

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

CHEMISTRY 115 – FUNDAMENTALS OF CHEMISTRY

3 hours lecture, 3 hours laboratory, 4 units

Catalog Description

Elementary principles of inorganic and general chemistry with a brief introduction to organic and biochemistry. Previous chemistry background is not required. Recommended for students who need only a one-semester general chemistry course and for students entering paramedical and allied health fields. *Students will not receive credit toward graduation for more than one of the following courses: CHEM 115, 120.*

Prerequisite

Appropriate mathematics placement

Entrance Skills

Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:

- 1) Perform basic arithmetic operations: addition, subtraction, multiplication and division using positive and negative numbers.
- 2) Perform calculations involving fractions, decimals and exponents. Understand and express numbers in scientific (exponential) notation.
- 3) Understand and calculate percent. Convert percentages into decimal form and vice versa.
- 4) Calculate arithmetic average.
- 5) Use a scientific calculator to perform the types of calculations described above in items 1-4.
- 6) Solve linear algebraic equations; solve word problems involving linear equations.
- 7) Understand and determine the magnitudes of angles in units of degrees.
- 8) Recognize plane geometric figures such as triangles and squares; differentiate among the terms linear, planar and three-dimensional.
- 9) Perform calculations and solve equations involving ratio and proportion techniques.
- 10) Graphing of data in a rectangular coordinate system.
- 11) Understand and interpret graphs of linear functions.

Course Content

- 1) Atoms and Elements
- 2) Nuclear Radiation
- 3) Compounds and their Bonds
- 4) Measurements
- 5) Energy and States of Matter
- 6) Chemical Reactions
- 7) Chemical Calculations
- 8) Gases
- 9) Solutions
- 10) Acids and Bases

Course Objectives

Students will be able to:

- 1) Classify matter in a variety of ways including categorizing elements, metals, nonmetals, or as an ionic or covalent compound, among others.
- 2) Determine the number of each type of subatomic particle in an atom or monatomic ion and its isotopes using the periodic table.
- 3) Write the chemical formula, draw the electron dot structure, and predict and draw the geometry of a molecule or polyatomic ion using the periodic table.
- 4) For a given substance, determine its polarity and intermolecular forces and predicts its relative solubility and boiling point using the concept of electronegativity.
- 5) Determine the melting and boiling point of a substance from its heating or cooling curve.
- 6) Predict the products and write balanced chemical equations for ordinary chemical processes and reactions and nuclear reactions.
- 7) Predict the effect of concentration, temperature or catalysts on the rate or equilibrium position of a chemical reaction.
- 8) For a chemical reaction, calculate stoichiometric amounts using the mole concept and the technique of dimensional analysis.
- 9) Solve quantitative problems involving at least two variables using the gas laws.
- 10) Calculate concentrations of solutions in a variety of concentration units.
- 11) Predict the acid-base properties of substances and buffering properties of mixtures of substances.
- 12) Perform a variety of tasks in the laboratory, such as making and recording qualitative observations, measure quantitative properties of substances undergoing physical or chemical changes, analyze and evaluate these observations applying theoretical principles studied.

Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

- 1) Exams consisting of the following question types—definitions, short essay, qualitative problems, quantitative problems—that measure students' ability to explain and apply the basic chemical concepts.
- 2) Laboratory activities that evaluate students' ability to observe the properties of a wide range of chemical substances, to apply competent observational skills, and to demonstrate proper collection and recording of data.
- 3) Written laboratory reports that measure students' ability to interpret and analyze both qualitative and quantitative data.

Special Materials Required of Student

Scientific calculator, laboratory notebook, safety glasses

Minimum Instructional Facilities

- 1) Smart classroom with generous writing board space, wall-size periodic table, demonstration table with sink and gas tap
- 2) Standard laboratory facility

Method of Instruction

- 1) Lectures are designed to explain basic concepts. Ideas are introduced by presentation of data or generation of data through lecture demonstration. Analysis and explanations of data elicited from students by frequent and persistent questions. Applications to the real world are incorporated as much as possible.
- 2) Laboratories correlated with lectures are designed to allow students to make observations of chemical phenomena. Students work in pairs for most experiments. Lab reports and class

discussion require students to explain their laboratory observations employing the concepts discussed in lectures.

