INTRODUCTORY CHEMISTRY

CHEM 121.02 (Fall 2019)
Kenyon College
Professor Catherine Mauck
mauck1@kenyon.edu

Class: Tomsich 101, MWF 11:10 AM – 12:00 PM
Office hours: Tomsich 314, MW 2:00 – 4:00 PM; F 2:00 – 3:00 PM

REQUIRED MATERIALS & RESOURCES

Text: *Chemistry*, 11th ed. by Chang & Goldsby (ISBN: 9780073402680)
Tools: Basic scientific calculator
Electronic: ALEKS online course companion (Assessment and LEarning in Knowledge Spaces)
Course page for CHEM 121.02 (2019 Fall) at https://moodle.kenyon.edu/

COURSE DESCRIPTION

This course provides a thorough introduction to the fundamental concepts, theories, and methodologies of chemistry. Topics include stoichiometry, theories of molecular structure and bonding, the periodic table, acid-base chemistry, chemical equilibria and thermodynamics. This course provides a basis for the further study of chemistry. In addition to mastery of fundamental chemical concepts, students will develop skills in scientific problem-solving and teamwork.

COURSE STRUCTURE

Chemistry is a subject that requires memorization of facts as well as the understanding and application of concepts, and the integration and synthesis of knowledge from all parts of the course. The material in this course builds on itself. For this reason, this course requires that you keep up with the material, and is structured to encourage the use of effective learning strategies that can be transferred to other courses as you learn how to use them. An understanding of how we learn best is a valuable asset in this course (and others).[1] Active preparation is essential for success. This course is structured to encourage learning strategies that are well-supported by the science of how humans learn best, and shown to improve learning outcomes for ***all students***; it is especially valuable for maximizing the benefits of a class community composed of a diversity of backgrounds and life experiences.[2] The components of this course are:

- Pre-class engagement with concepts through Course Preparation Assignments (CPAs)
- Active learning through in-class challenge activities
- Regular practice through completion of ALEKS online coursework
- Assessment via weekly quizzes, 3 midterm exams, and final exam

[1] A recommended guide for further developing your own learning skills and strategies is "Make it stick: the science of successful learning," by Brown, Roediger, & McDaniel.
[2] For more information, see: Eddy & Hogan, *CBE—Life Sci. Ed.* Vol. 13, 453–468, Fall 2014

COURSE PREPARATION

Prior to each class (except the first day and prior to exam days), students are expected to:

(1) **Practice** and apply previous class concepts through progress on current ALEKS objective
(2) **Expose** yourself to the material and concepts that will be the focus of the next session
(3) **Process** and organize that information in your course notebook
(4) **Prepare** for the next class by completing the CPA

Your work preparing for class is essential and genuine engagement on each CPA will be rewarded with 10 points (~380 points total for the semester, 25% of your grade). In sum, your CPA grade makes the largest single contribution to your final grade. CPA grades are all or nothing (0 or 10 points). Each student will be permitted one missed CPA for the semester without a grade penalty. **CPAs that are submitted on time, are complete, and show genuine engagement with every question/prompt will receive credit.** It is your job to correct your CPAs (in your notebook) during the CPA discussion at the beginning of each class. If you have questions about one of your CPA responses it is your responsibility to ask about it during the CPA discussion - if you have the question, it is very likely that others do as well.

IN-CLASS WORK

Following a short lecture or discussion covering the CPA at the beginning of class, pairs or small teams of students will work on a challenge activity. These activities are designed to build from the CPA as well as concepts learned earlier in the course, and focus on engaging with the material at a higher level in the presence of the instructor. Unless otherwise stated, no electronic devices may be used as resources during the challenge activity.

Student teams will be randomly selected at the beginning of each class session. When you arrive in class, you will draw a number-letter pair (1A, 1B, etc) that designates your partner (1A with 1A, etc) and your four-person group (all 2's, for example). To be maximally effective, these collaborations must be inclusive endeavors. Group members who quickly understand a particular question or part of a challenge should transition to the role of mentor/teacher for other group members. Two individuals who both think they understand but have different answers should carefully listen to each other and try to discover the correct interpretation.

