

## Course Syllabus

### Chem 1012: General Chemistry I, Fall 2023

#### Section 1, MWF 10:15-11:14 AM

**Instructor:** Professor Tom Mallouk (he/him/his) Office: 249 Chemistry

Phone: 215-898-4859 (office); 814-571-6115 (cell)

Email: [mallouk@sas.upenn.edu](mailto:mallouk@sas.upenn.edu)

**Drop-in hours:** Tuesdays 9-10 AM and Wednesdays 3:30-4:30 PM in 249 Chemistry

You are welcome to set up meetings at other times. Please email [mallouk@sas.upenn.edu](mailto:mallouk@sas.upenn.edu) to arrange a time outside of office hours.

**Teaching Assistants:** TBA

**TA drop-in hours and location:** TBA

**Learning Assistants (LAs):** TBA

**LA drop-in hours and location:** TBA

**Recitations:**

Section 210, F 1:45-3:15 PM	TA/LA: TBA
Section 211 R 3:30-5:00 PM	TA/LA: TBA
Sections 212 & 214, R 12:00-1:30 PM	TA/LA: TBA
Section 213 F 3:30-5:00 PM	TA/LA: TBA

**Course Description:** CHEM 1012 is the first course in a two-semester sequence in general chemistry. Topics covered in the first semester include atomic and molecular structure, stoichiometry, chemical bonding, chemical reactions, properties of gases, liquids and solids, and basic molecular and biomolecular chemistry.

CHEM 1012 is intended for majors and non-majors who have a foundational background in high school chemistry and who have taken or are concurrently taking a course in calculus. We will cover most of the same topics and meet the same learning objectives as CHEM 1011, but we will move rapidly over the more basic topics in order to cover others in depth and make connections to concepts in physics and biology. CHEM 1012 will also place greater emphasis on specific topics that are critical for students majoring in the life sciences. The course will feature several case studies in which we will apply the chemical principles we learn to biochemical phenomena and topics such as protein folding, the origin of life, viral infection, and antibiotic drug resistance.

Understanding chemistry is critical to every major in STEM, to many societal issues, and to your future career. Introductory chemistry at Penn is also fast-paced and challenging. I am here to help, so please, don't be shy about asking for help when you need it!

I assume that students in CHEM 1012 have taken a high school level chemistry course relatively recently. If you did not take chemistry in high school, if your chemistry class was a long time ago OR if your initial placement exam score was very low, you should consider taking CHEM 1011 instead of 1012. It is a similar course with more emphasis on the basics and on developing problem-solving skills. You will still be able to enroll in CHEM 1022 next semester if you take

CHEM 1011, and you can remain in the CHEM 1101 lab course. Please see me ASAP if you think this applies to you.

### **Required Materials:**

**Text:** *Chemical Principles 8<sup>th</sup> Edition by Zumdahl and DeCoste*. The Penn Bookstore is selling digital rentals of the textbook for either 180 or 365 day access. This is the same textbook that will be required for Chem 1022 in Spring 2024. \*Other low cost options can be obtained with Amazon and other online sellers, including purchasing or renting used hardcover books.\* You will not need to purchase the solutions manual or study guide.

Chem 1012 is participating in the Penn First Plus Course Materials Initiative. If you believe that you would benefit from stretching your financial aid award through receipt of a free electronic access code for this course's primary text, please complete the following form: [https://upenn.co1.qualtrics.com/jfe/form/SV\\_ebQoJcka0jkJDx4](https://upenn.co1.qualtrics.com/jfe/form/SV_ebQoJcka0jkJDx4). Do not submit your request via email. This link also contains information on how to connect with additional resources through Penn Libraries. *Students are encouraged to register for the free trial while waiting for an access code, as orders for some texts might be delayed.*

**Calculator:** You will need a calculator for in-class problem-solving, online quizzes, and exams in this course. A simple scientific calculator (~\$10) will suffice. It should do both base 10 and base e logs, scientific notation, and basic math functions.

**Internet:** Because this course involves timed online pre-lecture quizzes, I strongly encourage each of you to have a reliable internet connection. Wireless internet is convenient but on occasion it can stall or be slow due to many users or poor routers.

