Virginia Western Community College
CHM 111
General Chemistry I

Prerequisites

MTE 1, MTE 2, MTE 3, MTE 4, MTE 5, MTE 6, MTE 7, MTE 8 and MTE 9; and a placement recommendation for ENG 111, co-enrollment in ENF 3/ENG 111, or successful completion of all developmental English requirements. High school chemistry or CHM 5 recommended but not required. Part I of II

Course Description

Explores the fundamental laws, theories, and mathematical concepts of chemistry. Designed primarily for science and engineering majors. Requires a strong background in mathematics.

Semester Credits: 4 **Lecture Hours: 3** **Laboratory Hours: 3**

Required Materials

Textbook:
Principles of Chemistry – A Molecular Approach with Mastering Chemistry Access Code. Tro. 3rd edition. Pearson Publishing. ISBN: 9781323402641
General Chemistry I Lab Manual. Upshaw. 1st edition. VWCC. In-house manual available at bookstore.
Lab Notebook. Hayden. McNeil. ISBN: 9781930882744

Course Outcomes

At the completion of this course, the student should be able to:

- Make accurate observations and measurements, to collect and correlate data, and to draw conclusions based on the data.
- Approach problem solving in a logical and organized fashion, focusing on the importance of units and the mole concept.
- Show skill in the language of chemistry, the writing and interpretation of chemical formulas and equations both qualitatively and quantitatively.
- Understand the fundamental principles of matter and energy, such as the particulate nature of matter, the relationship between the properties of substances to the making and breaking of chemical bonds and the energy aspect of chemical reactions.
- Appreciate and understand the impact of chemistry on our lives, food, health, prosperity and environmental quality.

Topical Description

Chapter 1: Matter, Measurement, and Problem Solving

- 1.1 Atoms and Molecules
- 1.2 The Scientific Approach to Knowledge
- 1.3 The Classification of Matter
- 1.4 Physical and Chemical Changes and Physical and Chemical Properties

- 1.5 Energy: A Fundamental Part of Physical and Chemical Changes
- 1.6 The Units of Measurement
- 1.7 The Reliability of a Measurement
- 1.8 Solving Chemical Problems

Chapter 2: Atoms and Elements

- 2.1 Imaging and Moving Individual Atoms
- 2.2 Modern Atomic Theory and the Laws That Led to It
- 2.3 The Discovery of the Electron
- 2.4 The Structure of the Atom
- 2.5 Subatomic Particle: Protons, Neutrons, and Electrons in Atoms
- 2.6 Finding Patterns: The Periodic Law and the Periodic Table
- 2.7 Atomic Mass: The Average Mass of an Element's Atoms
- 2.8 Molar Mass: Counting Atoms by Weighing Them

Chapter 3: Molecules, Compounds, and Chemical Equations

- 3.1 Hydrogen, Oxygen, and Water
- 3.2 Chemical Bonds
- 3.3 Representing Compounds: Chemical Formulas and Molecular Models
- 3.4 An Atomic-Level View of Elements and Compounds
- 3.5 Ionic Compounds: Formulas and Names
- 3.6 Molecular Compounds: Formulas and Names
- 3.7 Formula Mass and the Mole Concept for Compounds
- 3.8 Composition of Compounds
- 3.9 Determining a Chemical Formula from Experimental Data
- 3.10 Writing and Balancing Chemical Equations
- 3.11 Organic Compounds

Chapter 4: Chemical Quantities and Aqueous Reactions

- 4.1 Climate Change and the Combustion of Fossil Fuels
- 3.2 Reaction Stoichiometry: How Much Carbon Dioxide?
- 4.3 Limiting Reactant, Theoretical Yield, and Percent Yield
- 4.4. Solution Concentration and Solution Stoichiometry
- 4.5 Types of Aqueous Solutions and Solubility
- 4.6 Precipitation Reactions
- 4.7 Representing Aqueous Reactions: Molecular, Ionic, and Complete Ionic Equations
- 4.8 Acid-Base and Gas-Evolution Reactions
- 4.9 Oxidation-Reduction Reactions

Chapter 5: Gases

- 5.1 Breathing: Putting Pressure to Work
- 5.2 Pressure: The Result of Molecular Collisions
- 5.3 The Simple Gas Laws: Boyle's Law, Charles's Law, and Avogadro's Law
- 5.4 The Ideal Gas Law
- 5.5 Applications of the Ideal Gas Law: Molar Volume, Density, and Molar Mass of a Gas
- 5.6 Mixtures of Gases and Partial Pressures