Teams must work efficiently and make sure they have the opportunity to work on the difficult parts of the material as a collaborative team. Working in teams is an essential skill in the workforce today. The ability to function well in a team, make the most of all the human resources in a team, and team leadership skills are tremendously valuable. During challenges, the instructor will be available as a resource and groups that get stuck should get help quickly. Active engagement with the challenges will be evaluated by what is written during the class session; **challenge grades will be determined by the level of engagement as evidenced by a rich written record,**[3] **and not the correctness or amount of the challenge that was completed.** At the end of each class session, each team will submit their collective work on the challenge to be graded. After class, students are responsible for completing the challenge in their notebook.

[3] Text, diagrams, clear explanation of approaches, calculations, drawings, structures, mechanisms, etc.

COURSEWORK

In addition, ALEKS practice will be incorporated as a supplement to the text. This adaptive, web-based program serves as both a resource for learning and an assessment of your mastery of the course objectives as we progress through the material. **Your ALEKS grade for the course is determined by the percent mastery of objectives at each of the ALEKS due dates and at the end of the course.** Historically students who show a high level of mastery of an ALEKS course are successful in the accompanying lecture. **Please remember that ALEKS is tailored to assist you; therefore it is to be completed individually.**

In ALEKS, there are two modes in which you will work: Assessment Mode or Learning Mode. In assessment mode, ALEKS determines what you have and have not yet mastered; each assessment takes ~45 min. In Learning Mode, you will work on objectives through tutorials and problems to build your understanding. This is best done in small but frequent blocks of time (i.e. seven 30 min periods per week, vs. one 3.5 hr session in a week). In the syllabus schedule, due dates correspond to the class by which an objective must be completed, **by midnight before the date of that class**. For example, the first ALEKS assignment will be due at 11:59 pm on Sunday, 9/1.

COURSE NOTEBOOK

You will be provided with a course notebook (a bound composition notebook) on the first day of class. You may use the provided notebook or any bound notebook you prefer. Your notebook will be the record of your work for the class and will include your processing on readings and/or videos, your personal work on challenges and practice problems, your pre-session assignments, your CPA responses, and your quizzes. **Bring your notebook to every class session (including exams) and any office hours you attend**. It is important to note that because electronic devices will not be allowed during in-class work, **you will need to copy definitions, equations, and other necessary information from the readings and videos** into your notebook before class in order to have access to this information in class.

Your notebook will be a temporal record of your activities for the class. Many students find it helpful to number the pages and make an index on the first two pages. After the index, there will be no blank pages between your work. Each day upon entering class, students will date stamp where they completed their out-of-class work. Course notebooks will be checked during the midterm exams and final exam, and returned the same day.

QUIZZES

Quizzes are an important learning tool that will enable you to calibrate your own understanding of course material. Quizzes have also been shown to help students consolidate their memory of a topic and allow them to build durable knowledge (see "Make it Stick" for details). **Quizzes will be given at the beginning of class on Fridays** and will be 5-10 minutes in length depending on the topic. Students will write their responses to the quiz on the next available blank page of their course notebook.

SEMINAR SYNOPSES

You will attend two seminars during the semester that relate to the course material and prepare a one-page synopsis of each seminar that clearly describes the motivation for the work and the significance of the results presented in the seminar. It should be clear from your synopsis how the topic relates to this class. You should indicate your name, the title and date of the seminar clearly at the top of the page. **Synopses will be typed and submitted electronically on the course Moodle page.** If you don't know if a particular seminar relates to the class, you may email me, or ideally ask during class so that others may benefit from the information. **To receive credit, please submit your synopsis within 24 hours of each seminar you attend**.

