Master Course Syllabus

For additional course information, including prerequisites, corequisites, and course fees, please refer to the Catalog: https://catalog.uvu.edu/

Semester: Spring
Year: 2025
Course Prefix: CHEM
Course and Section #: 1210-002
Course Title: Principles of Chemistry I
Credits: 4

Course Description

This course is the first semester of a full-year course primarily for students in the physical and biological sciences and engineering. This course covers fundamentals of chemistry including atoms, molecules, reactions, stoichiometry, chemical bonding, thermochemistry, and gas laws
This is a GE course fulfilling PP - Physical Science Dist. It is a required course for chemistry majors.

Course Attributes

This course has the following attributes:
☒ General Education Requirements
☐ Global/Intercultural Graduation Requirements
☐ Writing Enriched Graduation Requirements
☒ Discipline Core Requirements in Program
☐ Elective Core Requirements in Program
☐ Open Elective
Other: *Click here to enter text.*

Instructor Information

Instructor Name: Bruce Wilson, Ph.D.

Student Learning Outcomes

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

- Use mathematical and chemical knowledge to solve stoichiometric and other types of chemistry problems.
- Use the periodic table to make predictions about the structure and properties of atoms, ions, and chemical reactions.
- Explain in basic terms the current quantum mechanical model of the atom.
- Differentiate types of chemical compounds on a molecular level.
- Apply basic thermodynamic principles to chemical reactions.

Course Materials and Texts

Chemistry 2e, https://openstax.org/details/books/chemistry-2e (Links to an external site.)Links to an external site.. This is a free textbook if you want the PDF only. The hardback book cost

about $60. You can read the text online (with highlighting and links to online resources), download a free PDF, or get the OpenStax app on your device. If you have the PDF, you will likely want to print several appendices and important tables & figures for reference while you work homework problems. It's a pretty good text, but there are a few places where they assume you aren't as smart as you are and take unneeded shortcuts. I don't take those shortcuts; they gimp your ability to demonstrate you are intelligent.

Calculator

You will need a calculator capable of scientific calculation. Here are some recommendations. most are under $10: Victor 920, Mr. Pen Scientific, Casio fx-260SolarII, Casio fx-991EX, Casio fx-115, TI-30Xa. These are not recommended: TI-30XIIS, TI-30SX, TI-36Xpro, TI-34, Casio fx-300. Graphing calculators will not be allowed on the Final Exam.

Course Requirements

Course Assignments, Assessments, and Grading Policy

This is a 1000-level general chemistry course intended for students majoring in the sciences. It is assumed that you are conversant with the principles of algebra (including quadratics and logarithms) and you can remember all you learned in CHEM 1210. It is our intention to study the fundamental principles of chemistry in some detail, concentrating on your ability to work problems in chemistry, thus demonstrating that you can use the theories which underpin our understanding of the properties of matter and its reactions. This course is accompanied by a required laboratory course, which will greatly supplement your hands-on understanding of chemicals as our in-class descriptions of matter and reactions can be somewhat abstract.

Class times

We are assigned a 50 minute block each day, Monday through Thursday. During our 50-minutes together I can answer questions, I will lecture, and we will do problem solving together. If you must miss a lecture for some reason, speak with your classmates and get their notes. I don't record lectures; during the shutdown they destroyed both learning and skill in working with others, both vital for a successful career.

Office hours are listed in the information above. USE MY OFFICE HOURS! If someone is camped in there, stand at the door and ask your questions. Don't camp in there; camp in the hall if you like and work problems there. I'm happy to look over your work in my office. If you want more problems to work I have other textbooks you can photograph to work those problems at home.

Grades

	A	94%	A-	90%
B+	87%	B	84%	B- 80%
C+	75%	C	70%	C- 65%

D+ 60%D 55% D- 50%

E <50%

The grade cutoffs are hard cutoffs, and I do not move them around nor “bump” anyone up because they provide a story more pitiful that the rest.