### **Course Policies and Expectations:**

**Attendance:** Your attendance in lectures and recitation sessions is expected at all scheduled class meeting times. Material presented in the lectures is the core of the course, and will be emphasized in the exams. Thus, it is in your best interest to participate in class. Also, in each class that you submit responses to all of the in-class problems via PollEverywhere, you will receive one point (up to a total of 40 for the semester). Please note that if you are ill for any reason, you should not come to class. Students who must miss class because of illness should submit a Course Absence Notice **before 9 am** in order to receive a Zoom link to participate in class remotely on that day. All lectures will be recorded and recordings will typically be available on CANVAS within one day.

**In-class discussion:** There is hardly anything I can offer you in class that will have more pedagogical value than an open discussion. I really encourage you to *ask questions during class*. This course runs at a fast pace, and if you are curious or confused about something, there is a *strong* possibility that many of your classmates are too. While it is best to speak up, you may also **text** your questions to me during class (814-571-6115), and I will answer them orally.

Please do not text outside of class time (use email instead!) because my antique flip-phone is texting-challenged! So please text me during class, or just interrupt and talk. I welcome your questions.

***Pre-lecture reading and quizzes:*** Each lecture (except the first one, the Wednesday before Thanksgiving, and the Friday lectures that immediately follow the dates of our three Thursday evening exams) will be preceded by a reading assignment from the textbook and a graded quiz, which you can access through the Assignments tab on the course CANVAS site. In general, the quiz will cover the material in the reading assignment and the previous lecture. These reading assignments and quizzes will be available two days before each lecture. The quiz must be completed before 10 AM on the scheduled class day in order for you to receive credit. Your two lowest quiz scores will be dropped from your total and the remaining scores will factor into your final grade as detailed below.

***Cooperative learning in recitations:*** Recitation sections will provide you an opportunity to meet in a smaller and less formal environment than the lectures. The recitations will provide practice in problem-solving in small groups to facilitate questions and discussion with your classmates. Our experience is that this is some of the best preparation you can do for exams in this course. Each recitation will have a worksheet that you must upload on CANVAS in order to earn credit. If you are unable to attend a recitation in person you should still complete the worksheet and upload it for credit.

**Academic Integrity:** Penn's code of academic integrity can be found here:

<https://catalog.upenn.edu/pennbook/code-of-academic-integrity/>

Your instructor and TAs consider it an honor to work with some of the best students in the world, and in turn we expect honorable behavior from you. While we encourage you to interact with and learn from your classmates, all pre-lecture quizzes you submit must be your own work. You may use any personal resources you wish (textbook, notes, etc.) on pre-lecture quizzes but you *may not consult with any other person*.

Specific examples of academic dishonesty in this course include, but are not limited to:

- Posting or otherwise communicating quiz questions or answers before the quiz is due
- Representing yourself to be another person online or in class
- Allowing another person to represent you online or in class
- Having someone take a quiz or exam for you
- Communicating with someone else during an exam
- Receiving information from any person during an exam
- Providing a false excuse for missed quizzes or exams

The consequences of these infractions may range from a grade of “0” on the quiz or exam in question to receiving an F in the course. It is our obligation to enforce these rules and to report infractions to the Office of Student Conduct.

**Grading and exams:**

**Pre-lecture reading assignments and quizzes:** Timed, five-question pre-lecture quizzes will be available on CANVAS via the Assignments tab, and must be completed before 10 AM on the day of each lecture. There will be no quiz due before the first lecture (Aug. 30 ), on the Wednesday before Thanksgiving (Nov. 22) or on Friday dates that immediately follow our three Thursday evening exams (Sept. 29, Oct. 27, and Dec. 1). These quizzes are based on assigned reading and the material covered in earlier lectures, and will be **open-book**. You will have two tries (30 min each) at each quiz and your higher score will be recorded. Some or all of the questions will change on your second try.

**Evening exams and final exam:** Three **closed-book** evening exams will be scheduled on the dates listed below and the final exam will be scheduled by the university at a specific date/time during finals week. The lectures/chapters covered by each exam will be announced the week before the exam.

