

PHYS1425: General Physics I - Mechanics and Thermodynamics

January 26, 2022 **Final Version**

([Course Calendar](#) Lecture notes)

Lecture Sessions:	Monday, Wednesday and Friday 11:00-11:50am
Lecture Location:	Wilson Hall 325
Instructor:	Xiaochao Zheng (xz5y)
Instructor Office Hours:	MWF 12noon – 1:30pm (Physics Building 106C)
In-Class TAs:	Benjamin Johnson (bsj7xxc), Ethane Steere (xaq5rz)
After-hour TA/graders:	Fady Abdelmalak (qyf4jb), Claire Thilenius (cat4rcc)
Grader:	Elizabeth Wu (vcn2fj)
TA Office Hours:	See Office Hour Google Spreadsheet in Physics Building 220 (TA office)

Before You Enroll

Section 3 is an active-learning version of PHYS1425. We will have 3(4) assignments each week. While typical work load is 4-6 hours per week outside lecture time, some people do spend significantly more (>10 hours).

This is a calculus-based physics course, but we use only a limited amount of calculus knowledge (not as much as PHYS2415). On the other hand, you must have a solid foundation of trigonometry, and be ready for a challenging science course where every week the lectures will keep you on your toes and the homework will make you scratch your head.

Course Goals & Objectives

Why is the highest degree in physics called “Doctor of Philosophy”, not “Doctor of Physics”? Will learning physics really change how you view the world? As a researcher, teacher, and continuing learner, I truly believe learning physics will change how you view and treat the world. Physics is a science that describes everything around us at the most fundamental level: Why does the sun shine? Why is sky blue? What is heat and what causes it? Can time flow backwards? Physics provides answers to all these questions, and any others you may have about the physical universe. Knowing there is a reason behind everything will help you to face your life differently, because

Nothing in life is to be feared, it is only to be understood

– Marie Curie

This course will get you started in physics, the most difficult subject in science. We will cover mechanics and thermodynamics, that underlie many of the basic phenomena in everyday life: forces and motion, rotation, equilibrium, energy conservation, oscillations, wave and sound, heat, and entropy. You will learn how to apply concepts and physical laws to solve problems. And you will develop problem solving skills that will serve as a foundation for your science, engineering or other career direction and your place as a rational, positive, and courageous member of our world.

By the end of the course, you will...

- Build a fundamental framework of concepts including forces and motion, energy, motion of solid and fluid, wave and sound, and heat and thermodynamics.

- Develop basic ability of solving problems by combining physical laws with math tools.
- Recognize one can use different methods to solve the same problem.
- Be able to check own solutions using estimation, “sanity” check, dimensional analysis, limit checks, and using different physical laws.

More important, I hope you will (eventually):

- When presented with a challenge, be it a physics problem, an engineering project, or a life crisis, be able to analyze the problem objectively, apply learned knowledge, prioritize, and solve the problem or develop a path to move forward.
- Look at the world around you and realize that there are laws behind every phenomenon. Realize how grand, yet simple Nature can be. Accept as human beings we are part of this beautiful universe, and be able to draw strength from it no matter what we face.

Course Organization

This course will follow a 2-to-1 ratio of lecturing vs. active learning. Note that because of midterm exams and snow days, the **M/W/F** sequence described below can vary from month to month or week to week, so check the [course calendar](#) and the week-by-week schedule on Collab carefully. *The following description is for weeks when Mondays and Wednesdays are lecturing (with in-class Q&A if time allows) and Friday is the “third/final day of learning” (HW due before class and quizzes held in class) of that week.* The M/W/F will be shown **in blue** hereafter in this section to indicate that they will vary from week to week, action items (assignments) and/or other important facts are shown **in bold**.

Each week, I will post on Collab the material to be covered in the following week in the form of reading assignments from the textbook and [lecture notes](#) that contain important concepts, examples, problem-solving skills, and (some weeks) short videos for demos and example solutions. You must **complete the reading** and then submit a **“Chapter Summary”** assignment on GradeScope by 2am on **Wednesday**. Grading of these Chapter Summaries will be based on completion (provide your submission has enough content). Ideally, you only need this Chapter Summary to complete the homework and the quiz of that week rather than flipping through the textbook. Keep your Chapter Summaries organized, as these will form an important part of your learning portfolio. With the Chapter Summary done, you will be more prepared for the Wednesday lecture, which will likely focus on examples.