Exams

During the semester I will assess your progress with **seven biweekly exams,** and a **final exam** at the end of the semester. All exams will be administered in our classroom on Thursdays.

Your final grade will be 70% exams, 30% final.

Exams will have between 14 and 20 multiple-choice questions. The lowest exam is dropped from your score. Since a C grade is 70%, I want all exams to have a 70% average, +/- 5%. When a class underscores significantly, I'll grade the exam out of fewer questions than I ask on the exam. It's not really curving the exam. For example, on a 20-question exam, if the class averages 11 correct (55%) I'll grade out of 14 (70%). This means that top students will score above 100%. They can thank those who don't study.

NOTE: If you miss an exam for *any* reason other than university-excused absences, you forfeit the points. The University expects you to be in class on schedule, just as Dr. Wilson is expected to be there and ready to teach.

ACS Standardized Final

The Final Exam will be the ACS Standardized Exam which covers the same material we do in this course. You must take the final to pass the course. This is a standardized final, which means your percentile score reflects where you stand out of 100 average university students taking general chemistry. Very informative. For the grade-book I add 100 to your percentile standing, and grade out of 200, compressing the class distribution to the top half.

Homework

This is a professional course, and I consider each of you a pre-professional of some sort. One of the great demarcations of a professional is that they don't have a boss telling them what to do and if they did it correctly. We train univeristy students to find, on their own, the right and best solution, and to know it is right when they have found it. Each of you has a completely unique mind and set of experiences which have brought you here. Your variety of experience is far beyond my ability to judge what problems you need to work to discover the ideas and problem-solving skills you haven't yet mastered. Thus I do not assign homework problems for you to work. At the back of each chapter are about a hundred problems, half of which have answers in the back of the book. Your job (and it is a job) is to spend 3 hours each school-day finding problems you cannot solve, and work to solve them. It will be difficult, and frustrating, because my expectation is that you will here discover how to do things you never imagined yourself capable of doing.

When you sit down to an exam, you need to already know that you can do the problems. If you

sat in class and took notes *but nothing more*, it is likely you can complete 25% of the problems you will see on the exam. A failing grade, because you haven't learned to *do* anything new. Chemistry is a very engaged discipline which will change the way you think; this change happens as you work problems. You will need to work a broad selection of problems. *Pay attention to how you do on each type of problem*; some will seem easy, others will seem difficult, or puzzling. A variety of difficult problems must be seen repeatedly, until you master the thinking and information involved. Work problems above and below the difficult problem until you gain enough exposure to master the topic. Monitor your own progress in solving problems. Repeat the ones that were difficult. You also have the privilege to skip any problem that now seems trivial or easily solved.

Required or Recommended Reading Assignments

Chemistry 2e, 1.1 Chemistry in Context
Chemistry 2e, 1.2 Classification of Matter
Chemistry 2e, 1.3 Physical and Chemical Properties
Chemistry 2e, 1.5 Uncertainty, Accuracy, and Precision
Chemistry 2e, 1.4 Measurement
Chemistry 2e, 1.6 Mathematical Treatment of Measurement Results
Chemistry 2e, 2.1 Early Ideas in Atomic Theory
Chemistry 2e, 2.2 Evolution of Atomic Theory
Chemistry 2e, 2.3 Atomic Structure and Symbolism
Chemistry 2e, 2.5 The Periodic Table
Chemistry 2e, 2.4 Chemical Formulas
Chemistry 2e, 2.6 Molecular and Ionic Compounds

