

Course Syllabus

Course Number: PH 213

Course Name: General Physics with Calculus

Prerequisite: MTH 254

Course Credits: The course combines 3 hours per week in lecture and 3 hours per week in lab for a total of 4 credit hours.

Course Description: A calculus-based introduction to the classical models of electricity and magnetism, including Coulomb's Law, Gauss' Law, Ohm's Law, the Biot-Savart Law, and Maxwell's equations.

Course Content: Electrostatics, electric potential and energy, direct-current circuits, magnetic forces and fields, magnetic induction, and electromagnetic waves.

Course Specific Measurable Student Learning Outcomes: By the end of this course, you will be able to:

- represent and analyze electric fields, forces and potentials, as caused by discrete or continuous charge distributions;
- represent and analyze magnetic fields and forces, as caused by steady currents or induced by changing currents
- analyze direct-current resistive, capacitive, LR and LC circuits;
- describe and analyze single-wavelength electromagnetic waves;
- make observations of physical systems, find explanations consistent with the observations, apply the explanations and physical laws to make predictions about the outcomes of experiments, and test the explanations and laws through experimentation;
- represent information in multiple ways (diagrams, graphs, words, equations, etc.), move between representations, use them to set up solutions to problems, to predict the behaviors of physical systems, and to check the solutions to problems;
- use critical thinking skills as described below.

Critical thinking is a fundamental part of any science, especially physics, which is a discipline of modeling and problem solving.

Critical thinking is being able to:

- analyze an open-ended, new physical system
- consider what assumptions and simplifications can be made
- breakdown the situation into manageable pieces
- apply concepts to analyze each piece; combine them into a solution
- evaluate if the solution makes sense

In this course, you will use critical thinking to examine new situations and make appropriate assumptions and simplifications about them to apply useful physical models.

The learning outcomes will be accomplished via class demonstrations, voting questions, peer-to-peer discussions, full-class discussions, in-lecture group work, and lab work. They will be formatively assessed through voting questions, lab work and homework assignments; and summatively assessed during exams.

Baccalaureate Core Learning Outcomes for Physical Sciences: This course fulfills the Baccalaureate Core requirement for the Physical Sciences category. It does this by requiring and scoring student problem-solving via homework and exam items (outcome: *recognize and apply concepts and theories of basic physical or biological sciences*); by requiring and scoring lab reports summarizing students' own experimental designs and conclusions (outcome: apply scientific methodology and demonstrate the ability to draw conclusions based on observation, analysis, and synthesis); and by requiring and scoring student classroom responses on questions connecting physics with engineering, geology, physiology and music (outcome: demonstrate connections with other subject areas).

Evaluation of Student Performance: Letter grades for overall student performance in the course will be assigned on a scale of A to F in compliance with Academic Regulations 18 and 19.

Required Learning Resources: Web and email access; scientific calculator; personal electronic device with the Top Hat app; *Physics for Scientists & Engineers (4th edition)*, by Knight (Pearson, 2017)—either hardcover book, softcover book, or e-text.

Optional Learning Resources: Mastering Physics access code.

Statement Regarding Students with Disabilities: Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at <http://ds.oregonstate.edu>. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations."

Student Conduct Expectations: Students are expected to conduct themselves in accordance with OSU's code of student conduct, summarized here: <http://studentlife.oregonstate.edu/code>.

More detailed course information is offered on the following pages (with quick-links provided here):

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Instructor

Name:	Chris Coffin
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Office:	Weniger 309
Mail box:	Weniger 301 (Physics Department office)
Office hours:	MWF 1000-1250, T 0900-1150
Daily schedule:	(click here)
Letters of recommendation:	(click here)

Required materials and resources

Prerequisite courses:	MTH 254.
Prerequisite skills:	Algebra, trigonometry, differential and integral calculus, vector calculus.
Required text:	<i>Physics for Scientists & Engineers</i> (either hardcover, softcover/loose-leaf, or electronic, by Knight, 4th ed. , (Pearson, 2017).
Required technology:	E-mail and internet access; Canvas access; Microsoft Excel (or compatible software). Scientific calculator; graphing calculator OK provided that it <u>cannot transmit wirelessly</u> . Response app licensed from Top Hat. <i>Mastering Physics</i> (online resource)—ONLY IF already packaged with the text.
Course web site:	http://www.physics.oregonstate.edu/~coffinc/COURSES/ph213/
Other online resources:	The textbook E-text version and <i>Mastering Physics</i> practice materials (click here).

Course format

OSU credit:	PH 213 is a 4-credit course, including required lecture and lab. <i>The 1-credit recitation portion is a separate course (PH 223), optional for some majors but required for others.</i>
Lectures:	3 hours/week (50 minutes – MWF), Weniger 151
Labs:	3 hours per week (170 minutes – MTWR or F), Weniger 204, plus take-home follow-up work.
Assignments:	All homework (HW) and other take-home assignments will be posted on the Course Calendar.
Exams:	2 group midterm exams, 80 min., Wednesdays (4/24, 5/15), 8:30 p.m.. 1 final group exam, 110 min., Thursday 6/13, 7:30 a.m.. All exam locations TBA a few days prior to the exams. No make-up exams. All exams closed-book, open-notes (1 handwritten sheet, 8.5" x 11" – both sides OK).
Religious Holidays:	OSU strives to respect all religious practices. If you have religious holidays that are in conflict with any of the schedules or requirements of this class, please contact the instructor as early as possible to make alternative arrangements.
Alternative accommodations:	Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you believe you're eligible for accommodations but have not yet obtained approval, contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu . DAS notifies students and faculty members of approved accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

Grading

All assigned (scored) works and due dates are shown on the [Course Calendar](#). *Scored works (including exams) earn points only; the only letter grade is the final grade for the course.* A total of 1000 points is available for the entire term.