Weekly **MasteringPhysics (MP) homework assignments** are due by 2am **Friday**. While this is an online platform, you are required to submit your written **“show your work” (SYW) solution on GradeScope** for most problems to demonstrate how you approach the problem/which physical law was applied, derivations, and numerical calculations when applicable. Grading of SYW assignments will be based on completion. Your MP grade will be counted towards the final grade only if your SYW is graded as complete.

Our **Friday lecture time** will be devoted to **weekly quizzes**: the first 10 minutes will be individual “thinking time”, followed by 25 minutes of group work, and we wrap up by asking volunteer presenters to outline the solutions so that all groups will be on the same page when we leave the room. The weekly quiz ideally should be submitted on GradeScope by the end of class, but the due time is set to 7pm (same day) in case you need more time to write the full solution. You can continue working with your group members after the lecture time, but you must write your solution independently.

Your in-class group assignment will be random at the start of the semester, and I’d like to keep them fixed throughout the semester if possible. The same group(s) can be considered as your “go to resources” when you continue studying course material and doing homework assignments. You will not grade or evaluate your group members (wouldn’t that take the fun

out of group activities?). I hope this means everyone will only gain, and never lose, from group discussions.

We will have **three exams (two midterms and a non-cumulative final)**. During the week of the midterms there will be no HW due, but you should review your chapter summaries. The exam will be **close-book and a formula sheet will be provided in advance**. The exams will be held in-class and solutions submitted both on paper and on Gradescope, will be pledged work and no collaboration and/or outside help will be allowed. Those requiring extra time will be contacted for alternate arrangement (such as a different classroom and/or time).

Textbook and Other Study Material

The **reference textbook** we will use is **Giancoli's Physics for Scientists and Engineers, 5th edition, with Modified MasteringPhysics** for completing homework assignments online. For Spring 2022 semester, this book will be offered through [UVA BookStore's "Inclusive Access" program](#). ALL students enrolled in the class will have immediate access to your digital course materials through UVA Collab for the first 2 weeks of class—for free – starting one week prior to semester start. **After the Add/Drop deadline, your student account will be charged ~\$70.** If you choose to drop the course, there will be no charge to your account. This inclusive access program is optional but if you choose to acquire your textbook elsewhere, you must opt out by the Add/Drop deadline to not be charged and you will lose online access after you opt out. Due to the special pricing, no refunds can be processed. This program aims to offer all students accessibility and affordability. If you have any questions regarding the program, please email UVAInclusiveAccess@virginia.edu

We will use **Modified Mastering Physics** to administrate the online portion of the homework assignments.

Learning portfolio: Your own weekly chapter summarizes should form the foundation of your learning portfolio. After completing the homework and the quiz, go back to your chapter summaries and summarize strategically what type of problems you solved and how. Before each exam, put all 4 summaries together and form/write your own study guide. By the end of the semester, you should ideally have condensed all 20 chapters into a comprehensive yet concise study guide that should be sufficient for preparing for the final exam.

Course material: All lecture notes and solutions (homework, quiz, exams) will be posted on Collab under Resources. Use your lecture time to listen and think, rather than speed-writing notes unless that's what you enjoy.

Assessments and Grading

The **final grade** for this course will be determined from: 30% Weekly homework assignments (that include the Chapter Summaries, MP assignments with the SYW), 20% Weekly quizzes, and 50% total from the three exams that includes 15% each for the two midterms and 20% for the final exam.

On the Chapter-Summary Assignments: These will be posted as assignments on GradeScope on Collab and are due by 2am on the second learning day of the week. I would assume most people will do this in writing to save time, but typed summaries are also fine. These chapter summaries will be graded based on completion.