Chemistry 2e, 2.7 Chemical Nomenclature
Chemistry 2e, 3.1 Formula Mass and the Mole
Chemistry 2e, 3.2 Determining Empirical and Molecular Formulas
Chemistry 2e, 3.3 Molarity
Chemistry 2e, 3.4 Other Units for Solution Concentrations
Chemistry 2e, 4.1 Writing and Balancing Chemical Equations
Chemistry 2e, 11.1 The Dissolution Process
Chemistry 2e, 11.2 Electrolytes
Chemistry 2e, 4.2 Classifying Chemical Reactions
Chemistry 2e, 4.3 Reaction Stoichiometry
Chemistry 2e, 4.4 Reaction Yields
Chemistry 2e, 4.5 Chemical Analysis
Chemistry 2e, 5.1 Energy Basics
Chemistry 2e, 5.2 Calorimetry
Chemistry 2e, 5.3 Enthalpy
Chemistry 2e, 6.1 Electromagnetic Radiation
Chemistry 2e, 6.2 The Bohr Model
Chemistry 2e, 6.3 Development of Quantum Theory
Chemistry 2e, 6.4 Electronic Structure of Atoms
Chemistry 2e, 6.5 Periodic Variations in Element Properties
Chemistry 2e, 7.1 Ionic Bonding
Chemistry 2e, 7.2 Covalent Bonding
Chemistry 2e, 7.3 Lewis Symbols and Structures

Chemistry 2e, 7.4 Formal Charges and Resonance
Chemistry 2e, 7.5 Strengths of Ionic and Covalent Bonds
Chemistry 2e, 7.6 Molecular Structure and Polarity
Chemistry 2e, 8.1 Valence Bond Theory
Chemistry 2e, 8.2 Hybrid Atomic Orbitals
Chemistry 2e, 8.3 Multiple Bonds
Chemistry 2e, 8.4 Molecular Orbital Theory
Chemistry 2e, 9.1 Gas Pressure
Chemistry 2e, 9.2 Relating Pressure, Volume, Amount, and Temperature: The Ideal Gas Law
Chemistry 2e, 9.3 Stoichiometry of Gaseous Substances, Mixtures, and Reactions
Chemistry 2e, 9.4 Effusion and Diffusion of Gases
Chemistry 2e, 9.6 Non-Ideal Gas Behavior

General Description of the Subject Matter of Each Lecture or Discussion

Chapter 1 (Lessons 1-7). Upon successful completion of this lesson, students will be able to:

- Describe the scientific method.
- Classify matter and chemical/physical changes using the scientific method.
- Navigate complex dimensional analysis problems using metrics, international system of units (SI), and other units of measurement.
- Calculate density and use it in applications such as identification of unknowns.
- Apply concepts of accuracy and precision to determine significant digits.

Chapter 2 (Lessons 7-9). Upon successful completion of this lesson, students will be able to:

- Describe the tenets of Dalton's Atomic Theory, Law of Multiple Proportions, and Law of Definite Proportions to explain atoms and molecules.
- Visualize the iterations of atomic structure through experiments including Thompson's Cathode Ray Tube, Milliken's Oil Drop experiment, and Rutherford's gold foil experiment.
- Describe the subatomic particles and their properties and behavior, and use them to identify elements, isotopes, ions, mass number and atomic number.
- Predict reactivity and ions by using the periodic table.
- Calculate weighted average atomic mass.
- Describe ionic and covalent bonds, distinguishing between molecular and ionic compounds.
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- Describe the subatomic particles, their properties and behavior, and use them to identify elements, isotopes, ions, mass number and atomic number
- Predict reactivity and ions by using the periodic table
- Define the mole chemical unit and use it to convert between masses and number of atoms or molecules
- Calculate weighted average atomic mass, molar mass, and the number of atoms in a given mass of an element

Chapter 3 (Lessons 10-14). Upon successful completion of this lesson, students will be able to:

- Define the mole chemical unit and use it to convert between masses and number of atoms or molecules.
- Calculate formula mass and molar mass of compounds.
- Calculate percent composition and, using elemental analysis, determine empirical and molecular formulas from mass percent composition.

- Calculate molar concentrations and use the dilution formula.
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- Describe laboratory techniques for preparing solutions and dilutions.
- Calculate concentrations of solutions using percent composition.