Exam 1: Thursday, September 28

Exam 2: Thursday, October 26

Exam 3: Thursday, November 30

All three evening exams will be held at 7:15-8:45 pm on the date indicated (location TBA)

*Cumulative final exam:* Will be scheduled during final exam week.

**Make-up exam policy:** Because we will drop your lowest exam score (including the final exam) and two lowest quiz scores, we will not have make-up exams or quizzes in this course. This includes exams you may have to miss because of illness, family emergencies, etc. If you miss an exam, it will be your dropped exam score for the semester. If you miss more than one exam, you will need to repeat the course in a future semester. We make every attempt to schedule exams so that they don't conflict with major religious holidays, and will provide an alternative exam time if you anticipate a conflict with the time or date of an exam. Students with evening lab classes or other university-associated schedule conflicts should contact me as soon as your dates are available. If you have any questions or concerns about this please contact me as soon as possible.

**Final exam:** A comprehensive final exam will be scheduled by the registrar and the date/time is subject to change, so please keep the University final exam schedule bookmarked at <https://www.registrar.upenn.edu/finals/index.html>.

Exam accommodations for students with disabilities will be granted with approval from the Student Disabilities Office. Please be sure to take care of this early in the semester if it applies to you.

Your grade will be determined by the following (maximum total is 725 points)

Assessment	Point Value	% of total
Best 34 of 36 quizzes + mid-semester course survey	175 (5 each)	24.1
Best 3 out of 4 exams (3 evening exams + final exam)	450 (150 each)	62.1
Class participation points	40	5.5
Best 10 of 12 recitation worksheets	50 (5 each)	6.9
Lucretius essay (due Sept. 14)	10	1.4

Please note the following regarding grades:

- We will drop your two lowest quiz scores, your lowest two recitation scores, and your lowest exam score in computing your final grade
- Final grades will be determined from the sum total of points earned (with 725 points being the maximum possible). The following are historical grade cutoffs for this course: "A" for a total  $\geq 665$ ; "A-"  $\geq 630$ ; "B+"  $\geq 595$ ; "B"  $\geq 554$ ; "B-"  $\geq 514$ ; "C+"  $\geq 466$ ; "C"  $\geq 429$ ; "D"  $\geq 392$ ; "F" for  $< 392$ . These cutoffs are guaranteed and might be adjusted to ensure that the final class average is not below a B.

**Academic Help:** Your TAs and I will be available for help outside of class. TA drop-in hours and locations will be posted on the course CANVAS site. You may also arrange for help outside of these times by email. Please do not hesitate to let me or your TA know if you are having difficulty.

**Ed Discussion:** We will use Ed Discussion as a discussion board for problem solving and general chemistry concepts. You should post questions on Ed Discussion for your classmates or your instructors and TAs to answer, and read the questions and answers posted by other students. Ed Discussion is a great resource for keeping up with the material and preparing for exams. If at any point you want additional academic help, I encourage you to contact the Penn Tutoring Center. It is best to get connected with a tutor early in the semester before all spots are filled. (It can be difficult to get a tutor if you wait until exam week.) More information can be found here: <https://www.vpul.upenn.edu/tutoring/>

**Community in the Chemistry Department at Penn:** One of the goals of the course is to develop a community with a shared appreciation of chemistry, where everyone has a sense of

belonging. This can only happen if all members of the course community, the instructor, TAs, and students, work together to create a supportive, inclusive environment that welcomes all students, regardless of their race, ethnicity, gender identity, sexuality, religious beliefs, political views, physical or mental health status, or socioeconomic status. Diversity, inclusion and belonging are all core values of this course and of Penn Chemistry. All participants in this course deserve and should expect to be treated with respect by all other members of the community. If you have any concerns in this area or are facing any special issues or challenges, you are encouraged to discuss the matter with me (set up a meeting by email), or with the Chemistry Undergraduate Office or the Undergraduate Biochemistry Program Office (see below).