Scored work: Class (lecture) participation (100 points). [Full lecture details here.](#)
Lab scores (100 points); [Full lab details here.](#)
HW scores (100 points); [Full HW details here.](#)
Two midterm exams (250 and 200 points, respectively);
One final exam (250 points). [Full exam details here.](#)

Grading scale: The final course letter grade is computed via the percentage earned by the student out of the total possible (1000) points available, as follows (and see below for [full grading details](#)):

≥ 84% = A
≥ 80% = A-
≥ 76% = B+
≥ 72% = B
≥ 68% = B-
≥ 60% = C+
≥ 52% = C
≥ 44% = C-
≥ 40% = D+
≥ 36% = D
≥ 32% = D-
< 32% = F

Academic integrity: Lab reports (the written work done during lab itself) are done as group work, as may be any exercises recommended for study before or after lecture. Also OK for group work are some items responded via clickers during lecture (others not—the instructor will so indicate). *But all homework (HW) sets and exams are to be done on an individual basis.*

Any incidence of academic dishonesty will be dealt with in accordance with OSU policies —refer as needed to the [Statement of Expectations for Student Conduct](#). See also the longer discussion of [personal integrity](#), below.

General Description

- Course level:** PH 213 is a 200-level course. It is more than a “survey” course (it’s not a 100-level course). It is comprehensive, time-intensive, challenging and mathematical, with problem-solving throughout. It is a 4-credit course and includes a laboratory.
- Bacc. Core certification:** This course is part of the OSU Baccalaureate Core (“Bacc. Core”); it fulfills Oregon State University’s requirement for study related to Physical Science. The Bacc. Core Curriculum represents what the OSU faculty believes is the foundation for students’ further understanding of the modern world. Informed by natural and social sciences, arts and humanities, the Bacc. Core asks students to think critically and creatively, and to synthesize ideas and information when evaluating major societal issues. Just as importantly, the Bacc. Core promotes understanding of interrelationships among disciplines in order to increase students’ capacities as ethical citizens of an ever-changing world.
- Science seeks to develop a fundamental description and understanding of the natural world, from elementary particles to the cosmos, including living systems. Students should have the opportunity to explore the insights of science, to view science as a human achievement, and to participate in scientific inquiry. This experience includes the challenge of drawing conclusions based on observation, analysis and synthesis. To ensure a broad perspective, the Bacc. Core science requirement consists of two parts: physical science (including earth science) and biological science.
- More specifically, PH 213 is designed to produce and assess (among others) these three essential learning outcomes. Students shall be able to:
1. Recognize and apply concepts and theories of basic physical sciences.
 2. Apply scientific methodology and demonstrate the ability to draw conclusions based on observation, analysis, and synthesis.
 3. Demonstrate connections with other subject areas.
- The following description/discussion of the course offers detail on each of these outcomes.
- Focus and approach:** PH 213 begins where Newtonian mechanics and its applications (both macroscopic, with rigid bodies or fluids; and microscopic, with thermal processes) leave off: How to explain the interactions of matter—how bodies exert forces on each other (and indeed, how macroscopic bodies form) in the first place? And how to explain the most elusive of phenomena—light? All this is the scope of classical electromagnetic theory, where seemingly “empty” space is viewed differently—as a fabric with distinct and consistent properties. Students are asked to track and distinguish force and field vectors, and potential and energy scalars—all in the internally consistent system of SI units. Their powers of visualization, mathematical analysis and synthesis and sense-making are tested and stretched in this, the most challenging topic in classical physics.
- As a chronological story line, electromagnetic starts with the ancient Greeks, whose term for amber (*elektra*), came to denote the strange crackling and attractions produced when it was rubbed with wool. But it wasn’t until the 18th century when Benjamin Franklin noted and named the two kinds of electrical charging objects could undergo. And then it took another full century—as the field theorists began to describe space itself (with both force and energy properties) and as the experimentalists tinkered with wires, magnets, coils and arcs—before Maxwell’s unifying mathematical reasoning connected all the clues.
- Finally, therefore, students put together the equations of Gauss, Biot/Savart, and Ampere—all as Maxwell summarized and formalized them—to arrive at the wave theory of light: The *calculation* of light’s expected speed—from a couple of other universal constants (one from electricity, the other from magnetism) is an unforgettable moment. The year’s tour of classical physics is thus completed in a mere 11 governing equations (5 for mechanics, including four Conservation principles; and 6 for electromagnetism, including the four Maxwell equations): Our physical universe, as it was understood prior to the year 1900.
- At all times, the students must make sense of the connections—not merely swallow formulas for later regurgitation; and to assess their success, they are required on exams to recognize and apply the basic principles to situations they have never before encountered—and to *justify, in their own words*, their reasoning.

The scientific method:

PH 213 examines science and the scientific method in three distinct ways. First (from the opening lecture), science is presented as a continuing, unfolding process, not a collection of facts. One new observation (properly vetted and repeated) can still unhinge our current theories. We continually seek to examine our reasoning and to test the consistencies we observe. We seek to generalize, simplify, unify. The story of Maxwell's equations drives this home.