GRADING

Your grade in the course will be determined by your engagement with class activities and your accomplishment of learning goals and objectives. The weighting of graded assignments is as follows:

Course Preparation Assignments (38 × 10 pts)	380 pts	(25%)
Challenges (38 × 5 pts)	190 pts	(12%)
ALEKS online homework	300 pts	(20%)
Quizzes (11 × 10 pts)	110 pts	(7%)
Seminar Synopses (2 × 25 pts)	50 pts	(3%)
Midterm Exams (3 × 100 pts)	300 pts	(20%)
Final Exam	200 pts	(13%)
Total Points	1530 pts	

The instructors will assign fair grades at the conclusion of the term. To estimate your grade during the semester, use the following grading scheme:

Grade	Percent of Total Points Earned
A (+/-)	100% - 90%
B (+/-)	89% - 80%
C (+/-)	79% - 70%
D (+/-)	69% - 60%
F	< 60%

TENTATIVE SCHEDULE (*subject to change at instructor's discretion*)

Date (session)	Topic/Book Sections (Chang 11 ed.)	DUE (midnight, day before class)
8/30 – F (0)	Introduction and Course Structure	
9/1 - Wksp 1	*Review Workshop on 2.6, 3.1-3.3, 4.5*	
9/2 - M (1)	2.1-2.8	CPA and ALEKS (Prereq. Review)
9/3 - Wksp 2	*Review Workshop on: 2.6-2.7, 3.7-3.10*	
9/4 - W (2)	3.1-3.3	CPA and ALEKS (Objective 1)
9/6 - F (3)	3.5-3.10 (Quiz)	CPA
9/9 - M (4)	4.1-4.2	CPA and ALEKS (Objective 2)
9/11 - W (5)	4.3, 4.4	CPA
9/13 - F (6)	4.5, 4.6 (Quiz)	CPA
9/16 - M (7)	4.7, 4.8	CPA
9/18 - W (8)	5.1-5.5	CPA and ALEKS (Objective 3)
9/20 - F (9)	**EXAM 1 (through Chapter 4)**	
9/23 - M (10)	5.6-5.7	CPA
9/25 - W (11)	5.8	CPA
9/27 - F (12)	6.1-6.3 (Quiz)	CPA and ALEKS (Objective 4)
9/30 - M (13)	6.4-6.5	CPA
10/2 - W (14)	6.6	CPA
10/4 - F (15)	7.1-7.4 (Quiz)	CPA and ALEKS (Objective 5)
10/7 - M (16)	7.5, 7.6	CPA
10/9 - W (17)	**EXAM 2 (through Chapter 6)**	
10/11 - F	**OCTOBER BREAK**	ALEKS Open Pie until 10/13 at 11:59PM

10/14 - M (18)	7.7, 7.8	CPA
10/16 - W (19)	7.9	CPA
10/18 - F (20)	8.1, 8.2 (Quiz)	CPA and ALEKS (Objective 6)
10/21 - M (21)	8.3-8.5	CPA
10/23 - W (22)	9.1, 9.2	CPA and ALEKS (Objective 7)
10/25 - F (23)	9.4, 9.5 (Quiz)	CPA
10/28 - M (24)	9.6-9.9	CPA
10/30 - W (25)	10.1, 10.2	CPA and ALEKS (Objective 8)
11/1 - F (26)	10.3 (Quiz)	CPA
11/4 - M (27)	10.4	CPA
11/6 - W (28)	10.5	CPA
11/8 - F (29)	10.6 (Quiz)	CPA
11/11 - M (30)	10.7	CPA
11/13 - W (31)	10.8	CPA
11/15 - F (32)	14.1, 14.2 (Quiz)	CPA and ALEKS (Objective 9)
11/18 - M (33)	14.3	CPA
11/20 - W (34)	14.4, 14.5	CPA
11/22 - F (35)	**EXAM 3 (through Chapter 14.3)**	
11/25-11/29	**THANKSGIVING BREAK**	ALEKS Open Pie until 11/29 at 11:59PM
12/2 - M (36)	15.1	CPA and ALEKS (Objective 10)
12/4 - W (37)	15.2, 15.3	CPA
12/6 - F (38)	15.4 (Quiz)	CPA
12/9 - M (39)	15.5, 15.6	CPA
12/11 - W (40)	15.7-15.9	CPA
12/13 - F (41)	15.12	CPA and ALEKS (Objective 11)
12/20 - F	**FINAL EXAM 1:30 PM**	

CONTENT LEARNING OBJECTIVES: *Students will be able to…*

Chapter 2:

- Can describe atomic structure (protons, neutrons, & electrons) and define atomic number and mass number.
- Understand the nature of isotopes, i.e. calculate atomic weight from isotopic abundances and isotopic masses.
- Interpret, predict, name, and write formulas for ionic and molecular compounds, e.g. recognize molecular formulas and empirical formulas.

