Syllabus for CHM 285: Advanced General Chemistry II

MWF • EPLY 107 • 11:00 AM–12:15 PM • Spring 2019

http://freitag.creighton.edu/CHM285

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Office Hours:

Monday:	8:00–11:00 AM, 12:30–4:00 PM
Tuesday:	10:00–11:00 AM, 2:00–4:00 PM
Wednesday:	8:00–11:00 AM, 12:30–2:00 PM
Thursday:	8:00–11:00 AM, 2:00–4:00 PM
Friday:	10:00–11:00 AM, or by appointment

I will be in during my scheduled office hours, but I am more than happy to see you anytime you find me in my office. You are also welcome to schedule an appointment; just send me an email.

Block Time Usage. We have 75 minutes every MWF for use in this course. For the exam days (see the calendar at the end) you will have the full time to work on your paper. On other days, class will start at 11:00 AM with an ∼10 minute question-and-answer period. When the Q&A is finished, lecture will begin and continue for approximately 50 minutes. If there is time remaining when lecture is over, you are welcome to stay in the room until the end of the 75-minute period to ask more questions or work problems.

Textbooks/Hardware. McMurry, J.; Fay, R.C.; Robinson, J.K. *Chemistry*, 7th Ed.; Prentice Hall: New Jersey, 2016, and Harris, D.C. *Exploring Chemical Analysis*, 4th Edition; Freeman: New York, 2009. You will also need a scientific calculator for exams and lectures. *You will not be able to use programmable calculators on the exams;* this includes graphing calculators. Pick up a $10 calculator that can do logarithms ($\ln x$, $\log x$) and exponentials (e^x, 10^x). This policy is followed in every general chemistry lecture and laboratory course.

Introduction/Attendance. Attendance will not be monitored, but you are responsible for all information given in lecture, even if you are not present. CHM 285 and CHM 286 are co-requisites, which means they must be taken at the same time. In the extraordinarily unlikely event of a cancelled class, I will notify you via your Creighton University email. If the *University* is closed (usually for weather-related issues), we will not have class and no special announcement will be made.

The Fundamentals. I believe the vast majority of students have the potential to be successful in this course, but that is not sufficient. You must also exercise the will, self-discipline, and fortitude necessary to do well. Since you have enrolled in this course, I assume you want to deepen and expand your knowledge of chemistry,* and I want to assist you by facilitating the development of your abstract mathematical and physical reasoning skills. To achieve these ends, I think we both have obligations. For my part, I shall do the following as best I can:

- **Give a well-organized presentation of the ideas.** Once the course topics are chosen, then my approach is this: I try to organize the ideas and present them to you as clearly, simply, and completely as possible. This presentation is the lecture and the accompanying lecture notes, which will be posted on the Blueline course website after each class.
- **Encourage communication.** Effective two-way communication between student and instructor is very important. I always try to be clear, but sometimes I say or write things that make no sense at all, either in lecture or one-on-one or in an email. Please tell me! You won't hurt my feelings (as long as you say it nicely), and the feedback will be much appreciated. Occasionally my attempts to give you an encouraging 'little push' seem more like a shove off a cliff. Let me know! Oftentimes when an assigned task seems unreasonably difficult, it is really a misunderstanding of expectations or a mistake on my part, and both should be cleared up as soon as possible.

*Indeed, since you have enrolled in this *advanced* course, I assume you're looking for a bit of a challenge...

- **Be available to answer questions and clarify ideas.** I have scheduled **20 hours** per week of office hours this semester. Even so, these are simply those times I *will* be in my office so you don't have to check ahead to be sure I'm there; I'm more than happy to see you anytime you find me in my office. (If there's something on my end that needs to be done without interruption, I'll do it from home.) I'll also do my best to answer emails quickly and completely.

  In my mind, my primary job is to *help* you genuinely understand some difficult, abstract ideas. But at the end of the day, I also have to evaluate your understanding of those ideas. Although I take both jobs very seriously, I enjoy the former much more—but I need a sincere effort on your part to do it well.

What do I mean by 'sincere effort'? Well...