Then, too, as individual topics in that story are examined to illustrate the underlying principles, idealized conditions and problems are hypothesized. Students detect this, and they comment/question: "But what about edge effects?" "What about other fields or charges—however distant?" "What about the reciprocal effects enunciated by Faraday and Ampere?" From that point, they begin to accept scientific modeling—even as "first approximation"—as useful and revealing; and we make a point to explicitly state the simplifying assumptions of any model used (and the resulting uncertainties that must accompany any experimental results). Later adjustments to theory simply make those models more robust, producing more and better predictive power. But the awareness of the physical limits to actual experiment/testing becomes built-in this way (especially after they experience trying to take actual lab measurements). They gain a better appreciation of "how we know what we know."

The highly autonomous labs, along with follow-up questions on the exams, are used to assess students' mastery of the scientific method.

Wider applications:

PH 213 is firmly connected to other fields—employing examples from many areas of common experience—both in the natural world and in everyday technology: Static electricity, lightning and other arcs, chemical conductivity, batteries, light bulbs, electric heaters, motors, electronic frequency filters, oscillating circuits and devices, ferromagnetism, geomagnetism, polar auroras, generators, alternators, transformers, antennae, radios and telecommunications.

These examples are offered not only in lecture/demonstration or reading but also in assessment forms: as scored homework exercises and as exam problems.

Critical thinking:

The clicker questions in lecture hone students' skills at organizing, comprehending, and predicting—distinguishing the apparently similar from the logically correct. The same goes for the conceptual questions of the pre-lab assignments. The lab sessions themselves then let students test learned principles in practice—don the skepticism of science and re-create knowledge; after all, no scientific knowledge came originally from a book. The skills acquired in these parts of the course are tested in the short-answer sections of the exams.

Then the longer, more complex homework problems sharpen students' application, analysis and problem-solving skills—tested subsequently in the long-form ("write-out") problems on each exam. In those problems, students must synthesize (from known principles) their own solutions to multi-part situations they have never before encountered. To do so, they must first take these situations apart and identify the basic physical principles at work ("spot the physics"). Then they must apply what they know about those principles (equations, relationships) to construct either a numeric or descriptive solution.

In this way, PH 213 helps build in students a skill set that, while shaped via training in one area of science, impacts their lives more generally—and many students become aware of this and comment on it by the end of the course: They learn to think logically and critically, to listen and evaluate, to apply and synthesize in new situations, and to organize—and get the details right. They learn science literacy and walk away with a new vocabulary (and confidence) and awareness of science in the news: dark matter, wind and wave energy capture, a new particle collider. They see the relevance and connections of these to their lives. They are better prepared to be voting citizens, taxpayers, professionals—and parents—in the future.

Specific Course Content (See the Course Calendar for details on topics, assigned work, due dates and exams.)

<u>Topic(s)</u>	<u>Learning Objective(s)/Outcome(s)*</u>
Week 1: Electric charge types; charging of objects; conductors and insulators; Electrical force; Coulomb's Law; Electric field of point charges.	Correctly describe charge types and behaviors on both conductors and insulators, incl. contact and induction. Correctly calculate electrical force and field (both magnitude and direction) caused by one or more point charges.
Week 2: Electric fields of continuous charge distributions: rings, disks, planes and spheres; Motions of charge(s) in electric fields.	Correctly construct/integrate field effects of a continuous distribution of charge, in various common configurations. Correctly apply N. Laws to charged masses in E-fields.
Week 3: Electric flux and Gauss's Law; Applications: E-fields around spheres, wires, and on or inside conductors.	Correctly calculate net electric flux over symmetric closed surfaces. Correctly apply Gauss's Law to find enclosed charge or field strengths, including in/on/near conductors.
Week 4: Electrical potential energy of charged plates and point charges; Electrical potential due to point charges and continuous charge distributions.	
Week 5: Connecting electric potential and electric field; Capacitors; dielectrics. Electric current and resistance.	
Week 6: Ohm's Law; Kirchhoff's Laws; DC circuits: purely resistive and RC circuits. Batteries and energy/power supplied/dissipated.	
Week 7: Magnetic fields: Biot/Savart and Ampere's Laws; Magnetic forces on point charges, wires and loops; Ferromagnetism.	
Week 8: Electromagnetic induction: motional emf's and eddy currents; Magnetic flux; Lenz's Law; Faraday's Law Inductors.	
Week 9: LC and LR circuits (DC); Generators and transformers; RC filter (AC) circuits; RLC (AC) circuits.	
Week 10: EM field transformations; Maxwell's and Lorentz's equations; EM waves: speed, fields, intensity, polarization.	

**Note: For all application, modeling and calculation objectives and outcomes, an accompanying outcome is also required of (and explicitly stated to) the student: That he/she be able to summarize/restate the physical situation in words (including the recognition of when there is insufficient information or identifying relevant information amidst an excess), construct a mathematical representation from which his/her numerical model is then derived; state any assumptions or simplifications inherent in the model, recognize the limitations and/or shortcomings of the model, and defend his/her overall reasoning, approach and conclusions.*

See the Course Calendar for complete details on all topics, assigned work, due dates and exams.