On Weekly HW Assignments: These are administered on MasteringPhysics. In addition to submitting your answers on MP (and receive automatic grades), you must submit your written work (SYW) through GradeScope.

On Weekly Quizzes: These are typically 1-2 written problems (per quiz) that are based on the material you have learned in the previous and the current week, and have practiced on by doing the homework assignments on MasteringPhysics. The quiz problems will likely be challenging, and working in groups will help. The quiz will be given through GradeScope and will be graded “by hand” by me or the grader.

On the two Midterm Exams: These will be **close-book exams and a formula sheet will be provided beforehand (for review) and along with the exam**. All exams will be held in-class. Printed exam will be handed out, and solutions should be submitted through GradeScope by the end of the exam time. You should also submit your exam paper in case the electronic submission had an error. You must pledge that you have not received or given aid on these exams.

On the Final Exam: The final exam will be in a similar form as the midterms. The final exam is not cumulative, i.e., it will not test on material that appeared on the two midterms. However, the final exam will be longer and will focus more on your problem solving skills than memorization, thus will be counted more towards your final grade. Please also bear in mind that knowledge itself is cumulative, and thus implicit use of earlier material in the final exam may not be avoidable.

Because your written work will be graded by human beings (myself, TAs and graders), neat handwriting will be greatly appreciated. Label your problems clearly as “Problem 1”, “Problem 2”, etc, and box around your final answers. Use of a black or blue colored pen (or use a pencil) is preferred. Please avoid red color except for Chapter Summaries.

Grading Policy Regarding Multiple Sessions

Each session instructor may assign different weekly assignments, exams, and may follow different pedagogical methods. To ensure equity across different sessions of the same course (PHYS1425), the following grading policy will be observed across all sessions: By the end of the semester, it is expected that roughly 40% of those who complete the course may receive A (including A+, A, A-), and the class average will be between B and B+ (class GPA between 3.0 and 3.3).

In addition, for multiple sessions that follow the same active learning pedagogy, the following grading partition will be observed: 50% of your final grade will be from weekly assignments that includes 20% from weekly quizzes; 50% of your final grade will be from three exams that includes two midterm exams (15% each) and a final exam (20%).

Course Policy

Attendance Policy

There is no strict attendance policy, though missing in-person classes may cause loss of learning (and possibly some fun).

By the end of the semester, those of you who fill out the course evaluation will have the lowest HW grade exempt from the final grade. Additionally, each of you will receive a “free pass” on quizzes which means one of the weekly quizzes is exempt. This should take care of occasional illness or other unexpected “bad week” reasons for missing the HW or quiz.

Please note that Chapter Summaries are not excused, and you should still submit the Chapter Summary for the excused week.

Late Work Policy

This course has a packed schedule. Keeping up your course work – completing your reading, HW and quizzes, for example – on time is really important. For this reason, late work will be graded with a penalty unless if an extension has been granted by the instructor PRIOR to the due date. Please email your instructor (me) in advance if you anticipate difficulties or delays due to official travel, unexpected illness, and family emergencies. Such extension requests are typically granted, all you need is to ask in advance. On the other hand, extension requests based on arguments such as “having too many projects due this week” will be reviewed more carefully on an individual basis, as such challenges are considered typical for college learning (and life in general).

COVID/Illness Policy

We will follow strictly UVA Policy regarding COVID mitigation in the classroom and during in-person office hours. Should you test positive, needs quarantine, or have symptoms, please do not come to the classroom or in-person OH. Email your instructor (xz5y) by 10am the day of the class and a Zoom link will be provided for the lecture. All assignments can be done outside the classroom (including weekly quizzes).