- **Attend every lecture.** Unless you must be gone for an officially excused event or a family emergency, you should be coming to every lecture. Lecture is a presentation of the major ideas you will be expected to understand. Since we have only about three hours a week, there isn't time to cover every bit of information; therefore, *everything* that *is* covered in lecture is very important and could certainly show up on an exam.
- **Actively participate in lecture.** At a minimum, this means taking careful, accurate notes and working along with the examples done in lecture (bring your calculator!). Participation also means promptly asking questions when things don't make sense. To do this, you must be engaged and *thinking* during the lecture as it is presented, not just passively writing down what's on the board with the expectation of figuring it out later.
- **Realize that genuine learning does not happen during lecture.** In high school (and maybe even in CHM 203), you may have just showed up to class, stayed awake, and did fine. Even now, if you take that approach you might absorb enough to get by. (I hope that's not your goal.) Lecture can help to raise questions, clarify ideas, present materials in a way you hadn't thought of before, etc., but eventually you have to ponder these things on your own in order to truly learn the material. Don't settle for a shallow, superficial understanding.

  I'll throw down an intellectual gauntlet: if no questions are coming to mind as you study, you're not thinking about the material deeply enough!
- **Realize that genuine learning takes time.** As a general rule, you should be spending *three hours* studying chemistry outside lecture for *every hour* in lecture. In the sciences, that's what we mean by a 'three-credit' course. This may mean that you need to re-prioritize your time commitments. Unless you have an eidetic memory, cramming *does not work* at this level. For most people, it is much better to study a little bit every day rather than a lot at once. Do *not* let yourself get behind!
- **Take responsibility for your learning seriously.** Universities hire Ph.D.s as professors, not trained teachers. That means it is your responsibility to ask questions when you don't understand something. I am eager to help, but oftentimes I don't know what your specific difficulty is, or that you even have one. All the ideas introduced and discussed in lecture should eventually make sense to the point that you can explain them clearly to an interested third party. If you can't do that, then you should see me for help. You must seriously engage the material and have the humility to admit you don't *really* understand something when that's the case.
- **Study the assigned problems from each lecture.** Even though they are not graded, you *must* do the assigned problems from each lecture promptly as a self-test of your understanding. While 'doing problems' is not the main focus of this course, if you can't do the problems, then you don't understand the material, and you need to get help right away. Again, don't settle for a facile understanding by relying on memory games, rote algorithms, or other apparent shortcuts; you are a human being made to freely contemplate, not a machine made to be programmed.
- **Work on the problem sets conscientiously.** In addition to the problems assigned from each lecture, there will be graded problem sets that are meant to be more challenging. If you wait until one or two days before a problem set is due to begin, you're likely wasting your time. Start working on the problem set questions as soon as we cover the relevant material in lecture. Give yourself time to really think about and internalize the problems. Don't accept anything less than a solid understanding of the question and your solution, particularly if your solution is the result of a group activity. (See *Problem Sets* below and the separate *General Chemistry Problem Sets* handout for much more on problem sets.)
- **Take full advantage of office hours.** Successful stu-

dents ask questions. Highly successful students ask really good questions. If you're not asking questions, it is likely you are (1) trying to figuring things out on your own, which is fine if you know what you're doing, but dangerous if you don't or aren't sure; (2) not thinking about the ideas, in which case you may not realize how much you don't know—the exams will remedy that; or (3) not doing the assigned problems, which will all but guarantee failure in a course like this. Office hours are set aside specifically for students to come in and ask questions. I warmly encourage, and indeed *expect you* to come in during these times.

- **Take a simple, thoughtful, and honest approach to your studies.** There are no shortcuts to learning chemistry, and it is difficult to feign understanding on an exam (indeed, it becomes impossible in the more advanced courses). Be simple and honest: do you *really* understand the definitions and concepts? If not, see me! I get paid to help you. To the extent that you spend your time trying to do well without really understanding the underlying ideas, you will find yourself frustrated and not doing well. To the extent that you work to build up a fundamental understanding of the material, you *will* do well, and with fewer and fewer roadblocks as time goes on.

