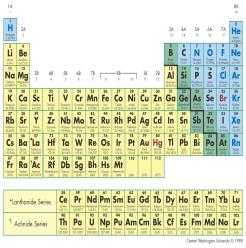

CHE 004A – 2021

General Chemistry for Physical Sciences and Engineering

MWF, 12:10 - 1:00 PM, Wellman Hall 6

Prof. C. William McCurdy

cwmccurdy@ucdavis.edu
Canvas website: https://canvas.ucdavis.edu/courses/626074
Chemistry Annex, Room 4467
Office Hours: M 2 pm and W 3pm, also by appointment MWF
subject to change depending on student needs
Head TA: Marshall Hutchings, mehutchings@ucdavis.edu
TA Office Hours: TBA

Class Meetings: We will meet in person in Wellman 6. As of this writing masks are required in all indoor settings at UC Davis, so we will be masked, including me. There will be no exceptions. We will all adapt, and I will repeat what you miss because of the mask upon request. Almost all campus buildings have filtration and ventilation systems that can mitigate coronavirus spread (https://facilities.ucdavis.edu/ventilation-filtration). Our building, Wellman Hall, has among the better filtration levels on campus (Minimum Efficiency Reporting Value (MERV) 13 or better and has a combination of recirculated and outside air (RA + OA).

Attendance: Learning is easier in person, and questions are best answered in that context. Nonetheless, I understand if you are hesitant to be present in the class room with nearly 100 students. Your presence is strictly required only for the examinations (two Midquarters and one Final Exam). Lectures will be recorded, barring technical difficulties, and posted the same day in the Media Gallery on Canvas. **However,** attendance in Labs and Discussion sections is *required*.

Course Description: This is an introductory general chemistry course directed to fill the needs students in the physical sciences and engineering, in particular for chemistry majors and chemical engineers. However all students with the prerequisites (see below) are welcome. This course differs from the regular general chemistry course (CHE 2A) by not emphasizing in lecture the more basic concepts of stoichiometry and chemical reactions (which are covered in the lab and discussion sections), and instead covering the following topics in more depth than is done in CHE 2A.

- Atomic Shells and Classical Models of Chemical Bonding: Using the simplest concepts of ionic and covalent bonds and the shell model of the atom to understand the periodic table and its meaning
- Introduction to Quantum Mechanics in Chemistry: Mastering the basic concepts of wave mechanics and the interaction of radiation with atoms and molecules
- Quantum Mechanics and Atomic Structure: Understanding the origins of the properties of atoms and the quantum mechanical basis of the periodic table

- Quantum Mechanics and Molecular Structure: Understanding molecular orbitals and the quantum mechanical basis of the chemical bond
- Bonding in Organic Molecules: Application of the molecular orbital and valence bond ideas to understand bonds involving carbon, nitrogen, oxygen and hydrogen
- kinetic theory of gases, ideal gas behavior, and intermolecular forces

Prerequisite(s): Prerequisites are high school chemistry and physics, and concurrent enrollment in mathematics at or above the level of MAT 012 strongly recommended; must earn a qualifying score of 28 or better on the Chemistry Placement Exam. The Placement Exam can be taken more than once, but students with lower scores will be administratively dropped from the roster after the third week. High school calculus is strongly recommended, although not formally required. We will make frequent use of derivatives and simple integrals in our study of the quantum mechanical nature of atomic structure and bonding. Concurrent registration in introductory calculus is therefore very strongly recommended.

Texts:

(Oxtoby) Principles of Modern Chemistry, David W. Oxtoby, H. P. Gillis and Laurie J. Butler 2016 8th edition. Cenage; **ISBN:** 978-0-357-67100-9. This text is available through Equitable Access (https://ucdavisstores.com/EquitableAccess). Paper editions are also available and the 7th edition in paper will suffice if that is what you prefer. Links to the text will be on the CANVAS website that you can access with your Equitable Access credentials.