Strategy for remote learning:

- Obtain Zoom link from your instructor
- Call in to Zoom during lecture time. Zoom recording will also be posted after every lecture
- Follow weekly schedule closely and complete all assignments
- Get to know your group (via self-organized communication channel such as group-chat) or join discord. This way, you will have access to group discussions and peer-assistance for completing the quizzes and homework assignments
- If needed, check out TA OH schedule (to be linked) and email the TA to request for Zoom access. They may be able to hold OH both in-person and on Zoom at the same time

Equity and Inclusiveness Policy

This course provides an inclusive space and all people are welcome regardless of their race, age, nationality, gender, and gender identity. Since we will be interacting with each other in class, we must show respect and exhibit courteous and collegial behavior throughout all class experiences. For more information, the Code of Conduct of the Physics Department can be found at <http://www.phys.virginia.edu/DEI/CodeOfConduct/>

Honor/Academic Integrity Policy

I trust every student in this course to fully comply with all of the provisions of UVA’s Honor Code. By enrolling in this course, you have agreed to abide by and uphold the Honor System of the University of Virginia, as well as the following policies specific to this course:

- You may collaborate on the weekly homework assignments, but each one of you must submit your solution independently. Copying solutions from online “study helper (=cheater)” websites is a violation of the honor policy.
 - Posting assignment and/or exam problems from this course to online “study helper” websites is a violation of the honor policy. **Such posting will be tracked and possibly resulting in the whole class receiving zero for the corresponding problem.**
 - You will work in groups on the weekly quizzes, but each of you must write and submit your solution independently. Copying others’ solutions is a violation of the honor policy.
 - You must complete your Chapter Summaries independently.
 - You must not give or receive any help on the midterm and the final exams.
- If achieving knowledge through honest work is not your goal, please do not take this course.

Our Team

My experience as an experimental physicist tells me that being good as an individual is important, but it only gets you to 80% of your potential. The rest comes from team work, and sometimes, a bit of luck. Our class will be diverse, some of you have not taken any physics class, while some may have taken both Physics 1 and 2 classes but still have to be here. I believe everyone has their own place. If you are comfortable with physics and problem solving, please lead the discussion within your group and/or volunteer to present the quiz solution outline in class. This course will be challenging for sure, but should not be boring nor tormenting (I hope not, at least).

You may not realize, but most of our TAs are recruited from previous terms’s classes and they will be on your side every week: They will help to explain your homework problems, guide your quiz discussion, answer your questions during office hours, and help monitoring online Piazza chat room after-hours. **In turn, if you enjoy the course, please consider working as a TA in a future term (email me, please).**

Accessibility

There are plenty of opportunities should you wish to discuss course material or other matters with me: Office hours are offered mostly in-person, email inquires are always replied within 24 hours on weekdays and often more promptly (within reasonable hours) if it’s about an assignment that is due soon. In summary, I wish I can be there whenever you need me, and please let me know how I can help.

Special Accommodations

There is no doubt the ongoing pandemic (even if it might be waning) is posing great difficulty to everyone’s life, and perhaps more so for some than others. Please do not hesitate to contact me (email or in person) if you need special accommodations and we can explore potential options without lowering quality of teaching and learning.

Students with disabilities may wish to work with the Student Disability Access Center (SDAC) to discuss a range of options to remove barriers of learning, including official accommodations. Please visit their website for information on this process and to apply for services online: sdac.studenthealth.virginia.edu. If you have already been approved for accommodations through SDAC, you will be contacted by email (from me) and we will

develop an implementation plan together. If you are in the process of evaluation, please let me know as well.

Words from a future you (well almost a future you)

From Fall2021 class, one of the End-of-Semester survey question is "Looking back, what would you like to be told regarding this course, in particular during the first 6-8 weeks of the semester?". I copied many of the answers below, un-edited, and I hope you find them useful:

I would have liked to have been told how useful it is to attend office hours and how important it is to form study groups to help understand how to complete the homework.

If you do all the practice examples on the lecture notes, you will succeed in this class.

I would like to be told that the course is extremely fair and fun, all I have to do is keep up with the work and have a genuine desire to learn. Furthermore, I would like to be told to push aside my previous notions of physics and enter the course with a fresh-mind. I hated, yes a strong word, physics in high-school, but this course had made me appreciate the value of physics and the elegance in solving these physics problems.

Start your homework the day it is assigned so that you can do a little at a time. It will make the course much more enjoyable and manageable. Waiting until the last minute only creates bad stress.

I would like to be told that it was going to be a difficult course, especially for someone who has never studied physics before. However, it is very doable if you keep on top of your work which is easy given the chapter summaries, weekly quizzes, and homework.

