

Virginia Community College Course Content Summary

Course Title: CHM 111: General Chemistry I

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. Part I of II. Lecture 3 hour. Laboratory 3 hours. Total 6 hours per week. 4 credits. Prerequisites: MTE 1-9 and ENG 111 Eligible. Students must earn a grade of C or higher in the lecture portion of the course to earn an overall grade of C or higher.

General Course Purpose

The general purpose of this course is to prepare the student for advanced study in science through development of: skills in problem solving and in critical thinking, an understanding of the methods of scientific inquiry, and an understanding of the general concepts and principles of chemistry.

Course Prerequisites/Corequisites

MTE 1-9 and ENG 111 Eligible

Course Objectives

Upon completing the course, the student will be able to:

Matter and Measurement

- Employ the scientific method, explain measurements and uncertainty, and use dimensional analysis and problem solving in conversion questions. Describe the phases and classifications of matter.
- Apply significant figures in calculations and measurements.

Atoms, elements and moles

- Explain atomic theory. Explain the organization of the Periodic Table and predict periodic properties of the elements. Describe Isotopes and calculate average atomic mass.
- Explain molar mass and the mole concept: convert between mass, moles, number of molecules, number of atoms, and molarity.

Nomenclature and chemical reactions

- Use Chemical Nomenclature. Use the periodic chart to predict the ionic charge of the main group elements. Apply the rules for nomenclature to write formulas as well as name: ionic compounds, binary molecules and acids.
- Predict the solubility of ionic compounds. Describe and predict properties of electrolytes. Write and balance chemical equations. Write net ionic equations and predict products for precipitation and acid/base reactions. Explain Redox and redox reactions. Assign oxidation states.

Stoichiometry

- Determine empirical and molecular formulas. Demonstrate an understanding of stoichiometry by calculating theoretical yield, actual yield, percent yield and limiting reagent.

Electronic Structure of the Atom

- Explain the electronic structure of the atom. Show how light and spectroscopy led to the understanding of the wave-particle duality. Explain quantum numbers and apply quantum numbers to depict electron configurations of neutral atoms and ions.
- Recognize the periodic properties of electronegativity, electron affinity, ionization energy, and ionic or covalent radius from the position of the element in the Periodic Table.

Chemical Bonding

- Differentiate between ionic, polar covalent and covalent bonds.
- Draw Lewis structures for covalent compounds and use VSEPR concepts to predict: a) bond angles b) geometry c) polarity. Apply formal charge to understand resonance and determine the best Lewis structure.
- Apply hybrid orbital theory to predict hybridization and explain pi and sigma bonding. (optional: M.O. Theory)

Thermochemistry

- Describe and employ basic Thermochemistry. Explain enthalpy. Use Hess's law and enthalpies of formation to calculate heats of reactions. Perform calorimetry calculations. Distinguish between endothermic and exothermic processes and do energy calculations that accompany reactions.

Gases

- Apply the Kinetic Theory of Gases. Use the Gas laws to do gas law calculations. Explain the difference between real and ideal gases.

Laboratory Skills

- Perform a minimum of 8 "wet" supervised hands-on labs per semester.
- Work in the lab safely. Wear Splash resistant goggles, proper clothing and closed toed shoes.
- Properly handle and dispose of chemicals.
- Read and analyze an SDS.
- Properly collect hazardous waste.
- Recognize basic laboratory equipment.
- Make measurements using the correct number of significant figures.
- Utilize notebook skills (especially data acquisition, data handling and data analysis). Students will perform a minimum of 2 wet labs using a lab notebook. The notebook needs to include an introduction, procedure, data table and conclusion.
- Utilize spreadsheets to graph (plot) and analyze data and do basic error analysis.
- Students will write 1 formal lab report using proper scientific analytical writing. The formal lab report must include good data analysis.
- Use volumetric glassware, including a buret.
- Perform accurate titrations.
- Use basic lab equipment including: balance, hot plate and thermometer.
- Connect topics discussed in lecture and lab observations.

Major Topics to be Included

Matter and Measurement

Atoms, elements and moles

Nomenclature and chemical reactions

Stoichiometry

Electronic Structure of the Atom

Chemical Bonding

Thermochemistry

Gases

Laboratory Skills