CHEM 110 – INTRODUCTORY CHEMISTRY | 4 CREDITS (3+2P)

SYLLABUS

CATALOG DESCRIPTION

An introductory survey of basic chemistry including scientific and dimensional analysis, states of matter, atomic and molecular structure, reaction dynamics, acid-base systems and electrochemistry. Fulfills lab science requirement for non-science majors, and as an introductory course for students with no prior chemistry.

Prerequisites: Completion of MATH-096 or appropriate Accuplacer Math Score

Semester Offered: Fall, Spring and Summer

Common Student Learning Outcomes

Upon successful completion of San Juan College programs and degrees, the student will demonstrate competency in…

BROAD AND SPECIALIZED LEARNING

Students will actively and independently acquire, apply, and adapt skills and knowledge with an awareness of global contexts.

CRITICAL THINKING

Students will think analytically and creatively to explore ideas, make connections, draw conclusions and solve problems.

CULTURAL AND CIVIC ENGAGEMENT

Students will act purposefully, reflectively, and ethically in diverse and complex environments.

EFFECTIVE COMMUNICATION

Students will exchange ideas and information with clarity in multiple contexts.

INFORMATION LITERACY

Students will be able to recognize when information is needed and have the ability to locate, evaluate, and use it effectively.

INTEGRATING TECHNOLOGIES

Students will demonstrate fluency in the application and use of technologies in multiple contexts.

Student work from this class may be randomly selected and used anonymously for assessment of course, program, and/or institutional learning outcomes. For more information, please refer to the Dean of the appropriate School.

Course Learning Outcomes

Upon successful completion of the course, the student will be able to…

1. Physical measurements
2. Dimensional analysis
3. Atomic structure
4. Atomic Properties
5. Chemical bonding
6. Molecular geometry
7. Chemical nomenclature
8. Stoichiometry

9. Gases, liquids, and solids
10. Solutions
11. Reaction rates and chemical equilibrium
12. Acids and bases
13. Electrochemistry

Specific Learning Outcomes

Upon successful completion of the course, the student will be able to…

1.1 Safely and effectively manipulate solid, liquid, and gaseous chemical samples.
1.2 Obtain valid data from analog and digital instrumentation.
1.3 Explain precision and accuracy and how these are determined.
1.4 Express experimental data in valid precision using the correct number of significant digits in scientific and engineering notations with appropriate units.
1.5 Express experimental results to the correct number of significant digits in scientific and engineering notations with appropriate units.
1.6 Calculate average and average deviation from experimental data.

2.1 Convert between units using dimensional analysis
2.2 Determine meaningful quantities from given parameters without the use of a specific formula using dimensional analysis.

3.1 Predict the trajectories of charged particles in an electric field.
3.2 Describe Rutherford's gold foil experiments and how this supports the current model of the atom.
3.3 Know the charges and approximate masses of protons, neutrons, electrons, and photons.
3.4 Describe the planetary (Bohr) model of the atom consisting of protons, neutrons, and electrons.
3.5 Determine the number of protons, neutrons, and electrons from the ${}^{A}_{Z}X$ isotopic notation.
3.6 Relate energy, wavelength, and frequency of electromagnetic radiation.
3.7 Describe how transitions between quantized energy levels in an atom give rise to absorption/emission line spectra.
3.8 Describe the shape and meaning of s, p, and d orbitals.
3.9 Determine the electron configuration of elements.

4.1 Describe the approximate sizes trends of elements, and ions within the periodic table.
4.2 Describe ionization energy trends within the periodic table.
4.3 Show where the s, p, and d blocks are on the periodic table.
4.4 Relate periodic trends to quantum mechanical shell theory.
4.5 Distinguish between metals, metalloids, and nonmetals and locate these on the periodic table.

5.1 Describe ionic bonding and which groups of elements can form ionic compounds.
5.2 Describe covalent bonding and which types of elements can form molecules.
5.3 Determine the direction of the dipole arrow in a given bond and overall polarity in a molecule.
5.4 Describe a metallic bond.

6.1 Draw Lewis dot resonance structures.
6.2 Use VSEPR theory to determine three dimensional electronic and molecular geometry.

7.1 Give the names and charges of common cations, anions, and polyatomic ions.
7.2 Name common ionic compounds from a given chemical formula and vice versa.
7.3 Name common binary compounds of nonmetals from a given chemical formula and vice versa.
7.4 Name common acids from a given chemical formula and vice versa.

8.1 Calculate formula weights (formula masses) and molecular weights (molar masses).
8.2 Perform mass to mole and mole to mass calculations.
8.3 Perform moles to particle calculations.
8.4 Calculate moles from molarity and molarity from moles/volume data. 8.5
Write and balance molecular, ionic, and net ionic chemical equations.
8.6 Calculate theoretical yields (from limiting reactant) and percentage yields for reactions.

9.1 Explain gas behavior in context of the ideal gas law.
9.2 Use Dalton's law of partial pressure to find the pressure of a gas collected over water.
9.3 Use the ideal gas law in stoichiometric calculations.
9.4 Describe how intermolecular forces affect the melting and boiling points of elements and compounds.
9.5 List and explain the implications of the unique properties of water.
9.6 Calculate energy changes that occur during heating, cooling, and changes of state.
9.7 Classify solid compound types.

10.1 Describe dynamic solubility equilibria.
10.2 Predict what types of compounds will dissolve in given solvents.
10.3 Describe osmosis and dialysis and differences in the membranes required for each process.

11.1 Explain activation energy.
11.2 Discuss forward and reverse reaction rates at equilibrium.
11.3 Use Le Châtelier's Principle to predict shifts in equilibrium.
11.4 Describe and use equilibrium constant expressions to determine equilibrium concentrations.

12.1 Define acids and bases in terms of Bronsted-Lowry theory.
12.2 Calculate the pH of a solution using the hydronium ion or hydroxide ion concentration.
12.3 Use K_w and pH to determine hydronium ion and hydroxide ion concentrations in acidic, basic and neutral solutions.
12.4 Identify salts that give acidic, basic and neutral solutions upon hydrolysis.
12.5 Perform acid-base titrations and titration calculations.

13.1 Determine oxidation numbers for elements in polyatomic ions and compounds.
13.2 Identify elements being oxidized and reduced in oxidation reduction reactions.
13.3 Balance oxidation and reduction reactions using half reactions.
13.4 For a given electrolytic or voltaic cell, identify and diagram the anode, cathode, salt bridge, and reactions that occur at each.