Do not wait until the last moment to study for exams. Because there is a large amount of information/content that is covered, by actively studying or looking over what you did each week even if it is for a small amount of time will actually be more beneficial than cramming and trying to learn all of the concepts at once.

The in-class and lecture notes examples end up being very relevant to the tests and quizzes so it's a good idea to make sure you understand all of them

I wish I knew that the TA's were personal and friendly. I also think that it's important for this class to find out what learning material works best for you, whether that's the lecture notes, textbook, or demonstration videos on practice problems.

Stay ahead of the course. Once you fall in line or behind, it gets exponentially harder to learn effectively.

I would have liked to have been told to do the extra textbook problems or even had been recommended textbook problems to practice in preparation for the exam.

Don't take notes on everything in lectures -- the pace is too fast. Focus on writing down only vital pieces of information and go back to watch lectures if needed. If you're new to physics, make sure you read the textbook chapters associated with the lecture notes (I usually read the textbook and use the lecture notes to guide me to the information in the textbook I need to read).

I would like to be warned that this class is very hard.

It would have been nice to know that it is important to have a good understanding of the first part of the course because the material builds on itself. Having a good understanding of the initial material will help you do better in the future.

The textbook is such an undervalued resource. Use it as much as possible! Also, the TA's are mostly undergrad students and are extremely dedicated and helpful, so you should try to set aside time to get help with them as much as possible. Don't overlook the first third of the semester - I actually found that portion of the course to be fairly difficult even though the concepts were supposedly less complicated.... Build relationships with your table as much as possible - that group work element is invaluable throughout the semester.

Do all example problems in lecture notes for full comprehension.

It may not seem like it at first, but this course moves extremely fast and if you let up even for a second you will find yourself falling behind. Physics is a hard subject, but it is very rewarding and very cumulative so you should really use the first couple weeks of the semester to adjust and get in the physics mindset.

I would like to be told to make sure I understand each week's material during that week instead of piling it up towards the exams.

Staying on top of all the chapter summaries and quizzes is essential to understanding the course material.

I would have liked to be told the value of going to office hours and asking TAs to check over answers and work processes in class. You may think you understand a problem, but your process could still be wrong. Going to TAs and office hours really helps clarify concepts and helps you be able to solve the HW, Quiz and eventually Exam problems.

I would've liked to have known about the review option on Mastering Physics. Redoing the HW (with randomly generated new values) a couple weeks after you originally did it is super helpful in checking if you fully understood the concept and of course, if you realize you've forgotten, you can always look back at your old work or go to office hours.

I would definitely tell future students to try to at least read and annotate the lecture notes before the lecture. I found the lecture much easier to understand and follow when I began annotating the notes beforehand. Trying to do the examples before the lecture sometimes got frustrating, but reading them gave me a good idea of what we would be doing in class and got me thinking about how to solve them.

For HW, and Quizzes work with your group and your friends. You might understand something they don't or vice versa. You can help each other learn and spend less time struggling to figure it out on your own.

Start your work early for this class so that you can stay on top of all assignments, continuing to smoothly sail throughout this class.

One thing that I think it's important to know (and that I figured out over the course of the semester) is that a "take a formula and just plug stuff in" approach is very rarely a good idea. You really need to work towards a conceptual understanding of what you're doing. Instead of simply grabbing the nearest formula, you need to make sure you understand what the formula means, when it applies or doesn't apply, what other physics principles are at play, etc. Yes, formulas are very useful, but you can't take them out of context.

The homework can be difficult but is very manageable if you spread it out over a few days, an hour at a time. The quizzes are great previews of the exams and should absolutely be done in class whenever possible.

I wish I knew how important it is to read the actual textbook and not only go off of the lecture notes provided!

This course may seem daunting at first but the TAs and the professor are there to help you, and they want to help you, so don't be shy going to office hours for help! Also, the first few weeks may make the class seem super challenging, but once you find a rhythm in doing the work and using the resources available to you to help you understand the material, you'll realize it is a very manageable class and it is easy to keep yourself on track.