**Formal and Informal Accommodations:** The Chemistry Department at Penn is committed to assisting students requiring special accommodations for circumstances that are registered with the Office of Student Disability Services (SDS; <https://www.vpul.upenn.edu/lrc/sds>). If you are not formally registered with SDS and experience learning disabilities or other issues that affect your ability to fully participate and learn in this class, you are encouraged to check-in with me or with the Chemistry Undergraduate Office or the Undergraduate Biochemistry Program Office (see below) so that we can help you to secure the resources to promote your success.

**Mental Health Resources:** At Penn Chemistry we care about the holistic well-being of our undergraduates. While your focus should be on academics, it is important to attend to your physical and mental health as well. Anxiety and depression are very common in high-stress environments. If you are concerned about yourself or a friend, please reach out to either the Chemistry Undergraduate Office or the Undergraduate Biochemistry Program (see below) who will direct you to the appropriate resources. If you, or anybody you know, is in need of mental health care, please refer to the following campus resources: (1) Counseling and Psychological Services, CAPSLinks to an external site. 215-898-7021 (off hours and weekends 215-349-5490); (2) Department of Public Safety 215-898-7333, or 511 if imminent danger to themselves or others; (3) Finding Programs for Student Wellness through [University Life](#); and (4) [Student Health Services](#).

For help with any of these issues, please feel free to reach out to the Chemistry Undergraduate Office [Professor Jeffrey Winkler, Undergraduate Chair ([winkler@upenn.edu](mailto:winkler@upenn.edu)) or Ms. Candice Adams, Undergraduate Coordinator ([chemugrad@sas.upenn.edu](mailto:chemugrad@sas.upenn.edu))] or the Biochemistry Undergraduate Office [Professors Ponzy Lu ([ponzy@sas.upenn.edu](mailto:ponzy@sas.upenn.edu)) and Jeffrey Saven ([saven@sas.upenn.edu](mailto:saven@sas.upenn.edu)), Co-Chairs Undergraduate Biochemistry Program or Ms. Leslie Shinn, Undergraduate Biochemistry Program Coordinator ([biochemistry@sas.upenn.edu](mailto:biochemistry@sas.upenn.edu))] who will direct you to the appropriate resources.

#### **Course Outline** (Approximate and subject to changes/deletions/additions)

1. Introduction to Molecules and Reactions (Chapters 2-4) (very brief coverage) • Chapter 2: the nature of the atom, isotopes, molecules and ions, compounds and

- mixtures • Chapter 3: the mole, mass, balancing equations, limiting reagents • Chapter 4: solution chemistry, ions, molarity, acid-base reactions, oxidation states
2. Gases (Chapter 5): Introduction to gases, the ideal gas law, the atmosphere and barometric pressure, partial pressures, van der Waals equation
  3. Quantum Mechanics and Atomic Theory (Chapter 12): intro to quantum theory, electromagnetic radiation, wave-particle duality, atomic spectrum of H, Bohr model, quantum numbers, hydrogenic wave functions, electron spin, Pauli exclusion principle, Hund's rule, Aufbau principle,  $Z_{\text{eff}}$ , periodic trends
  4. Chemical Bonding (Chapters 13 & 14) • Chapter 13: Ionic and covalent bonding, electronegativity, bond polarity, ionic character, Lewis structures, resonance structures, formal charge, VSEPR model, molecular dipoles • Chapter 14: valence bond theory, orbital hybridization, molecular orbitals
  5. Liquids and Solids (Chapter 16): intermolecular forces, liquid properties, vapor pressure, changes of state, phase diagrams
  6. Introduction to organic and biological chemistry (Chapter 21): Structures of organic molecules; isomerism; functional groups; biomacromolecules: proteins and nucleic acids; origin of life; viral infection, enzyme-drug interactions, antibiotics and drug resistance

