Chemistry 2740
Physical Chemistry
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> On most campuses the course in physical chemistry has a reputation for difficulty. It is not, nor should it be, the easiest course available; but to keep the matter in perspective it must be said that the IQ of a genius is not necessary for understanding the subject.
>
> — G. W. Castellan

Course prerequisites

The prerequisites for this course are **Chemistry 2000** with a minimum grade of C−, **Mathematics 2560** (or 2565), and **Physics 2000** (corequisite). If you do not have these prerequisites, you must talk to me as soon as possible.

Required materials

The textbook is *A Life Scientist's Guide to Physical Chemistry* by Roussel.

You will also need a graphing calculator, particularly for the kinetics portion of the course. A basic graphing calculator, if you don't already have one, is a great tool. You will however have to invest a little time learning to use it. In addition to the usual arithmetic operations, make sure that you can (1) use it to solve nonlinear equations, (2) perform a linear regression to obtain the slope and intercept of some data displaying a linear relationship, and (3) obtain a graph of some data points with the line of best fit. In addition, I would strongly advise you to learn how to store and retrieve values from your calculator's memories. This is a huge time saver, as well as a way of minimizing transcription errors during tests. It is *your responsibility* to learn these features of your calculator.

Email

Important information will frequently be communicated to the class via email. It is *your responsibility* to keep an eye on your email during the term.

Office hours

I strongly encourage office visits to clarify any material with which you are having difficulty. I will have hybrid (in person and online) office hours each week. The schedule will vary from week to week and will be announced by email in a timely way, as well as posted in Moodle. The link for online office hours will also be posted in Moodle.

Grading scheme

Evaluation type	Weight	Dates
Lab	30%	
Quizzes	7.5%	
Class participation	7.5%	
Tests	$4 \times 12.25\%$	Jan. 28, Apr. 1, Apr. 13, Apr. 27
Assignments	$3 \times 2\%$	Apr. 29, May 4, May 5

A grade of F will automatically be assigned if your lab mark is less than 15/30. A grade of F will also automatically be assigned if you score less than 35/70 in the lecture part of the course.

If you miss one of the tests or assignments for a valid reason (e.g. medical, bereavement), a waiver will be provided. If you miss **one** test, the overall weight of the tests will be maintained at 49%, with each of the remaining tests worth 16.33%. If you miss more than one test, a makeup test will be administered covering the material in the missed tests. In some cases, this may require delaying the assignment of a final grade. For missed assignments, the weight of the tests will be increased by the weight of the assignment(s) missed. **You must notify me** of your reason for missing a test or assignment as soon as you are able to. Advance notification is appreciated when possible. Although I do not require documentation for missed tests, I expect honesty. Note that not being prepared for a test is not a reason to skip a test except under very unusual circumstances (e.g. missing many classes leading up to a test due to illness). In these cases, I would expect to discuss the matter with you *before* the test, and I reserve the right to decide whether or not you will receive a waiver for the test.

There will be online (Moodle) quizzes for most lectures, although sometimes one quiz will cover two lectures. Watch the deadlines on Moodle carefully and make sure to complete your quizzes on time. No extensions will be granted. Your quiz mark will be calculated after dropping the three quizzes with the most negative effect on your mark. This means that you can miss up to three quizzes without needing to specifically inform me about it. If illness causes you to miss more than three quizzes, please let me know and we can discuss how to adjust the grading scheme for your situation. **It is strongly recommended that you complete all quizzes as they are essential preparation for the classes.**

Numeric to letter grade conversion

Students who obtain similar numeric grades should get the same letter grade, insofar as this is possible. I therefore try to set the grade boundaries so that the students to either

side of the boundary are separated by as many marks as possible, consistent with assigning grades roughly in line with typical practice in this Department. The following table shows the median and 95% confidence intervals (CI) of the lower boundaries of each letter grade for the 9 times I have taught this course since our last major round of curriculum changes:

Grade	Median	95% CI
A+	90	(88.5, 90.1)
A	85.0	(82.6, 85.9)
A−	80.0	(77.8, 80.6)
B+	76.0	(74.1, 76.7)
B	73.0	(71.1, 74.1)
B−	70.0	(67.8, 70.6)
C+	66.0	(64.9, 67.1)
C	62.0	(61.3, 63.2)
C−	60.0	(58.1, 60.4)
D+	55.0	(53.9, 55.2)
D	50.0	(50.0, 50.0)

The grade conversion boundaries chosen at the end of the term are very likely to fall within the historical confidence intervals. Having said that, I reserve the right to stray outside of these confidence intervals (in either direction) by up to 1% in order to assign the same letter grade to students who have performed similarly.

Conduct of tests and other evaluations

Online tests will be open-resource, i.e. you can use any resources you want (books, web sites, etc.) **excluding** any technology that allows you to communicate with other people during the test (email, text messaging, posting to Q&A websites, etc.). For some questions, it may be convenient to use a spreadsheet program instead of a calculator. Consult me if you would like to use other kinds of software.

We have become very adept at finding cheaters in online exams. Don't test me.

There will be four tests and three assignments. The tests will be time-limited and will be completed during class time with solutions turned in through Crowdmark. The assignments will have short deadlines (as little as 24 h), but will be completed after class, and again the solutions will be turned in through Crowdmark. Each of these late-term assignments will consist of a single question.

Participatory problem solving

> As a means of instruction, they [lectures] ought to have become obsolete when the printing press was invented. We had a second chance when the Xerox machine was invented, but we seem to have muffed it.