- 5.7 Gases in Chemical Reactions: Stoichiometry Revisited
- 5.8 Kinetic Molecular Theory: A Model for Gases
- 5.9 Mean Free Path, Diffusion, and Effusion of Gases
- 5.10 Real Gases: The Effects of Size and Intermolecular Forces

Chapter 6: Thermochemistry

- 6.1 Chemical Hand Warmers
- 6.2 The Nature of Energy: Key Definitions
- 6.3 The First Law of Thermodynamics: There is No Free Lunch
- 6.4 Quantifying Heat and Work
- 6.5 Measuring ΔE for Chemical Reactions: Constant-Volume Calorimetry
- 6.6 Enthalpy: The Heat Evolved in a Chemical Reaction at Constant Pressure
- 6.7 Constant-Pressure Calorimetry: Measuring ΔH_{rxn}
- 6.8 Hess's Law and Other Relationships Involving ΔH_{rxn}
- 6.9 Enthalpies of Reaction from Standard Heats of Formation

Chapter 7: The Quantum-Mechanical Model of the Atom

- 7.1 Schrödinger's Cat
- 7.2 The Nature of Light
- 7.3 Atomic Spectroscopy and the Bohr Model
- 7.4 The Wave Nature of Matter: the de Broglie Wavelength, the Uncertainty Principle, and Indeterminacy
- 7.5 Quantum Mechanics and the Atom
- 7.6 The Shapes of Atomic Orbitals

Chapter 8: Periodic Properties of the Elements

- 8.1 Nerve Signal Transmission
- 8.2 The Development of the Periodic Table
- 8.3 Electron Configurations: How Electrons Occupy Orbitals
- 8.4 Electron Configurations: Valence Electrons and the Periodic Table
- 8.5 The Explanatory Power of the Quantum-Mechanical Model
- 8.6 Periodic Trends in the Size of Atoms and Effective Nuclear Charge
- 8.7 Ions: Electron Configurations, Magnetic Properties, Ionic Radii, and Ionization Energy
- 8.8 Electron Affinities and Metallic Character

Chapter 9: Chemical Bonding I: The Lewis Model

- 9.1 Bonding Models and AIDS Drugs
- 9.2 Types of Chemical Bonds
- 9.3 Representing Valence Electrons with Dots
- 9.4 Ionic Bonding: Lewis Symbols and Lattice Energies
- 9.5 Covalent Bonding: Lewis Structures
- 9.6 Electronegativity and Bond Polarity
- 9.7 Lewis Structures of Molecular Compounds and Polyatomic Ions
- 9.8 Resonance and Formal Charge
- 9.9 Exceptions to the Octet Rule: Odd-Electron Species, Incomplete Octets, and Expanded Octets
- 9.10 Bond Energies and Bond Lengths
- 9.11 Bonding in Metals: The Electron Sea Model

Chapter 10: Chemical Bonding II: Molecular Shapes, Valence Bond Theory, and Molecular Orbital Theory

- 10.1 Artificial Sweeteners: Fooled by Molecular Shape
- 10.2 VSEPR Theory: The Five Basic Shapes
- 10.3 VSEPR Theory: The Effect of Lone Pairs
- 10.4 VSEPR Theory: Predicting Molecular Geometries
- 10.5 Molecular Shape and Polarity
- 10.6 Valence Bond Theory: Orbital Overlap as a Chemical Bond
- 10.7 Valence Bond Theory: Hybridization of Atomic Orbitals
- 10.8 Molecular Orbital Theory: Electron Delocalization (optional)

Laboratory Topics

Notes to Instructors

1. Please note that a three-hour time slot is allotted to the laboratory and the student should be aware that this time will be fully utilized. The laboratory time is used not only for experimentation, but may also be used for demonstrations, movies, and problem solving. Whenever time permits, homework problems will be worked out in the beginning of the laboratory and the student is expected to participate.
2. Attendance in the laboratory is mandatory at the scheduled time. In case of an unavoidable situation, the student should contact the instructor beforehand to be excused and to see if any arrangements can be made to make up the laboratory. It may or may not be possible. Approved safety glasses must be worn in the laboratory ***over the eyes*** as required by state law.
3. Laboratory reports are due at the beginning of the next lab period. The report consists of the data report sheets included in the lab manual or handout. To aid not only the instructor but also especially the students, reports will not be accepted two weeks after the lab was assigned. Completion of the lab experiment followed by turning in the data and calculations on the due date with appropriate write-up insures a good grade. Grading scales for laboratory reports are at the professor's discretion, but will count towards the overall grade for the course.