Chemistry is a difficult discipline, and not everyone has the necessary aptitude to tackle it. If that is the case, you should talk to your advisor about a change in your program of study to a discipline that better compliments your interests, abilities, and potential. (The last day to drop this course with a 'W' grade is 5 Apr 2019.) However, the majority of freshman *do* have the required abilities to do well. With help and perseverance, it *can* be done, and many generations of hard-working, successful students that have passed through these halls can attest to that. In fact, with hindsight most successful students will say that, all things considered, the course wasn't really that hard at all—as long as one was willing to *make the decision* to seriously engage the material. In the end, you must decide if you are going to do this or not.

Problem Sets. The problem sets are meant to be an opportunity for you to learn something, and are *not* intended to be an evaluation of what you know (that's what the exams are for). Since I am happy to help you with them, *there is no excuse for getting a low problem set grade.* If you get stuck on any part of a problem, come and see me and I'll help you get over whatever hurdle has blocked your progress. If you get stuck again, come back. Believe me, there is nothing more frustrating than banging your head against the wall for hours on end only to find that you've made a simple mistake someplace. Instead, bang your head for 15 or 20 minutes, then come see me. (I'm quite serious here... it will be much more beneficial to you if you make a reasonable effort at solving the problem yourself first.)

If your problem sets are insufficiently legible, I will ask you to type them up using a word processing program with an equation editor. (Failure to do this as requested will result in a point deduction.) If you can't write well by hand, you will need to learn how to use these programs efficiently if you're going to be successful in college and beyond.

You may work together on the problems if you wish. For some people, these group discussions are a critical part of the learning process; others prefer to work alone. If you work with others, be careful: in the group setting, you can help each other understand the problem and its solution, but *I don't want to see identical solutions.* Once you understand the problem and the basic technique required to solve it, work out the details on your own. I will not grade identical or nearly identical problem sets.

Problem sets are due at the beginning of lecture on their due date. It may happen that you forget to bring it one day; these things happen. Therefore, I will accept assignments until **1:00 PM** on their due date; half of the points will be deducted for each day they are late. For example, if you turn in your problem set at 1:01 PM on its due date, it has lost half its value. It will lose the other half at 1:01 PM the next day. If that seems harsh, remember: it is already late! The extension to 1:00 PM is a *grace period* that should only be used under exceptional circumstances. You are allowed one grace period per semester; if you turn in a problem set after 1:00 PM, the set is late *and* you forfeit any unused grace period. Detailed solutions to the problem sets will be posted on the course Blueline site at 1:00 PM (hence the firm deadline). Use these solutions to check your work, as it could take me several days to carefully grade and comment on all the problem sets and return them.

Exams. Exam questions will fall into two categories:

Lecture: Questions based on the material presented in lecture. (Or *Homework* questions that lend themselves to a multiple-choice format.) These may include definitions—which are very important—worked examples, proofs, derivations, or the explanation of conceptual ideas. You'll want to be thinking through your lecture notes

regularly to prepare for these questions.

Homework: These problems will be very similar to the assigned book problems from each lecture. You should be getting the vast majority of points on these questions because you've seen them before and you've had time to think about them in detail and ask questions. If you're not doing well on these problems, it is a clear sign you need to re-evaluate your approach to the material.

If you look at the exam from 2018 that is posted on the Blueline course website,[†] you'll see that many of the questions require a few words of explanation; can you *clearly* communicate what you know? At this level, understanding the ideas is only half the battle (well, maybe 85% of the battle); you also must be able to communicate what you know clearly and effectively. Therefore, you will be graded on this aspect of your work as well. Sloppy, sketchy, but arguably correct work will not earn full credit. I do not have the luxury of assuming that you know what you're saying; you need to *demonstrate* that you know what you're saying.

The exam dates are given in the *Course Timeline* section below. Plan on taking the exam on the given date. I will make other arrangements if you have an officially excused absence for University-sponsored events cleared with the Dean's office. If for any reason you cannot make it at the scheduled time, you must contact me at least one week before the exam. This does not necessarily mean that your absence will be excused, but if you fail to notify me in advance, you will not be able to reschedule the exam under any circumstances. Of course, emergencies and unforeseen circumstances will be considered on an individual basis. *"I couldn't find a babysitter,"* and *"I don't feel well"* aren't emergencies—car accidents, snowstorms, illnesses that require a doctor's visit (with appropriate, verified documentation *excusing you from class the day of the exam*), and other acts of God are.