— R. P. Boas

In order to succeed in physical chemistry, you have to devote time to the material on an ongoing basis. You simply can't wait until the week before the exam to study and hope to assimilate the material at the last minute. Furthermore, while lectures can be effective for some material and some learners, it's not the ideal learning environment for most of us. Learning anything worthwhile is an active process that requires time and effort. Lectures encourage many of us to lapse into a passive mode in which we simply accept information. (This is the best case. I used to sleep in a lot of my lectures when I was an undergrad. Needless to say, I did most of my learning after class, by spending many hours with textbooks and problem sets.)

In this course, I do not lecture. Rather, you will be assigned readings from the book which you must work through *before* you come to class. You will also complete a quiz for each set of readings *before* class. The quizzes are not very difficult and are intended only to make sure that you did the readings and have made some effort to understand the material. Accordingly, you should be coming to class with at least a basic understanding of the material.

So what will we actually do in class? You learn physical chemistry by doing problems. In an online class, flipped instruction poses some difficulties, so what we will do is to solve problems *collaboratively*. I will discuss the problem and ask you to help develop ideas, explain procedures, etc. In this style of teaching, you accumulate participation marks for helping with problem solving, but also for asking questions.

Note that online classes will be recorded in case you miss a class due either to internet problems or to illness. The recordings will be made available through a link only available in Moodle to members of this class. The videos will be available for streaming, but it will not be possible to download them to protect your privacy. Moreover, the videos will be deleted after the end of term.

Participation marks

I set participation marks based on a pair of principles:

- You should contribute throughout the term. You can't (for example) be a super-participator in January and then coast the rest of the way.
- An average rate of participation gets full participation marks.

Every student can get full participation marks if they make an effort to participate regularly.

Not everyone can participate in every class, and I do not expect you to do so. Accordingly, I don't need to know if you miss a class or two. I should however be advised of longer periods of absence.

Reading the textbook

Here are a few hints on how you can profitably read the textbook:

- Only prodigies can make a single pass through a technical text and get all the information they need from it. Most of us (myself included) have to read some passages two or three times before we fully understand them. Don't get discouraged if it seems to take you a lot of effort to make sense of some parts of the text. On your first reading, look for the important and/or difficult passages. On your next pass through the text, you can focus on these.

- You may occasionally need to read (or reread) previous sections or go back to your first-year textbook for background information to help you make sense of some particular point. This is also a normal part of reading a technical text.

- As you read, take some notes. What are the key points? What are the major formulas? Your notes should of course be much briefer than the text, which necessarily includes a lot of background material, detailed mathematical derivations, and so on. Also take notes on the parts you feel you need extra help with and want to ask about in class. Reading with a pencil in your hand is perhaps the most important aspect of active reading and will help you greatly in making sense of the information presented.

- Physical chemistry textbooks contain a lot of mathematical derivations. You'll have to make a judgment call as you go as to whether you think a derivation is really important or whether it just covers a minor technical point. If it's the latter, you don't need to follow every step. If the former, then start by asking yourself what the key steps in the derivation are. If there are bits you don't quite follow, pick up a pencil and try to work through it yourself. Note too that you will be expected to understand derivations at different levels depending on their length. (Think about the constraints imposed by the examinations: Even on the final exam, I can't ask you to reproduce a three-page derivation since it would prevent me from examining the rest of the material in the course.) For a really long derivation, you will typically only need to know the basic assumptions and key ideas behind it. On the other hand, you should understand key, shorter derivations thoroughly, and be able to reproduce them in an exam.

Quizzes

After you are done reading, you should immediately test your knowledge by trying the associated quiz. The quizzes will be available on Moodle as soon as they are ready (at least a week ahead of the quiz deadline). If you do the quiz right after completing your readings, you will likely find that you can do the quizzes quickly. I'm aiming for quizzes that can be completed by a student who has read the text in 5 to 15 minutes for a quiz associated with a single lecture, or well under 30 minutes for a weekly quiz. The quizzes won't be examining deep knowledge, only basics, and will usually involve just a handful of short questions, some of which will be extremely easy, and none of which should require much working out. The intention is to make sure you do the readings, and to reinforce some key points.

You will be allowed **one attempt per quiz**. So do your readings, and then read each question carefully before you answer it and hit the "Check" button. By all means go back to the textbook as necessary.

Syllabus

The syllabus is subject to change. Changes will be announced by email. Major adjustments will be posted on the course web site.

Date	**Readings**
Jan. 5	Introductory lecture, Chapter 4
Jan. 7	Sections 5.1–5.7 excluding 5.6.1
Jan. 12	Sections 5.8 and 5.9
Jan. 14	Sections 6.1–6.4 and 6.7
Jan. 19	Sections 7.1–7.6
Jan. 21	Sections 8.1–8.4
Jan. 26	Section 8.6
Jan. 28	**Test 1** (Chapters 4–7)
Feb. 2–4	Sections 9.1–9.3
Feb. 9 & Mar. 23	Sections 10.1–10.4 and 10.5.3
Mar. 25	Review session
Mar. 30	Chapters 11 and 12
Apr. 1	**Test 2** (Chapters 8–10)
Apr. 6	Section 13.1
Apr. 8	Sections 13.2 and 13.3.1
Apr. 13	**Test 3** (Chapters 11–13)
Apr. 20	Section 14.1
Apr. 22	Sections 14.2–14.4
Apr. 27	**Test 4** (Chapter 14)
Apr. 29	Sections 15.1–15.2
May 4–5	Chapter 17