron.
8	Describe covalent and ionic bonding in terms of Lewis Dot Theory, Valance Bond Hybridization, and VSER (Valence Shell Electron Pair Repulsion). Relate chemical and physical properties to bonding and structure.
9	Identify acids, bases, and salts. Describe solutions of strong, weak, and non-electrolytes. Predict and balance ionic reactions involving precipitation, displacement, and neutralization.
10	Perform thermodynamics calculations involving calorimetry, Hess's Law, and heat of formation.
11	Describe gases, liquids, and solids and perform calculations involving these three phases. Relate properties of each to Kinetic Molecular Theory and intermolecular forces.
12	Discuss solutions and factors governing solubility. Perform calculations involving concentration units, especially dilution and neutralization.
13	Use the concept of equilibrium and equilibrium constant to describe and perform calculations on equilibrium systems, especially in the gas phase. Apply Le Chatelier's Principle to predict response of equilibrium system to perturbations in concentration, temperature, and pressure.

Course Content

Lecture/Course Content

1. Basic
   a. Math review—dimensional analysis, significant figures, and scientific notation
   b. Chemistry review—composition of the atom, atomic symbols, chemistry formulas, nomenclature, chemical reactions
2. Mole Concept
   a. Conversions among number of atoms/molecules, mass and numbers of moles
3. Stoichiometry
   a. Weight percent, formula weight, empirical and molecular formulas
   b. Combining weights, yield, percent yield, limiting reactants
4. Solutions
   a. Concentrations, dilution/titration calculations, electrolytes, nonelectrolytes, acids, bases, salts
   b. Reaction types, net ionic equations, stoichiometry with solutions
5. Thermochemistry
   a. First Law, system/surrounding, heat/work, units, calorimetry
   b. Enthalpy, Hess's Law, heat of formation
6. Atomic Theory
   a. Historic background, Bohr atom and atomic spectroscopy
   b. Quantum mechanical atom, quantum numbers, orbitals, energy levels, electron configuration
   c. Correlation of electron configuration with molecular properties
7. Bonding
   a. Lewis dots, octet rule, ionic and covalent bonding, resonance, electronegativity and polarity
   b. VSEPR (Valence Shell Electron Pair Repulsion) Theory, molecular geometry, molecular polarity
8. Gases
   a. Ideal gas laws, Boyle's, Charles's, Avogadro's, Combined Laws, gas mixtures, stoichiometry of gases, partial pressures
   b. KMT (Kinetic Molecular Theory)
9. Liquids and Solids
   a. Inter-particle forces, phase changes, colligative properties, structure of liquids and solids
10. Equilibrium
    a. Gas phase equilibria, equilibrium constants and concentrations, heterogeneous equilibria, Le Chatelier's Principle
    b. Ionization of water, pH concept, pH of strong acids and bases

Laboratory or Activity Content

1. Graphing and Exponential Notation
   a. Written exercises in graphing various relationships
   b. Written exercises in determining significant figures in mathematical operations
   c. Written exercises in use of exponential notation
2. Nomenclature and Formula Writing
   a. Writing chemical formulas from chemical names and chemical names from chemical formulas
   b. Reaction types defined and reactions written and balanced
3. Determination of an Empirical formula
   a. Experimental determination of the formula for a chloride of manganese
   b. Use of evaporating dish and burner to dissolve Mn sample in HCI
   c. Dried product is weighed and formula calculated from initial and final masses
   d. Use of desiccator is learned
4. Stoichiometry and Limiting Reactants
   a. Written exercises in use of balanced equations to calculate quantities products formed from given quantities of reactants
5. Writing Net Ionic Equations
   a. Written exercises in predicting whether a reaction takes place from the mixing of given reactants
   b. Writing balanced total molecular, total ionic and net ionic equations when a reaction takes place
6. Formulation of the Activity Series
   a. Reactions observed between metals and acids, and metals and metal salt solution
   b. Activity series developed on the basis of observations in #1 above
   c. Net ionic equations written to describe chemical reactions
7. Study of Thermochemistry
   a. Heat of neutralization determined by measuring the temperature change during the reaction of an acid solution with a base solution
   b. Heat of solution determined by measuring the temperature change during the dissolving of a base in water