Lecture (and clicker) policies

- Seeing and hearing:** The lecture hall is large (and the center board area is small). The viewing screens are good, but the overhead lights can sometimes wash out details. If you have trouble seeing or hearing, please try to find optimal seating for your needs. Also, please advise the instructor if there's anything he can do (e.g. speak louder, write larger, move out of your view of the board, etc.).
- Courtesy and etiquette:** At all times, you are expected to show mature courtesy toward each other and the instructor. Just like you, every student around you has paid real money (\$15-25) for each class session. Of course, you're free to use your own tuition purchase however you wish, but you are NOT free to prevent others from getting the most for their money. In particular:
- Be prompt to class. It's disruptive to everyone (including the instructor) to arrive and "unpack" after class has started. And if you know you must leave early one day for a specific reason, please sit near the back, so that you can go quietly.
 - Unless authorized by the instructor: Silence all cell phones and other electronic devices.
 - Refrain from conversing except during group discussions. In fact, refrain from any activity that distracts your fellow students (or the instructor).
 - The instructor will dismiss you at (or usually before) 10 minutes before the hour. Do NOT begin to pack up before being dismissed, as it makes it very difficult for other students to hear the last part of the lecture (which is often a key point).
- Class format:** The class sessions are a mix of conventional lecture, small-group discussion among classmates, and interactive response (using a clicker app—an electronic response program operated by each student on their smart phone). A typical session will include 2-5 clicker questions, often with one such question at the start of the hour.
- Scoring:** A full 10% of the entire course grade is for class participation—scored via clicker questions. You earn 3 points per question simply by responding—regardless whether your response is correct. If it is correct, you earn 4 points. However, the maximum number of points possible for the term is simply $3N$, where N is the number of clicker questions asked. Thus you can get all possible clicker points simply by always attending and participating. But an extra point is awarded for each correct answer to allow for some "insurance points;" in case you must miss class for any reason. (Any such "insurance" points left over at term's end are discarded). Then for final grade calculation, your clicker point total is divided by $3N$, and the result is multiplied by 100 to convert your score to the proper points weighting for the whole course. (Clickers are 10% of the grade: 100 points out of the 1000 total available in the course.)
- Frequently asked questions:**
- "If I miss my regular lecture time, can I drop in on the other section?"* Yes (so long as there are spare seats), but you won't get any clicker points that day. Your clicker app is activated only for your registered lecture time (either 1400 or 1500).
- "What if my clicker app fails or my phone runs low on batteries during class?"* Due to the size of the class, it's not feasible to note individual circumstances for this—sorry, you won't get clicker points that day. But just as with unforeseen absences, this is why an extra point is offered for every right answer: it's up to you to "bank" those extra points as insurance against such contingencies. (And of course, be sure to get your clicker app and/or phone ready for next time.)
- "How can I get the answers to the clicker questions we do in class?"* You'll have to be there to note them yourself (or get them from a classmate if you miss lecture). With some exceptions, they are usually not posted.

Lab policies

- Overview:** Not every week has a lab, but for each lab, all pertinent materials will be posted on the [Course Calendar](#)—numbered to match that week of the term. For that week, you should read and/or prepare in advance for the coming lab’s expectations. You will then go to your lab session, do a lab activities as part of a small group (3 students, typically—but lab teams may change week to week), and complete a written group Lab Report.
- Your lab session is three hours (170 minutes, actually). Some labs require all this time, so if you don’t read the lab activity ahead of time, you’ll run out of time and have to schedule a make-up time. Be ready! The lab TA will fill you in on details about equipment, etc., but you should walk in already knowing the basic activity itself. The labs offer (demand) a high degree of autonomy from you and your lab group. *Neither the TA nor the written lab material will offer you a “cookbook” guide as to what to do; you will be, to a large degree, designing your own experiments.*
- Lab reports:** The lab activity is indeed group work, and your group’s responses in the Lab Report must be put into your and your lab partners’ own words. Turn in your group’s report (containing each partner’s name) to your lab TA before any of your group leaves the lab.
- Take-home portions of lab:** Many (but not all) labs will include a take-home exercise to be done individually and turned in (to your Lab TA’s box). Due dates are shown on the Course Calendar and on each exercise. Do not confuse these take-home lab portions with Homework (HW)! Any assignment with the word “lab” attached to it is part of lab and should be submitted to your Lab TA, not to the HW submission box.
- Scoring:** Your lab TA will score your group’s Lab Report during the week after that lab, returning it the following lab session. Certain randomly chosen items from each report will be scored, so the raw total points possible may vary from week to week. However, this raw total will be recalibrate to 100 points total possible for the term (which includes the take-home portions of the labs that are scored separately and handed back within a week of their due dates).
- Lab Zeroes:** If for any reason you earn **zero** points for **either** the lab report or the take-home portion of any lab, that will result in a “Lab Zero” for that week. **You do not want any Lab Zeroes.** Why? Because for each Lab Zero you have at the end of the term, your total course score is reduced by 5%. *Example: Suppose, after the entire term is done, you have earned 540 points out of 1000. Normally this would be a C grade for the course, but if, in accumulating those 540 points, you had one Lab Zero (say you were absent one week and didn’t make that up in Week 7 or 9—or say that you failed to turn in a take-home portion), you would lose 27 points. That’s 5% of 540. This would then give you 513 points, a C– for the term. Bottom line: Don’t miss labs (and prepare/participate fully), and don’t skip the take-home portions. You have to do both parts each week!*
- Making up lab reports:** Week 10 (Tuesday-Friday) is designated as lab report make-up week. Lab TAs will be in the lab during all normal lab times, and there will be various apparatus from the term’s previous labs arranged and available for you to do the labs and prepare the reports. *You are allowed to make up **no more than 2 (two) lab reports** during any make-up week.* (Note, you do not need to restrict yourself to the lab hours of your own lab TA during make-up weeks.)
- Making up take-home lab work:** The due dates for the take-home portions of lab are firm. If you are late with any such assignment, you can still get some credit by turning it in **no later than June 7 at 5:00 p.m.**, but the credit will be just 1/4 of what it would have been otherwise. Beyond that point, you’ve earned a Lab Zero for that lab.
- Frequently asked questions:**
- “If my group gets a really low score on a lab report, may we re-do it?” Yes. But that, too, is a make-up lab (one of two maximum) that you could do only during the make-up week where that lab is set up.
- “Are lab activities/procedures covered on exams?” Not the lab reports. All evaluations of your work in the lab come from the lab reports. However, the take-home lab portions cover basic course concepts and methods—those are fair game on the exams.