Chapter 3:

- Explain the concept of the mole, and use molar mass in calculations.
- Derive compound formulas from experimental data, i.e. empirical formulas from percent compositions.
- Perform stoichiometric calculations using balanced chemical equations.
- Understanding the meaning of limiting reactants in a chemical reaction.
- Calculating theoretical and percent yields of a chemical reaction.

Chapter 4:

- Understand the nature of ionic substances dissolved in water.
- Understand the solute-solvent relationship and expressing solutes in molarity.
- Recognize common acids and bases, and understand their behavior in aqueous solutions.
- Recognize common oxidizing and reducing agents and identify oxidation-reduction reactions.

Chapter 5:

- Understand the physical characteristics of gases.
- Understand the basis of gas laws and how to use those laws.
- Use the Ideal Gas Law.
- Apply the gas laws to stoichiometric calculations.
- Recognize why gases do not behave like ideal gases under some conditions.

Chapter 6:

- Assess the transfer of energy as heat associated with changes in temperature and changes of state.
- Understand and apply the first law of thermodynamics.
- Define and understand state functions (enthalpy, internal energy).
- Learn how energy changes are measured.
- Calculate energy evolved or required for physical changes and chemical reactions using tables of thermodynamic data.

Chapter 7:

- Describe the properties of electromagnetic radiation.
- Understand the origin of light from excited atoms and its relationship to atomic structure.
- Describe the experimental evidence for particle-wave duality.
- Describe the basic ideas of quantum mechanics.
- Define the four quantum numbers (n, l, ml & ms), and recognize their relationship to electronic structure.
- Write the electron configurations for atoms.

Chapter 8:

- Write the electron configurations for monatomic ions.
- Rationalize trends in atom and ion sizes, ionization energies, and electron affinity.

Chapter 9:

- Recognize when the rules of Lewis dot structures fail and understand the concept of resonance.
- Understand the properties of covalent bonds and their influence on molecular structure.

Chapter 10:

- Use the VSEPR theory to predict the shapes of simple molecules and ions and to understand the structures of more complex molecules.

- Use electronegativity and formal charge to predict the charge distribution in molecules and ions, to define the polarity of bonds, and to predict the polarity of molecules.
- Identify the hybridization of a molecule or ion.
- Understanding the difference between valence bond theory and molecular orbital theory.

Chapter 14:

- Understand the nature and characteristics of chemical equilibria.
- Understand the significance of the equilibrium constant (K) and the reaction quotient (Q).
- Understand how to use K in quantitative studies of chemical equilibria.

Chapter 15:

- Use the Brønsted-Lowry and Lewis theories of acids and bases.
- Apply the principles of chemical equilibrium to acids and bases in aqueous solution.
- Predict the outcome of reactions between acids and bases.
- Understanding the influence of structure and bonding on acid-base properties.

COURSE LEARNING GOALS

a) **Critical Thinking Skills** – Students will learn how to evaluate concepts, material, problems and challenges posed in the class and thoughtfully apply appropriate and efficient techniques to meet the needs of a given situation.

b) **Individual and Collaborative Efficacy** – Students will develop skills to effectively solve problems individually and as a member of a team. Students will take responsibility for their own success and seek help and resources appropriately.

c) **Metacognitive Skills** - Students develop the ability to reflect on their own process of learning and relationship to the material to evaluate where their strengths lie and how to how to focus their energy to improve.

d) **Communication** – Students will develop oral, written, and symbolic communication skills. Communication between peers, with the instructor, and to the class as a whole all represent different and important settings to exercise professional communication skills.

e) **Engagement with Scientific Information** – Scientists continue to learn and develop skills throughout their career. Acquisition of information and skill development occurs in a variety of settings using a diversity of information sources including: the professional literature, scholarly texts, technical online resources, seminars, workshops, team members, and professional superiors. Students will develop their ability to make use of all of these information sources to advance their own learning and skills.

f) **Content Mastery** - Students master the foundational concepts in chemistry that will allow them to advance in their education.