Exams are written under the assumption that the student has reasonably mastered the material. For those who have not, the exams may be challenging to complete in the allotted time period. The exams will focus on the material covered in the chapters listed with each exam in the *Timeline* below. Absolutely **NO** cell phones or programmable calculators are allowed. If you are seen with either during any exam for any reason, you will receive a zero for that exam. This penalty is also applicable for other electronic devices except a non-programmable calculator. You will not be permitted to leave the room once the exam has started, but you may leave when you are finished.

Grading.

Item	Points	% of Course
Four exams, 100 pts each	400	80%
Problem sets	100	20%
Total	500	

Your problem set score will be scaled so that it is always worth 25% of the exam points that have been completed to date. At the end of the semester, this means that each problem set 'point' may actually be worth more or less than an exam point, since we will probably have something other than exactly 100 problem set points. Other than the items listed above, there are no sources for points in this course.

If you believe you have found a grading error, you may submit your exam for regrading up to three days after it has been handed back. In some cases, I may ask you to attach a written explanation of why you are requesting a regrade. With your explanation(s) in mind, the *entire* exam will be regraded and returned to you after making any appropriate adjustments.

Determining Letter Grades. I do not have strict, predetermined cutoffs for letter grades; instead, I look for natural breaks in the final course distribution. However, the actual cutoffs will be within a few percentage points of the following:

A	**B+**	**B**	**C+**	**C**	**D**
91%	87%	80%	76%	68%	60%

These cutoffs are never increased. Course grades are rounded to the nearest whole number; for example, if you end up with 86.6% for the course, you will get a B+. To move on to CHM 321 this fall, you must get a C or better in this course.

Creighton University defines letter grades as:

A *outstanding achievement and an unusual degree of intellectual initiative*
B+ *high level of intellectual achievement*
B *noteworthy level of performance*
C+ *performance beyond basic expectations of the course*
C *satisfactory work*
D *work of inferior quality, but passing*
F *failure—no credit*

[†]The exam from last spring is posted so you can get a feel for my style of writing questions and general exam expectations. Do **not** think of it as a 'practice exam,' as I make a point of not repeating questions from the previous year if I can help it.

Notice that satisfactory work is reflected in the C grade. Therefore, I am not alarmed (but I am disappointed) if the average grade in the course is a C. On the other hand, I'd be quite thrilled if everyone demonstrated *'outstanding achievement and unusual degree of intellectual initiative'* and I could give all As. If you sign the FERPA waiver, I will send you grade reports after each exam until midterm, and after that by request.

Extra Help. If for some reason you can't stop by my office, send an email. I should be able to reply fairly promptly, especially on weekdays. (Occasionally, emails sent to me from a non-Creighton account are held up by the University's spam filter. In that case, I will probably never see it. Your best bet is to use your Creighton account.) To request an appointment to see me outside of office hours, send an email. I tend to email the class over the course of the semester; all emails will be sent to your official Creighton University account, so you should get in the habit of checking it regularly.

Christian Hannah, a senior chemistry major, will be holding Attached Tutoring sessions from 7:00–8:30 PM every Thursday and Sunday (except as announced; location TBD) this semester as part of a program in the Academic Success office.[‡]

I will post my detailed course notes on the Blueline site after each lecture for those who need to miss class for legitimate reasons, or if you need to fill in a gap in your own notes.

I've set up a website[§] with many more help suggestions, and links to some other outside resources. There is a link to this site on the main course page. There is also a solutions manual for the textbook problems (including the odd-numbered end-of-chapter problems) on reserve in the Reinert-Alumni Memorial library. Be sure to ask for Freitag or CHM 285.

Academic Honesty. Creighton University has an established policy on academic honesty. You can read about it at your leisure in the Catalog.[¶] In addition to the specific items mentioned there, academic misconduct includes representing the work of another to be your own, defacing or tampering with library or student materials, or facilitating dishonesty on an exam. If you are found guilty of academic misconduct, you will receive a zero for the activity. Don't do anything foolish.