Homework (HW) policies

Overview: There are Prep problem sets posted each week (or sometimes a double set over two weeks)—look for the blue links on the Course Calendar. These are to help you prepare for the actual HW sets (one HW set posted per exam unit—orange links on the Course Calendar). You will not turn in any Prep problem solutions, but you will turn in your completed HW sets (to the HW TA's box—see the Contacts page on the course web site for that information).

Solutions: Prep problem solutions are posted 24-48 hours after that problem's "do" date (shown on the Course Calendar). HW solutions are posted very shortly after their turn-in deadlines.

Frequently asked questions: *Where do I turn in my HW assignments?* See the Contacts Info page.

Can I work with others to do my HW? Yes, but the solutions you turn in must be in your own words, diagrams, variable names and logic. Points for any verbatim or close resemblance to others' work will be split accordingly—with warnings.

Why aren't the HW sets posted until a week before the exams? Because you won't be ready to try them until then. The HW problems are fresh variations on the subject matter; **just like the upcoming exam problems**, they involve mixes of different concepts—taken from throughout the unit we're studying (all 3-4 weeks). So you won't have studied enough (lecture, lab, and **especially Prep problems**) until about a week before the exam. Consider the HW assignment to be your final prep before the actual exam (and last year's actual exam is posted with the HW set to further help your studying).

You scored only some HW parts/problems that I didn't get to—but I did others. Do I get a zero for that HW?
Yes—sorry. You are expected to do all the HW problems.

"How will I know my HW scores?" The HW TA grader will score your work and then return it to me—pick that up in my office. But that may not be for up to a week after you turn it in, and there will be the exam in the meantime. So you should always keep a copy of your completed HW, because right after the due deadline, the solutions will be posted.

"Why do we have both Prep problem sets and Homework (HW) sets?" The Prep problems are for your practice—you don't turn those in for credit, and you should be doing these a few at a time, pacing as indicated on the Course Calendar (and their solutions will be posted on that same pace, about 1-2 days after the recommended "do" date for the problems). *You will NOT have good success with the HW sets—or the exams—if you haven't worked Prep problems!* (They're all from exams in past years, by the way—as are the problems we will be working together in class.)

"So, what's the best way to study using the Prep problems?" First and foremost: Work a few each day—**do NOT put off all your Prep practice until a few days before the midterm**. That is a recipe for failure. *This is why the Course Calendar shows a few recommended Prep problems each day—that's the pace you should try to follow—and you won't be able to do well on the HW or the exams without this work!* Definitely try each problem for yourself first—without looking at the solution (if that solution is indeed already posted). Really work it until you've done it or gone as far as possible—and that means seek out "partial" help, with classmates/study partners or office hours visits. (Note here, too: Often, issues related to Prep problems will be part of the lecture hour—bring your clicker and be prepared to tear into the tough parts in a group setting.)

"Do I need to finish all of each Prep sets?" "Need" is the right word to use here. You should do Prep problems until the topics are making sense—until you're "conversant" if not "fluent" with the physics tools you're practicing. That may be true after a few items; it may not. You'll need more practice on some topics than others (and each person is different). So **you work them until you don't need any more practice—only then should you try last year's exam and the HW set.**

Exam policies

Overview: There are two group midterm exams, each 80 minutes in duration. There is one group final exam, 110 minutes in duration. (See the course [calendar](#) for all exam dates and times.)

The midterms are worth 250 and 200 points, respectively; the final exam, 250 points. Each exam emphasizes the most recent material, but all exams are cumulative; use of material on previous exams is fair game. This gives everyone incentive to continue to look at past material and cement into their understanding even after the first exam that covered that material. This is especially important this term in mechanics, when so much earlier material is used later.