(LAB) Chem 4A Lab Manual The lab manual will be in an electronic copy (.pdf) and will be provided to the students prior to the start of the lab by the head TA

Class communication: All class announcements and assignments, as well as class resources (e.g. notes and outside references and images, recorded lectures, document camera material used during lectures etc.) will be posted on the class Canvas website. You can access that site through the Canvas URL: http://canvas.ucdavis.edu/. All announcements to the class will be made from the Canvas website, and students are responsible for setting their Canvas preferences to receive them immediately and directly via email. It is your responsibility to check the Canvas website for any pertinent announcements or information. If you have questions, check Canvas first. Then, your section TA is your next line of contact. You must use your @ucdavis.edu email address. Neither Prof. McCurdy nor the TAs will respond to messages from other domains. To contact the course instructor, use only email with "Chem 4A" in the subject line. **Do *not* use Canvas Messages**.

Academic Etiquette in Emails and Other Communication: Respect of others is a fundamental principle in University classes. In this class we will insist on mutual respect between all parties in all communications. Your instructors and TAs deserve to be treated with respect at all times, and you as students in this class deserve the same respect. Your instructor will always address you as Mr. or Ms. followed by your last name, or simply by your full name if that is what you prefer. In emails to the instructor you will please address him as Professor McCurdy or Dr. McCurdy. Emails beginning with "Hey," "Hello," or other informal salutations will not be answered. Emails to your TA should address her or him by Ms. or Mr. followed by the last name unless you are explicitly invited by your TA to do otherwise. A one page explanation of the rules of academic etiquette is posted on our website under the Files link at the left of the page as

`Etiquette_Handout_M_Worthen.pdf`

Cheating/Plagiarism: Cheating or plagiarism will result in a referral to Student Judicial Affairs (SJA) https://ossja.ucdavis.edu/code-academic-conduct. A negative judgement from SJA will result in automatic failure of the respective assignment, and may result in dismissal/suspension from the class. In laboratory, all students must use their respective data to finish each post-laboratory exercise. Students are not allowed to copy or post any data, calculations, or answers of any kind from any other person or website. Post-laboratory exercises must be done entirely independently of your lab partner or other persons. You may not copy or paraphrase another's work without appropriate citation. On examinations, you must do your own work and may not consult any outside sources in any way. All suspected violations will be referred to SJA.

Health Services: Here at UC Davis we care about the holistic well-being of our undergraduates. It is all too often that while focusing on academics students forget to attend to both their physical and mental health, resulting in anxiety, depression, and a multitude of detrimental issues. If you, or anybody you know, is in need of mental health care, please refer to the following campus resources: (1) Counseling & Psychological Services (CAPS): North Hall. (530) 752-2349; (2) Urgent Care: Student Health and Wellness Center; (3) 24-Hour Advice Nurse: (530) 752-2349.

Grade Components and Weights:

Labs	20%
Homework Assignments	15%
Discussion	10%
Midterm Exam I	15%
Midterm Exam II	15%
Final Exam	25%

Discussion Sections: Each week we will post a short discussion assignment via OWLv2. It will consist of a small number of problems to establish the initial topic of the discussion meeting. You must do this assignment to receive credit for the Discussion component of the course.

Homework Assignments: Homework assignments (problem sets) will be posted weekly on Canvas, accompanied by Canvas announcements. *Please note:* Homework is 15% of your grade in this course. It is one the most important part of the learning experience of this course and preparation for the exams. Make it a priority.

Exams: The midquarter and final exams will be in class, closed book, with no notes or outside resources allowed. There will be no make-up exams, and the policy for excused absences will be explained in class.

Tentative Schedule of Topics, Readings, and Exams:

Weekly reading assignments represent the main topics of the classes, although students are expected to read the chapters in the Oxtoby text in their entirety. Reading the textbook material prior to class is strongly advised. This schedule may be revised during the quarter, but the list of major topics will not change.