Chapter 4 (Lessons 15-19): Upon successful completion of this lesson, students will be able to:

- Balance chemical equations
- Calculate theoretical yield, limiting and excess reagents, and percent yield using stoichiometry
- Solve solution stoichiometry problems using molar concentrations
- Identify the solubility of ionic compounds based on the classification of electrolytes and non-electrolytes
- Identify oxidation-reduction reactions using oxidation numbers
- Identify oxidizing and reducing agents in oxidation-reduction reactions
- Identify acids and bases using Brønstead-Lowry and Arrhenius definitions
- Calculate the endpoint of a titration using solution stoichiometry
- Predict products for common gas-forming reactions

Chapter 5 (Lessons 20-24): Upon successful completion of this lesson, students will be able to:

- Distinguish between potential and kinetic energy
- Summarize the 1st Law of Thermodynamics in terms of state functions and heat and work
- Evaluate the difference between the system and surroundings and the sign of heat and work
- Calculate internal energy under constant volume conditions as modeled by bomb calorimeters
- Calculate enthalpy under constant pressure conditions using coffee-cup calorimeters
- Use Hess' Law to calculate heat of a reaction as a combination of other reactions
- Use heat of formation reactions to calculate reaction enthalpy

Chapter 6 (Lessons 25-29): Upon successful completion of this lesson, students will be able to:

- Describe the properties of light, including diffraction and interference
- Calculate wavelength, frequency, and energy of light using dispersion relations
- Distinguish between the wave nature and particle nature of the electron, citing examples from the photoelectric effect and the double slit diffraction
- Use the de Broglie relation to relate wavelength of light to momentum of particles
- Interpret the Bohr model of the atom using concepts of atomic emission spectra and calculate the wavelength of light emitted from a Hydrogen atom using the Rydberg equation
- Describe shapes of molecular orbitals that arise from probability distribution of wave-functions
- Describe orbitals occupied by electrons using quantum numbers
- Draw orbital diagrams and electron configurations using the aufbau principle and Hund's rule
- Use orbital diagrams to determine paramagnetic and diamagnetic properties of atoms
- Distinguish between valence electrons and core electrons, calculating effective nuclear charge and utilizing this concept to describe periodic trends in atomic radius, ionization energy, and electron affinity

Chapter 7 (Lessons 35-39): Upon successful completion of this lesson, students will be able to:

- Represent valence electrons as dots and predict ionic compound structure using Lewis Theory
- Predict structures for atoms, isomers, and resonance structures
- Use electronegativity to predict bond polarity
- Use formal charge to predict dominant resonance structures
- Identify and justify exceptions to the octet rule
- Use bond energies to calculate reaction enthalpy

Chapter 8 (Lessons 40-44): Upon successful completion of this lesson, students will be able to:

- Predict molecular and electron group geometry using valance shell electron pair repulsion (VSEPR)

- Predict bond angles using VSEPR
- Predict polarity of molecules using VSEPR
- Describe bonds in terms of orbital overlap, sigma, and pi bonds
- Predict hybridization using hybrid orbital bond theory
- Calculate bond order and predict para- and dia-magentism of molecules using molecular orbitals

Chapter 9 (Lessons 45-49): Upon successful completion of this lesson, students will be able to:

- Explain pressure and kinetic molecular theory of gases
- Use Boyle's Law, Charles' Law, Lussac's Law, Avogadro's Law, the combined gas law, and the ideal gas law
- Calculate densities of gases
- Explain the origin of the "absolute zero" concept in terms of an ideal gas thermometer
- Describe how pressure is measured using a manometer
- Convert commonly used units for pressure, volume, and temperature and compare conversions to defined Standard Temperature and Pressure (STP)
- Distinguish between effusion and diffusion of gases
- Calculate root-mean-square velocities of gases and relative rates of effusion and diffusion between various gases
- Explain deviations from ideality in gases based upon conditions that result in real gas behavior and the resulting changes in molar volume and pressure
- Describe the components of the Van der Waals equation for real gases

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Required Course Syllabus Statements

Generative AI

Artificial Intelligence in This Course

Use ChatGPT (and all generative AI) as a learning assistant, not as a crutch, so use it for information, not as a substitute for thinking. You are responsible to make sure that any submitted content is cited properly, including generative AI results. Because AI can't think, don't accept anything AI generates at face value without checking it critically. AI is notorious for getting chemistry facts wrong (they "hallucinate" an answer because they know words, not numbers). Potential employers will expect you to know how to use tools like ChatGPT to generate content, so it is a skill you should learn. If it helps you learn some things faster, GREAT because you can spend more time doing hard things. Just remember: If you REALLY want to be good at thinking, you need to modify your brain, not find a new tool.