All exams are closed-book but you're allowed one 8.5" x 11" sheet of paper, with any notes you want on it (both sides), *so long as they're in your own handwriting*. You're also allowed a calculator of any type, provided that it doesn't send or receive wireless communications (no laptops, palmtops, PDAs, cell phones, etc.). *Always bring pencil(s), eraser, and your OSU ID.*

- Scoring:** The exams are scored by TAs—one TA per problem or part, so that scoring for that item is consistent across the whole class (and point values are shown, to help you budget your time).
- Reviewing your exam:** It takes a week to score and record exams. Then they're available for pick-up (in Wngr 309). You must present your OSU ID to pick up scored work. When you get your exam back, be sure to check the scoring against the solutions (which are posted shortly after the exam). If you find discrepancies, **do not make any marks on your exam**. Instead, file an exam appeal.
- Appealing your exam score:** To file an exam appeal you must use the [Exam Appeal Form](#) and follow all of its instructions. As you will read on that form, you must identify the problem/item and specifically why the scoring is incorrect, etc. It is NOT sufficient simply to say "I think I deserved more points for this." You have to say why. And as the form recommends, the best approach for this is to use a photocopy of your exam and basically "re-score" the problem in question, as if you were the grader, showing how your version of the scoring is more aligned with the posted solution.
- Leave your appeal for the instructor in Wngr 301 (the Physics Department office). He will accept for review all appeals that are filed by the deadline (and make every effort to review and return them promptly), but no appeals will be reviewed until after the deadline has passed.
- The instructor's decisions on appeals are final; there are no re-appeals at the course level. If you wish to re-appeal at a higher level, you should promptly notify in writing (an email is fine) the Head of the Physics Department—and copy the instructor on this notice, as well. You will then receive instructions on the next step in that process.

Frequently asked questions about exams:

"What are the exams like?" About 4-5 days before each exam, full details are posted about it: exam room locations, what to expect, what's "fair game," what information will be provided (and what won't). Last year's exam is also posted. **The best guides as to the scope and depth of the exams are the Prep problems and the HW.** Each exam is a lot like a HW problem set, actually (but again, with all-new problems). Lab activities are generally not covered on exams; take-home lab concepts are, however.

"The exams don't reflect what I know. I study hard, and I think I really get this stuff, but then I get to the exams and I just freeze up or make mistakes I wouldn't normally make. How can I improve my exam performance?" A lot of difficulties come from simply losing confidence and poise in the exams—you rush and misread things you wouldn't when not under time pressure. So use the HW set to practice! Put yourself under timed conditions—see how you do, correct your mistakes, score the results, identify the missing concepts. The more you do this, the better you'll get. And then the other question is: Are you getting from the Prep and class problems what you should be? They're not just busy work—they're intended for you to study and generalize from, so that when you encounter test questions with new situations, you can recognize the same physics principles operating there, too.

"Why are the exams so difficult?" Physics is a difficult subject—no question about that (but see the comments below about [how to do well](#)). The exams are actually written to be as brief and as easy as possible while still testing to see if you really understand the material. But "understand the material" doesn't mean simply memorizing certain problems or situations or recognizing/regurgitating formulas. It means correctly applying the physics principles you've learned—and the only way to test that is to ask you to apply those principles in situations you've not seen before. This is a different sort of learning and a different kind of exam than you're used to in other courses, so the raw class averages on the exams are typically between 30 and 50%—but don't panic about this. You may be used to getting 70-90% on exams in other courses, but a lower percentage exam average here does not indicate that you're failing—nor even that you're destined for a lower grade: be sure to track your progress (see page 14 here)!

"When we first encounter a topic in reading or Before Class items, it seems fairly simple and easy by itself, but then when it appears on exams, it's all mixed up with other topics. Why?" That's the only way to tell if you can understand when/how a certain physics principle is operating: when you can distinguish it correctly from others. Before Class items and textbook materials alone are not sufficient preparation for exams. Lectures are hopefully going to show you how to "think out loud" as you approach new problems, but you still need to continue on your own, through **the Prep problems, and the HW sets**. You will not do well in the course simply by doing the Before Class and class activities. You need to go in-depth and practice. (Consider: A dictionary is a succinct list of words and definitions, but you don't learn to read and write by studying a dictionary. You need to see examples of writing, and then practice—and practice some more. You learn by doing—not by seeing.)

"The problems on the exams take so long—they're like the HW problems. How can you expect us to do them in the time allowed on the exams?" Before worrying about finishing any problem—grinding out the math and getting an answer—you should be **setting up the problem**. About 70-80% of the credit for any HW or exam problem is for doing that—not for crunching down to an answer. The setup—that's the "Spot the Physics" skill we'll be working on in class a lot. So unless/until you are getting all the setups correct on exam problems, you shouldn't be worrying about how long they take to finish—**the partial credit you'll be getting will add up to excellent exam scores anyway**. The "finish" portion of most physics problems is essentially math—but that's after the real work has been done: Each exam problem is about translating the physics situation from one language (English) to another (math) in order to understand it more clearly. Physics is the story; math is merely the language we tell it in.

Grading policies

General discussion:

Besides the exams (worth 700 points over the term), there are three other parts to the course (clickers, lab and HW) in which you earn points. A full 30% (300 points) is offered in these ways, a built-in incentive to actively participate in all those parts of the course, where you're learning thinking and communications skills, in addition to physics principles. In general, if you do well with the three non-exam parts, it will typically raise your grade at least half a letter above what you'd have as a result of your exam average alone. So use those other parts of the course as intended: "Max out" those points by working hard and monitoring your understanding as you go, and it will serve you twofold: The extra points you earn in the course; and (more importantly) the work habits and preparation it gives you.