   c. Heat of neutralization determined by measuring the temperature change during the reaction of an acid solution with a solid base
   d. Heats of reaction determined using computer interface and temperature probe
   e. Hess's Law is verified by manipulation heats of reactions determined in #1, 2, and 3 above
8. Analysis of the Hydrogen Spectrum
   a. Three lines of the Balmer Series of the hydrogen spectrum are measured using a spectroscope
   b. Angles are converted to wavelengths of light, then to corresponding energy
   c. Rydberg equation is used to convert energy of transition of electron to the corresponding initial principle energy level and final principle energy level
9. Chemicals in Everyday Life are Examined
   a. Specific tests are learned used to identify cations and anions found in chemicals used daily
   b. Tests learned are used to identify cations and anions in unknown salts
10. Quantitative Analysis of a Mixture
   a. Mixture of two compounds is analyzed by decomposing one of the compounds using a burner and a crucible
   b. Stoichiometric calculation is done to determine percent of the compound in the mixture
11. Use of Molecular Models to Predict Molecular Shape and Polarity
   a. Lewis dot structures are drawn in a written exercise in order to build models
   b. Molecular models are used to show geometric shape of molecules and bond angles
   c. Molecular polarity is predicted using electronegativities and vector forces
12. Determination of the Molar Mass of a volatile Liquid
   a. Sample of volatile liquid is vaporized using a flask and boiling water
   b. Volume, temperature, and pressure of the gas is measured
   c. Molar mass of the gas is calculated using the ideal gas equation
13. Gas Stoichiometry Examined
   a. Magnesium sample is reacted with hydrochloric acid
   b. Hydrogen gas generated is collected over water in a gas collection tube
   c. Ideal gas equation is used to calculate moles ofhydrogen
   d. Stoichiometry of the balanced equation used to calculate mass of Mg in sample
14. Volumetric Analysis using Acid-Base Titration
   a. Base solution is standardized against a standard acid using buret, flasks and indicator
   b. Unknown acid solution is titrated using the standard base, buret and volumetric pipet
   c. Normalities of base solution and unknown acid solutions are calculated
15. Study of Colligative Properties
   a. Cooling curve for a solvent is graphed from a temperature and time data
   b. Cooling curve for a solution of an unknown substance dissolved in the solvent is graphed using temperature and time data
   c. Freezing point depression relationship is used to calculate the molarity of the unknown
   d. Molarity of the unknown is used to calculate the molar mass of the unknown
16. Study of Le Chatelier's Principle
   a. Several reactions examined that illustrate the shifting of the position of equilibrium when stresses are placed on a reaction at equilibrium
   b. Direction of shift is determined based on the given stress on the equilibrium
17. Use of Indicators to Determine pH
   a. Buffers of pH values 1 - 12 are used to prepare color standards with several indicators
   b. Standards are used to determine the pH of solutions of unknown pH

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Problem solving exercises
Written expression

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Computational homework
Essay exams
Essays
Laboratory activities
Laboratory reports
Objective exams
Oral presentations
Projects

Problem-Solving Assignments
Problem-solving exams
Quizzes
Reports/papers

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Audio-visual presentations
Computer-aided presentations
Collaborative group work
Class activities
Class discussions
Distance Education
Demonstrations
Field trips
Group discussions
Internet research
Laboratory activities
Lecture

Describe specific examples of the methods the instructor will use:

1. The instructor will use audio-visual instruction including powerpoint presentations, videos and chalkboard/white board lectures.
2. The instructor will incorporate group discussions and other class activities that allow students to participate in active learning. The instructor will be available for questions and clarification of chemistry concepts during these activities.
3. The instructor will identify laboratory activities and demonstrations that teach laboratory technique and apply concepts from the lectures. Experiments are typically in-person activities. However, use of audio-visual techniques and computer-aided simulations and presentations will also illustrate and underscore the important concepts from lecture.
4. The instructor will lecture on the topic of thermodynamics, Hess's Law and calorimetry. The instructor will assign laboratory activities in calorimetry that involve measuring the heat exchanged when HCl and NaOH (solution and solid) are reacted and when NaOH (solid) is dissolved in water. Subsequent calculations and analysis allow the instructor to show the applicability of Hess's Law.

Representative Course Assignments

Writing Assignments

1. Students answer the questions at the end of each chapter related with the electron configuration to the periodic table, and explain the metallic and non-metallic characters based on valence electrons, stoichiometry, thermochemistry, equilibrium constant calculation.
2. Students write essays to describe the properties of acid, base, and neutral solutions.
3. Students enter the data collected in the lab period, and give the explanation of the activities of metals. Students are required to write a formal lab report related to Hess's Law.

Critical Thinking Assignments

1. In the experiments involving calorimetry, students are asked to compare the results of their work to the theoretical results using standardized tables and Hess's Law. They must then calculate the percent error and evaluate what are the possible factors that contribute to this error.
2. Students are asked to evaluate and describe the structure of a molecular compound. From their understanding of the properties of bonds, the students can then predict the properties of the compound.

Reading Assignments

1. Textbook and Lab Manual
2. Professional Journals, such as Journal of Chemical and Engineering News, published by America Chemical Society.
3. Internet, such as www.acs.org (http://www.acs.org), www.chemweb.com (http://www.chemweb.com), http://ocw.mit.edu/OcwWeb/Chemistry/, www.anytimetutor.com (http://www.anytimetutor.com)

Skills Demonstrations

1. Students will demonstrate the ability to collect calorimetry data using a calorimeter then show ability to graph and process the subsequent data.
2. Students will be able to standardize NaOH solutions with solid oxalic acid dihydrate, then use the standard base solution to titrate an acid of unknown concentration.