#### TENTATIVE LECTURE SCHEDULE AND READING ASSIGNMENTS CHEMISTRY 1012, SECTION 1, FALL 2023

Week	Mon	Wed	Fri
1		<u>Aug. 30 (1)</u> <b>Appendix, Ch. 1, Zumdahl</b> Intro to Chemistry Significant figures	<u>Sept. 1 (2)</u> <b>Ch. 2, Zumdahl</b> Atomic structure Mass spectroscopy
2	<u>Sept. 4</u> LABOR DAY	<u>Sept. 6 (3)</u> <b>Ch. 3, Zumdahl</b> Mole, mass, empirical formulas	<u>Sept. 8 (4)</u> <b>Ch. 4, Zumdahl</b> Solutions, electrolytes
3	<u>Sept. 11 (5)</u> Solutions, dilution	<u>Sept. 13 (6)</u> Reactions in solution	<u>Sept. 15 (7)</u> Precipitation Acid-base reactions
4	<u>Sept. 18 (8)</u> Assigning oxidation states Redox reactions	<u>Sept. 20 (9)</u> Redox reactions-balancing	<u>Sept. 22 (10)</u> <b>Ch. 5, Zumdahl</b> Gas laws Pressure



5	<u>Sept. 25 (11)</u> Limiting reagents, % yield	<u>Sept. 27 (12)</u> Dalton's law of partial pressures	<u>Sept. 29 (13)</u> Real gases van der Waals equation
6	<u>Oct. 2 (14)</u> <b>Ch. 12, Zumdahl</b> Intro to quantum theory Electromagnetic radiation Bohr atom	<u>Oct. 4 (15)</u> Matter waves Quantum numbers H atom orbitals	<u>Oct. 6 (16)</u> Multi-electron atoms Pauli principle, Hund's rule, Aufbau principle
7	<u>Oct. 9 (17)</u> Periodic trends Atomic radii Ionization energies	<u>Oct. 11 (18)</u> <b>Ch. 13, Zumdahl</b> Ionic and covalent bonds Lattice energies of solids	<u>Oct. 13</u> FALL BREAK no class
8	<u>Oct. 16 (19)</u> Lewis structures	<u>Oct. 18 (20)</u> Formal charge Resonance	<u>Oct. 20 (21)</u> Hypervalency Exceptions to the octet rule
9	<u>Oct. 23 (22)</u> Molecular shapes Valence shell electron pair Repulsion (VSEPR) theory	<u>Oct. 25 (23)</u> Bond polarity Molecular dipoles	<u>Oct. 27 (24)</u> <b>Ch. 14, Zumdahl</b> Valence bond theory Orbital hybridization
10	<u>Oct. 30 (25)</u> Hybrid orbitals and resonance	<u>Nov. 1 (26)</u> Molecular orbital theory Bonding and antibonding orbitals	<u>Nov. 3 (27)</u> Molecular orbital theory Diatomic molecules
11	<u>Nov. 6 (28)</u> Molecular orbital theory Spectroscopy	<u>Nov. 8 (29)</u> <b>Ch. 21, Zumdahl</b> Organic molecules Isomers	<u>Nov. 10 (30)</u> Organic functional groups Amino acids Chirality
12	<u>Nov. 13 (31)</u> <b>Ch. 16, Zumdahl</b> Intermolecular forces	<u>Nov. 15 (32)</u> Hydrogen bonding	<u>Nov. 17 (33)</u> Phase changes Heating curves



13	<u>Nov. 20 (34)</u> Vapor pressure Phase diagrams Surface tension	<u>Nov. 22 (35)</u> <b>Ch. 21, Zumdahl</b> Biological macromolecules: Proteins	<u>Nov. 24</u> THANKSGIVING
14	<u>Nov. 27 (36)</u> Protein secondary and tertiary structure	<u>Nov. 29 (37)</u> Nucleic acids: DNA	<u>Dec. 1 (38)</u> RNA and the origin of life
15	<u>Dec. 4 (39)</u> Enzyme-drug interactions	<u>Dec. 6 (40)</u> Antibiotics	<u>Dec. 8 (41)</u> Antibiotics and drug resistance
16	<u>Dec. 11 (42)</u> Molecular basis of drug resistance		

Evening exams on:      **Thursday, September 28**  
                                     **Thursday, October 26**  
                                     **Thursday, November 30**

**Comprehensive final exam: In the final exam period, date and time TBA**