By the way, note: The percentages you will earn for clicker and HW for the term will never be lower than your exam average. Say, for example, that you have earned a 75% exam average (525 points out of 700), but only, say, 50% (50/100) for clickers. Your clicker score would be adjusted automatically to match your exam average (75%)—you'd get credit for 75/100 for clicker. And likewise for HW. But **this is NOT true for lab—only for clicker and HW.**

Note, too: The [grading scale](#) has a "borderline" policy. Under certain conditions, if your earned point total for the term is within 10 points of the next grade cutoff line, you're moved to that grade. Those conditions are as follows (you must satisfy them all): (i) Complete all your work in lab (no Lab Zeroes); (ii) turn in all three HW assignments, all reasonably attempted and original work; (iii) max out your clicker score (100/100—not hard to do—see page 7 here); and (iv) and show steady/improved exam performance during the term (your final exam percentage must equal or exceed your overall exam percentage for the term).

Frequently asked questions:

"Are the exams—or the course overall—graded on a curve?" No. But sometimes adjustments are made for difficulty. Here's the distinction: A "curve" means that the instructor looks at the distribution of points earned by all students and arbitrarily divides the A's from the B's from the C's, etc.—based on "natural" cutoff points (i.e. where there aren't very many scores, and/or where the highest and lowest scores landed). That's not done in this course; [the grading scale](#) is fixed. But each midterm exam may have an adjustment—points added to everyone's score, based upon the instructor's estimation of that exam's difficulty. This gives you the clearest possible picture of where you stand as the term goes along. Then the final exam adjustment is not only for the difficulty of that exam but also as a retrospective judgment for the term as a whole. *This final adjustment is, by instructor policy, always sufficient to get the class average to C.* But there is no attempt to "shape" a curve and divide it into A's through F's. *Everyone can earn a high grade in this course; there's no "minimum quota" of D's or F's.*

"I got an F on my exam. Am I going to fail the course?" No, you didn't get an F on your exam. You didn't get any letter grade at all—it's all just points in your total, and there's no letter grade associated with that total until the end of the term. And don't forget that a full 30% of your course grade is earned via lecture, lab and HW—your exams are NOT the whole picture. To see where you really stand, you'll need to [calculate your current grade](#) correctly. It's your responsibility to do this.

"My lab TA is a tough grader, but other TAs are easier. My friends are getting more points for their groups' lab reports than I am for mine, and yet I know we had similar results. How is this fair? Those points affect our grades!" Yes: Some TAs are more particular in insisting that you give more complete answers. They all get the same answer keys/rubrics from the instructor, but of course, they're all human; each has his/her own style. So the instructor's spreadsheet is designed to detect, week-by-week, if/when certain TAs have been tougher graders than others. And the playing field is then automatically re-leveled—by adding some points to the students with tough TAs—so essentially you're all being graded by the same (the most lenient) measuring stick. So be glad if you have a strict TA, because if you can learn to get good scores from him/her, then when the spreadsheet adds points to compensate you for the extra rigor, you'll have "icing on the cake," points. Sit down with your TA and go over your scored lab reports and find out where you missed points. You have the answer keys already—the rubrics that appear in your lab materials.

"This course is so hard—aren't you causing a lot of students to fail?" No—quite the contrary: This course is more lenient in grading than OSU's own Academic Regulations actually allow. According to AR 17, a grade of "C" (GPA 2.00) is supposed to be the average grade. In other words, assuming a normal distribution of scores (a reasonably symmetric-looking bell curve), *only about half of the students would be getting grades of C or better in this course.* But last spring, for example, of the 290 students who enrolled in this course, 216 (74.5%) got a grade of C or higher. In other words, we reported that 3 out of every 4 students were "average" or better. So if there's any grading issue here, it's grade inflation. A grade in PH 213 at OSU right now actually denotes less achievement than it's supposed to.

"But still, this course is way too hard and too much work for a 200-level course!" That comment simply reflects unrealistic expectations brought from other courses or schools. There's nothing in any OSU AR that says 200-level courses are "supposed to" require only a certain (modest) level of time and effort. Physics is a difficult subject—more so than many others. But even then, its workload is not out of line: OSU's own Academic Success Center lists guidelines for average time budgeting in any course at the university—2-3 hours of study time for every hour in class. That's exactly where this course is, **if you spend your time studying in the manner prescribed (which is quite different than you may be accustomed to).** Here's the key: It's not just about how much time you spend—*it's how you spend it.* You will not succeed if you approach this course as merely a set of equations and situations to memorize without really understanding the meaning of what you're doing. Please keep reading here....

How to do well: notes from the instructor

Comments on the topic and the course:

What is the purpose of this course? For almost everyone, it's a required course; few take it as an elective. And no wonder: It's intense, fast-paced, wide-ranging, time-consuming—and more difficult than most other science courses.

So, why is this course required for your major at all? What do “we” (whoever “we” are—your advisors, professors, admissions officers, future research or industry colleagues and employers) want you to walk away with from a course in General Physics? One over-arching goal is one you may not have fully considered (or encountered) before now: **We** want you to be able to think clearly about complex problems—ones you've never encountered before—using the familiar principles and practical reasoning about the physical world: “What is this new situation similar—to that I've already seen?” “What must the solution approach if I simplify it—or let it proceed to some logical extreme?” **We** also want you to be able to clearly and compellingly communicate and defend this reasoning to others, including acknowledging your assumptions, your models, and their inherent limitations.

The other major goal here, of course, is the basic content itself: We want to give you a thorough grounding in basic physics—mechanics, fluids, thermodynamics, electricity/magnetism, optics, etc.—so that in your professional careers, you can recognize and work with the principles, terminology and units of physics.