- 3) Textbook and supplementary materials are required reading and are essential to successful solution of homework problems, performance of laboratory experiments, and performance on quizzes and exams.
- 4) Students are strongly encouraged to form study groups as well as seek help through peer tutoring and instructor office hours.

Out-of-Class Assignments

- 1) Reading and homework problems, as assigned
- 2) Formal lab reports
- 3) Specialized project involving selected topics in chemistry, as required; this project may require the use of research on the internet, at the library, or other resources

Texts and References

- 1) Required (representative examples):
 - a. Timberlake, Karen. *General, Organic and Biological Chemistry*. 6th edition. Pearson, 2019.
 - b. LeBlanc & Villarreal, *Chemistry 115 Lab Manual*. AcademicPub, 2014.
- 2) Supplemental: None

Exit Skills

Students having successfully completed this course exit with the following skills, competencies and/or knowledge:

- 1) Classify a substance as a type of element, metal or nonmetal, or as a type of compound, ionic or covalent, using the Periodic Table.
- 2) Determine the number of each type of subatomic particle in an atom or monatomic ion and its isotopes using the Periodic Table.
- 3) Write the chemical formula, draw the electron dot structure, and predict and draw the geometry of a molecule or polyatomic ion using the Periodic Table.
- 4) For a given substance, determine its polarity and intermolecular forces and predicts its relative solubility and boiling point using the concept of electronegativity.
- 5) Determine the melting and boiling point of a substance from its heating or cooling curve.
- 6) Predict the products and write balanced chemical equations for ordinary chemical processes and reactions including the following specific types: combination, decomposition, single replacement, double replacement, combustion, oxidation-reduction, and acid-base.
- 7) Predict the products and write balanced chemical equations for nuclear reactions.
- 8) Predict the effect of concentration, temperature, or catalysts on the rate of a chemical reaction.
- 9) Predict the effect of concentration, temperature, or catalysts on the equilibrium position of a chemical reaction using Le Chatelier's principle.
- 10) For a chemical reaction, calculate stoichiometric amounts using the mole concept and using the technique of dimensional analysis.
- 11) Use the mole concept to calculate the empirical formula of a substance from its percent composition.
- 12) Determine the proper number of significant figures in a calculated number.
- 13) Solve quantitative problems involving at least two variables using the gas laws.
- 14) Calculate concentrations of solutions in a variety of concentration units.
- 15) Predict the acid-base properties of substances.
- 16) Write a chemical equation for the dissociation of an acid or base.
- 17) Identify the acid, base, conjugate acid, and conjugate base in an acid-base reaction.
- 18) Predict the equilibrium position of an acid-base reaction.
- 19) Calculate the hydroxide ion concentration of a solution from its hydrogen ion concentration.
- 20) Calculate the pH of a solution from its hydrogen ion concentration.
- 21) Predict the acid-base properties of salts.
- 22) Identify combinations of substances that act as buffers.

- 23) In the laboratory, observe qualitative phenomena for substances undergoing physical or chemical changes.
- 24) In the laboratory, measure quantitative properties of substances undergoing physical or chemical changes.
- 25) Analyze and evaluate both qualitative and quantitative observations acquired in the laboratory applying the theoretical principles being studied.

Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- 1) Classify matter in a variety of ways.
- 2) Apply knowledge of the periodic table and theories of atomic structure in a variety of ways, including determination of the number of and placement of subatomic particles in an atom and writing electron configurations, among others.
- 3) Apply knowledge of bonding theory to draw Lewis dot structures and predict molecular geometry.
- 4) Classify bonds in substances according to their polarities and use these classifications to predict the presences of intermolecular forces and various physical properties, including relative boiling points and melting points, among others.
- 5) Using a heating or cooling curve, determine melting points and boiling points of pure substances.
- 6) Predict the products and write balanced equations for ordinary chemical reactions and nuclear reactions.
- 7) Predict the effect of concentration, temperature or catalysts on the rate or equilibrium position of a chemical reaction.
- 8) Determine the acid-base properties of substances and buffering properties of mixtures of substances.
- 9) Solve a wide variety of chemical calculations and unit conversions in a variety of topics, including chemical reactions (stoichiometry), drug dosages and clinical calculations involving solutions, acids and bases, and gases, among others.
- 10) Perform a variety of experimental techniques in a laboratory setting.