POLICIES & EXPECTATIONS

Academic honesty and collaborative work:

Kenyon College is, at the core, an intellectual community of scholars — students and faculty — engaged in the free and open exchange of ideas. Critical to this lively exchange and deep engagement with learning is the academic integrity of our work, both inside and outside the classroom. At Kenyon we expect all students, at all times, to submit work that represents these standards of academic integrity. It is the responsibility of each student to learn and practice the proper ways of documenting and acknowledging those whose ideas and words you have drawn upon (see Academic Honesty and Questions of Plagiarism in the Course Catalog). Ignorance and carelessness do not excuse academic dishonesty. If you are uncertain about the expectations for academic honesty in a class, please ask me for clarification.

Modern science at Kenyon and beyond is an inherently team-based, collaborative discipline. The scientific community has developed ethical guidelines for this type of work, in which co-collaborators are expected to openly cite and list all direct collaborators in any piece of scientific publication or presentation. Similarly, in this course, you will often work in small groups to complete assignments. Whenever you have collaborated with other students to arrive at an answer or work through a problem, you must list your collaborators on the work that you produce together. **However, exams, quizzes, and ALEKS assignments will be your work alone.**

Attendance:
Your attendance at every class session is expected. In the case of excused absences, there will be no grade penalty. **Please notify the instructor in advance of any excused absence** so a plan to minimize its impact can be devised. The penalties for an unexcused absence are the points for any class activity that takes place during the absence (challenge, quiz, exam, etc.) and missing the powerful learning experience that took place in class on the day that was missed. Students are responsible for learning material missed as a result of any absence.

Devices:
Full engagement with the in-class portion of this course will be a key component of success. **All electronic devices should be turned off before the beginning of every class session unless otherwise directed by the instructor**. On occasion, wireless devices (computers or phones) will be used in class when indicated by the instructor, and you are encouraged to bring such devices to class but keep them put away unless they are needed for a particular activity. In fact, educational research has shown that laptops in class negatively affect the performance of the student using the laptop,[3] as well as the performance of the students *around* the laptop user.[4] Notes should be taken on paper (in the course notebook). Please also note that cell phone use will affect your class participation, which is a component of your grade in this course as a part of the in-class work.

[3] H. Hembrooke & G. Gay (2003) https://doi.org/10.1007/BF02940852
[4] C.B. Fried (2008) https://doi.org/10.1016/j.compedu.2006.09.006

Title IX:
As faculty members, your instructors are deeply invested in the well-being of each student we teach. We are here to assist you with your work in this course. If you come to an instructor with non-course-related concerns, they will do their best to help. It is important for you to be aware that all faculty members are mandated reporters, which means that faculty are obligated to report to the Office of Civil rights on campus (OCR) any incidents of harassment, discrimination, sexual misconduct, interpersonal violence, or any other form of harassment or discrimination based on a protected characteristic. Please also know that there *are* confidential resources that do not have the same mandatory reporting requirements, should you need them; these are the Health and Counseling Center, the College chaplains, and the staff at New Directions Domestic Abuse Shelter & Crisis Center in Mount Vernon.

Accommodations:
Students who anticipate they may need accommodations in this course because of the impact of a learning, physical, or psychological disability (including non-visible disabilities such as chronic diseases, learning disabilities, head injury and attention deficit/hyperactive disorder) are encouraged to meet with me privately early in the semester to discuss their concerns. To set up a meeting time, please email me. In addition, students must contact Erin Salva, Director of Student Accessibility and Support Services (740-427-5453 or salvae@kenyon.edu), as soon as possible, to verify their eligibility for reasonable academic accommodations. Early contact will help to avoid unnecessary inconvenience and delays.