Parting Thoughts. Don't procrastinate, and don't be lazy. If you feel yourself falling behind, please come and see me even if you can't identify a specific problem. I should be able to tell where you're at progress-wise. If I think you're doing fine, I'll say so. If not, we'll try to figure out how to get you back up to speed. Take advantage of the resources that are available (myself, discussion groups, posted notes, etc.). If you require some other form of assistance, please don't hesitate to ask. If you sincerely want to learn, I want to help.

A final suggestion: unplug. Technology can be a good thing, but you know it can also be a mindless distraction and—despite its potential for the opposite—a lonely, detached waste of time. When it comes to technology, exercise prudence: just because you can do something electronically doesn't mean it's the best way to do it. Also practice temperance: if you can't go two minutes without fiddling with your smartphone, leave Precious at home. While you're on campus, allow yourself the time and silence to simply *think*.

Course Timeline. The calendar below is a tentative timeline and list of topics and readings for the course. Some of the dates and coverage may shift. For an updated topic calendar, see the course website.

MONDAY	WEDNESDAY	FRIDAY
14 January	16 1 Syllabus: Course Overview	18 2 Review of Significant Figures Solutions and Solvation Energy §1.9, §12.1–2
21 3 Units of Concentration §12.3	23 4 Colligative Properties §12.4–9	25 5 Colligative Properties, con't.

[‡]The Academic Success office is located in the lower level of the Reinert-Alumni Memorial Library (the EDGE office); see `http://blogs.creighton.edu/edge/academic-success/`

[§]`http://freitag.creighton.edu/guide/help.html`

[¶]`http://catalog.creighton.edu/undergraduate/academic-policies-procedures/academic-honesty/`

MONDAY	WEDNESDAY	FRIDAY
28 6 Reaction Rates §13.1	30 **University Cancellation** – No lecture	**1 February** 7 Rate Laws §13.2–3
4 8 Integrated Rate Laws §13.4–6	6 9 Integrated Rate Laws, con't.	8 10 Reaction Mechanisms §13.9–11
11 11 Rate Constants and Temperature §13.7–8, 12	13 12 The Equilibrium Constant K_c §14.1–2	15 13 **Exam I: Chs. 12–13**
18 14 Using the Equilibrium Constant §14.5	20 15 The Equilibrium Constant K_p and Kinetics §14.3–4, 10	22 16 Le Châtelier's Principle §14.6–9
25 17 Brønsted–Lowry Acid–Base Theory §15.1–2, 4	27 18 The pH of Strong Acids and Bases and Weak Acids §15.5, 7–9	**1 March** 19 Percent Dissociation and Polyprotic Acids §15.10–11
4 20 Weak Bases and Salt Solutions §15.12–14	6 21 Neutralization Reactions §16.1	8 22 **Exam II: Chs. 14–15**
11 **Spring Break** – No lecture	13 **Spring Break** – No lecture	15 **Spring Break** – No lecture
18 23 Buffer Solutions §16.2–4	20 24 pH Titrations §16.5–9	22 25 pH Titrations, con't.
25 26 pH Titrations, con't.	27 27 Solubility Equilibria §16.10–13	29 28 Activity and Activity Coefficients Harris, §12.1–2
1 April 29 Activity and Activity Coefficients, con't.	3 30 The Systematic Treatment of Equilibrium Harris, §12.3–4	5 31 The Systematic Treatment of Equilibrium, con't.
8 32 Entropy and Probability §17.1–3	10 33 **Exam III: Chs. 16 & Harris 12**	12 34 Calculating Entropy Changes §17.4–6
15 35 Gibbs Free Energy §17.7–9	17 36 Gibbs Free Energy and Equilibrium §17.10–11	19 **Good Friday** – No lecture
22 **Easter Monday** – No lecture	24 37 Balancing Redox Reactions §18.1	26 38 Galvanic Cells §18.2–3
29 39 Cell Potentials and Gibbs Free Energy §18.4–5	**1 May** 40 Using Standard Reduction Potentials and the Nernst Equation §18.6–8	3 41 Equilibrium and Electrolysis §18.9, 12, 14

Exam IV: Chs. 17–18
Tuesday, 7 May 2019, 3:30–5:10 PM