Week	Content
Sept. 22	• The experimental characterization of the building blocks of atoms: electrons, protons, neutrons: *Oxtoby 1.4, 1.5* • Summary of concepts from stoichiometry assumed in 4A: *Oxtoby Chap. 1, Chap 2* Basic stoichiometry will be covered in discussion sessions.
Sept. 27	• Experimental evidence leading to quantum mechanics *Oxtoby 4.1, 4.2* • The Bohr model and the failure of classical mechanics on the atomic scale *Oxtoby 4.3, 4.4* • The Schrödinger equation *Oxtoby 4.5-4.7*
Oct. 4	• The quantum states and energy levels of the hydrogen atom *Oxtoby 5.1* • The shell model of many-electron atoms *Oxtoby 5.2 - 5.4*
Oct. 11	• Periodic properties of the atoms and their electronic structure *Oxtoby 5.5, 3.2, 3.4* • Electron Affinity and Electronegativity and ionic bonding *Oxtoby 3.5 - 3.8*
Oct. 18	• Dipole moments, Covalent and polar covalent bonding *Oxtoby 3.9* • Classical models of bonding: Lewis structures and valence shell electron pair repulsion "theory" *Oxtoby 3.11, 3.12* • Midquarter I – in class, Friday October 22, Review session Wednesday.
Oct 25	• Quantum description of bonding, Born-Oppenheimer approximation *Oxtoby 6.1* • Molecular orbitals of H_2^+ *Oxtoby 6.2, 6.3* • Bonding in diatomic molecules, the Linear Combination of Atomic Orbitals (LCAO) approximation *Oxtoby 6.5-6.7*
Nov. 1	• Valence bond theory, hybrid orbitals and delocation *Oxtoby 6.8 - 6.13* • First topics in bonding in organic molecules, the Alkenes and Alkynes *Oxtoby 7.1-7.3*
Nov. 8	• Aromatic hydrocarbons, the concept of functional groups, Amines and amides *Oxtoby 7.4-7.6* • Begin bonding in transition metal compounds. Oxidation states, balancing redox equations *Oxtoby 8.1 and 3.12* Veteran's day, Thursday, Nov. 11
Nov. 15	• Coordination compounds and crystal field theory *Oxtoby 8.2 - 8.4* • Optical properties of coordination compounds *Oxtoby 8.5*
Nov. 22	• Midquarter II, Monday November 22 in class, Review session Friday. • Gases: Pressure, temperature and the ideal gas law *Oxtoby 9.1-9.3* • Thanksgiving holiday
Nov. 29	• The kinetic theory of gases *Oxtoby 9.5* • Intermolecular forces and molecular collisions *Oxtoby 9.6, 9.7* • Review session on Saturday or Sunday
Dec. 6	• Final Exam week • Exam: Tuesday, December 7, 8:00 a.m-10:00 a.m {Check exam schedule.}

Laboratory Schedule: Labs are a required part of the course, and by Chemistry Department policy ***you must pass the lab to pass the course.*** Generally there are no makeup labs. We will nonetheless try to accommodate legitimate abscences due to documented illness or accident.

Dates	Lab weeks	**Lab Experiment**
Sept 27 - Oct 7	2 wks	Safety Orientation; Expt 1 Calibration of Pipet (CP)
Oct 11 - 14	1wk	Expt 2 Charge and Mass of the Electron (CME)
Oct 18 - 21	1wk	Expt 3 Behavior of Gasses (BG)
Oct 25 - 28	1wk	Expt 4 Determination of Avogadro's number (NA)
Nov 1 - 4	1wk	Expt 5 Measurement of Planck's Constant (h)
Nov 9 - 1	No Labs	Veteran's Day holiday
Nov 15 -18	1wk	Expt 6 Optical Spectroscopy of Atoms and the Balmer Spectrum of Hydrogen (BSH)
Nov 22 - 25	No Labs	Thanksgiving week
Nov 29 - Dec 2	1wk	Expt 7 Quantitative Spectrophotometry and Beer's Law