Using Remote Testing Software

☒ This course does not use remote testing software.

☐ This course uses remote testing software. Remote test-takers may choose their remote testing locations. Please note, however, that the testing software used for this may conduct a brief scan of remote test-takers' immediate surroundings, may require use of a webcam while taking an exam, may require the microphone be on while taking an exam, or may require other practices to confirm academic honesty. Test-takers therefore shall have no expectation of privacy in their test-taking location during, or immediately preceding, remote testing. If a student strongly objects to using test-taking software, the student should contact the instructor at the beginning of the semester to determine whether alternative testing arrangements are feasible. Alternatives are not guaranteed.

Required University Syllabus Statements

Accommodations/Students with Disabilities
Students needing accommodations due to a permanent or temporary disability, pregnancy or pregnancy-related conditions may contact UVU Accessibility Services at accessibilityservices@uvu.edu or 801-863-8747.
Accessibility Services is located on the Orem Campus in BA 110.
Deaf/Hard of Hearing students requesting ASL interpreters or transcribers can contact Accessibility Services to set up accommodations. Deaf/Hard of Hearing services can be contacted at DHHservices@uvu.edu
DHH is located on the Orem Campus in BA 112.

Academic Integrity
At Utah Valley University, faculty and students operate in an atmosphere of mutual trust. Maintaining an atmosphere of academic integrity allows for free exchange of ideas and enables all members of the community to achieve their highest potential. Our goal is to foster an intellectual atmosphere that produces scholars of integrity and imaginative thought. In all academic work, the ideas and contributions of others must be appropriately acknowledged and UVU students are expected to produce their own original academic work.
Faculty and students share the responsibility of ensuring the honesty and fairness of the intellectual environment at UVU. Students have a responsibility to promote academic integrity at the university by not participating in or facilitating others' participation in any act of academic dishonesty. As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, assessments, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Likewise, instructors are responsible to clearly state expectations and model best practices. Further information on what constitutes academic dishonesty is detailed in UVU Policy 541: *Student Code of Conduct*.

Equity and Title IX
Utah Valley University does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, age (40 and over), disability, veteran status, pregnancy, childbirth, or pregnancy-related conditions, citizenship, genetic information, or other basis protected by applicable law, including Title IX and 34 C.F.R. Part 106, in employment, treatment, admission, access to educational programs and activities, or other University benefits or services. Inquiries about nondiscrimination at UVU may be directed to the U.S. Department of Education's Office for Civil Rights or UVU's Title IX Coordinator at 801-863-7999 – TitleIX@uvu.edu – 800 W University Pkwy, Orem, 84058, Suite BA 203.

Religious Accommodation
UVU values and acknowledges the array of worldviews, faiths, and religions represented in our student body, and as such provides supportive accommodations for students. Religious belief or conscience broadly includes religious, non-religious, theistic, or non-theistic moral or ethical beliefs as well as participation in religious holidays, observances, or activities. Accommodations may include scheduling or due-date modifications or make-up assignments for missed class work.
To seek a religious accommodation, a student must provide written notice to the instructor and the Director of Accessibility Services at accessibilityservices@uvu.edu. If the accommodation relates to a scheduling conflict, the notice should include the date, time, and brief description of the difficulty posed

by the conflict. Such requests should be made as soon as the student is aware of the prospective scheduling conflict.
While religious expression is welcome throughout campus, UVU also has a specially dedicated space for meditation, prayer, reflection, or other forms of religious expression.