You should expect to do a lot of out-of-class reading on your own before you fully understand the concepts of the class.

The homeworks are the most difficult part of the class and you should dedicate most of your time to them.

Work hard! Physics is not easy. In fact, this course was harder for me than Organic Chemistry. Utilize TA's Office Hours. They took this class before and are there to help!

Reading the textbook is the best way to understand a difficult topic and expose yourself to other examples.

Do the Chapter Summaries earlier rather than later, its helpful to be familiar with the lecture info before hearing the lecture.

Make sure to study both the lecture notes and textbook itself because they both have valuable examples to enhance your learning.

The work you put in = what you get out of the course

If you have credit for this course but not the lab section, you don't need to re-take lecture – the lab concepts are all explained pretty well in the lab and lecture adds a ton of work.

Take everything seriously! Don't relax if you've heard or learned a concept before, or you'll get lost soon.

Always do the readings before the lecture day and make time for understanding the homework's.

I wish I was told that all of the resources you need to succeed are given to you, even if that isn't apparent at first. You have the notes, the textbook, the TAs, and the professor to help you. If you are stuck or confused, those resources can help.

I think the best thing to do is finish the chapter summaries before the content starts to be discussed in class. This usually meant that the chapter summary should be done by the class before it is actually do. That way, you can write the summary and supplement the notes as you go through the lecture and learn the content.

The course is a lot of work and incredibly challenging, but if you keep at it, you'll get through it.

It will be difficult

I like how we were told from the beginning how everything would affect our grade

I can't think of anything that comes to mind. The syllabus laid out everything pretty clearly

Do each of the Pearson homework problems throughout the week (one a day makes it easier for the information to absorb rather than doing it all at once and stressing yourself out)!

If you have no prior experience, you will likely be lost. Read the textbook.

If you are struggling with the math side of things, read through the textbook examples and do the derivations on your own without the professor's guidance. The derivations are so important for later parts of the course where you have to synthesize equations we learn for different principles.

I would've told myself to make sure I understand each week's material fully before moving on.

I would like to be told how it is important to take notes in class and that people should learn how each equation is derived and used.

Do your work, go to lectures and all will be good (great)!

use the lecture notes well and seriously try all of the example problems yourself before coming to lecture and seeing the solution

I would have forced myself to complete the chapter summaries and read over them prior to coming to lecture, even though they were technically due the next night at 11:59PM. I would have gotten more out of lectures and have been able to understand in-class example problems with greater comprehension.

Always reference to the textbook when you come across difficult topics. The textbooks provide great examples and explains with clarity.

Keep up and don't fall behind, there's an insane amount of content in the course.

Course moves fast through lots of material, make sure to have a solid understanding of each week to effectively move on to next week.

There is some physics/math knowledge that is assumed going in to the course, so try to introduce yourself to some core concepts before classes begin if you can.

I would have loved it if I had been encouraged to do my homework and keep revising it at the same time so that I would do better on the exams.

For test studying, redo all pertinent test and quizzes. Go to office hours when things do not make sense. Make sure for exams you have a "first principles" understanding of the material so that you can answer questions of unfamiliar format without trouble.

Be diligent in understanding the lecture problems.

That it will be a good amount of work, but it'll all be worth it. Put in your all.

Start homework early, have a thorough understanding of course material.

I would have liked to know to read the lecture notes before class. I didn't start doing that until a few weeks into the semester.

Please talk to your classmates and ask questions when you need help.

do the homeworks days before they are do so you can have time to go to office hours for any problems you're stuck on.

Read lectures in advance.

Be prepared to do work and do the work early so that things become much easier.

That it is a difficult course but if you stay on top of work and figure out how to study effectively for the class you can succeed.

As someone who has had prior experience with physics before this class, I feel like one big thing that everyone needs to understand is to prepare to have to work so that you get all of the information down. From my experience, I feel like I put in a lot of work towards this class, especially on the homework assignment which would take me about two hours to complete. Overall though, practicing every concept in physics is necessary for success in the class.

I would like to be told that we would have a quiz every week.