Other assignments (if applicable)

1. Encourage students to form a studying group and work together to understand the chemical equilibrium.
2. Help students individually in instructor's office to help on homework related to chemical properties.

Outside Assignments

Representative Outside Assignments

1. Students answer the questions at the end of each chapter related with the electron configuration to the periodic table, and explain the metallic and non-metallic characters based on valence electrons, stoichiometry, thermochemistry, equilibrium constant calculation.
2. Students will also have additional assignments to textbook questions that are more challenging and require greater depth in thought and understanding.
3. Students are required to read the textbook and other outside reference materials in order to write a formal lab report related to Hess's Law and calorimetry.
4. Students are encouraged to form a studying group and work together to understand the chemical equilibrium.
5. Students will read a minimum of 50 pages each week from their textbook, lab manual and outside reference scientific journals before completing homework assignments.
6. Students will write experimental procedures before each lab, including theory from their reading material along with outlining materials and procedures.

Articulation

C-ID Descriptor Number
CHEM 110

Status
Approved

Comparable Courses within the VCCCD
CHEM M01A - General Chemistry I

District General Education

A. Natural Sciences

A2. Physical Science
Approved

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

B1 Physical Science
Approved

B3 Laboratory Activity
Approved

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

UC TCA

UC TCA
Approved

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 5A: Physical Science
Approved

Area 5C: Laboratory Science
Approved

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type
Textbook

Description
Tro, Nivaldo (2020). Chemistry: A Molecular Approach, 5th edition
Copyright by Pearson Education, Inc.
Published by Prentice Hall
Upper Saddle River, New Jersey

Resource Type
Manual

Description
L Crockett (2015). *Chem R120 Laboratory Manual* (Revised).
Oxnard College, Oxnard

Resource Type
Other Instructional Materials

Description
Scientific calculator.

Resource Type
Other Instructional Materials

Description
Duplicate Notebook.

Resource Type
Other Instructional Materials

Description
Safety goggles.

Distance Education Addendum

Definitions

Distance Education Modalities
Hybrid (51%–99% online)
Hybrid (1%–50% online)
100% online

Faculty Certifications

Faculty assigned to teach Hybrid or Fully Online sections of this course will receive training in how to satisfy the Federal and state regulations governing regular effective/substantive contact for distance education. The training will include common elements in the district-supported learning management system (LMS), online teaching methods, regular effective/substantive contact, and best practices.
Yes

Faculty assigned to teach Hybrid or Fully Online sections of this course will meet with the EAC Alternate Media Specialist to ensure that the course content meets the required Federal and state accessibility standards for access by students with disabilities. Common areas for discussion include accessibility of PDF files, images, captioning of videos, Power Point presentations, math and scientific notation, and ensuring the use of style mark-up in Word documents.
Yes

Regular Effective/Substantive Contact

Hybrid (1%–50% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Synchronous Dialog (e.g., online chat)	Instructors may choose to provide online chat room conference times.
Asynchronous Dialog (e.g., discussion board)	Regular discussions between students via discussion boards or other collaborative tools, such as Google Docs and CANVAS.
Other DE (e.g., recorded lectures)	Instructors may choose to record video lectures and presentations. They may also use preexisting video or other digital material.
Video Conferencing	Instructors may choose to provide online video conference times.

Hybrid (51%–99% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Synchronous Dialog (e.g., online chat)	Instructors may choose to provide online chat room conference times.
Asynchronous Dialog (e.g., discussion board)	Regular discussions between students via discussion boards or other collaborative tools, such as Google Docs and CANVAS.
Other DE (e.g., recorded lectures)	Instructors may choose to record video lectures and presentations. They may also use preexisting video or other digital material.
Video Conferencing	Instructors may choose to provide online video conference times.

100% online Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Synchronous Dialog (e.g., online chat)	Instructors may choose to provide online chat room conference times.
Asynchronous Dialog (e.g., discussion board)	Regular discussions between students via discussion boards or other collaborative tools, such as Google Docs and CANVAS.
Other DE (e.g., recorded lectures)	Instructors may choose to record video lectures and presentations. They may also use preexisting video or other digital material.
Video Conferencing	Instructors may choose to provide online video conference times.

Examinations

Hybrid (1%–50% online) Modality
Online
On campus

Hybrid (51%–99% online) Modality
Online
On campus

Primary Minimum Qualification
CHEMISTRY

Review and Approval Dates

Department Chair
09/02/2020

Dean
09/02/2020

Technical Review
09/09/2020

Curriculum Committee
09/09/2020

Curriculum Committee
11/25/2020

CCCCO
MM/DD/YYYY

Control Number
CCC000230504

DOE/accreditation approval date
MM/DD/YYYY