In other words, we want you to become “literate” in basic physics. If you are literate in a given language, it means you can read and write it, synthesizing and/or responding to new ideas with understanding and flexibility. It would not be correct to say, for example, that someone is “literate” if he/she has merely memorized the spelling and pronunciation of a list of words or phrases. You can train a parrot to do that—and the bird has no idea of the meaning of the sounds or symbols (nor, of course, how to combine them in new ways to deal with new situations).

So this course is not about memorizing formulas or verbatim definitions. That would be like memorizing a list of spelling words. This course is more like a course in vocabulary, grammar and phonetics—about grasping the meanings and connections between the principles and formulas of physics. That's why the short-answer portion of the exams will ask very exact questions about the meanings and implications of what you've learned—often with no calculations involved. And that's why the HW and exam questions (the longer, “write-out” problems) are built the way they are: They will put together the ideas that are presented separately in class and in the text—together in ways that *should be recognizable* to you if you're truly grasping the meaning of the principles, rather than just memorizing the formulas and symbols. In other words, if you really know your vocabulary, grammar and phonetics, then you'll have no trouble on an exam comprehending a new sentence made from familiar words (and likewise, you'll have no trouble spelling or pronouncing a word you've not encountered before)—nor any trouble explaining yourself and justifying your reasoning.

Now, think about the other science courses you've had: chemistry, biology, etc. Without question, it is necessary to do a LOT of memorization in those subjects, because there are just too many complex phenomena—and your purpose is not to reduce all the behaviors you see to a few underlying principles. But physics is the converse: It's the study of the (very) few principles that apparently operate without exception on everything in the universe—and which give rise to the astounding variation you see in say, chemistry and biology. Physics is the one field where we can look at a baseball, a planet and a molecule as basically the same sort of “thing” when it comes to, say, motion. Each is just an object—and each obeys the same principles of motion.

Physics is the science where we try most to see principles in action, not memorize phenomena. And that is what can make physics difficult if you've been immersed awhile in other sciences. You have to start thinking differently—start seeing the same physics in action behind lots of different situations (and of course, it's all expressed in terms of mathematical relationships, so your math needs to get sharp again, too)—situations which may or may not contain enough information (or too much, some being irrelevant). Your task in this regard is “Spot the Physics.”

Ultimately, of course, I have to judge whether you've learned basic physics “literacy” here—and how to communicate it and defend your reasoning.

I wish I could offer you a completely individualized, self-paced and self-guided course, where you could study and prepare on your own schedule, then arrange a time to come in and take an exam on each topic (including questions that relate that topic to others you've already studied, etc.). And you could take as much time as you wished on each exam—and repeat it until you got it right. It would be great, wouldn't it? Well, resources being what they are, of course, we have to get you there with just a few exams. And make no mistake, I do let the exams guide your grade—about 70% of it. But I do recognize how high the stakes become for those exams—and they're rigidly timed, too. That's a lot of pressure, and I know that very few of us do our best under such circumstances. Under such pressure, it's often hard to demonstrate how much you do understand. I know this. I acknowledge this. I am no different.

With that in mind, I've gathered some thoughts on how to do well—starting with these....

- This is a challenging 4-credit course, with lab. Take it seriously, get organized, and get focused. Do all the reading, all the writing—and don't let up. This is a good preview of what professional level dedication and concentration feels like (which, after all, is where you're headed with your education). It will require 12-18 hours per week of your time—spent properly, as described here— outside of class). Get ready, accept this, and plan on it. *There's no shortcut*.
- Use the web site daily to stay current—announcements appear regularly, and there is a complete course calendar. Do not get behind! There is a lot of material to cover; the pace is relentless and demanding. It's hard to catch up.
- Seek help early if you're having trouble! Besides my office hours, there's help from TA's in Weniger 334. Office hours for the TA's in this course are posted under the Contacts link on this site, too.
- All these warnings; all this work—why bother? *What are the benefits to motivate you?* These: Do this course right—really get your tuition money's worth—and you'll walk out as a more rounded scientist, a sharper problem-solver, a better thinker and communicator. And you'll know it; you'll have a new confidence. Don't settle for less.

How to study and use the course:

Time expenditure alone does not guarantee success in this course (rather, it's guaranteed to be impossible if you don't spend the time). You need to spend it in the right ways. Ask successful students who have been through this course, and they're likely to give you the following advice:

Watch for announcements daily (including weekends)—usually sent via Canvas, but time-stamped on the course home page, too.

Do the material/exercises recommended in the Before Class (and After Class) links. This (not in lecture) is where I'll do much of the traditional “story telling”—introducing the physics concepts and trying to guide your individual study of them. No, none of that material is “required” (scored for credit in any way). But believe me, everything will make far more sense if you follow my recommendations. MUCH of the story is what I lead you through “after hours” (online), and I'll be asking about it with clicker questions. I'm saving our class time more for discussing/developing our reasoning—the stuff that we really need to see live-and-in-person and talk about. So please: *Do not skip* the pre- and post- lecture material/recommendations I post online. Yes, this is a lot of time to spend on the course—and yes, I know you have to balance your time with other courses you're taking. But truly, I think I'm saving you time in the long run over the whole term. This is far better than putting things off and trying to “cram” before exams—that just doesn't work with physics. And by the way: This guided study and extra material is in response to many constructive student evaluation comments from past years, wishing for better guidance on how to spend individual study time. (“*I spend so much time, but I don't think I'm studying what I should be—I thought I knew this stuff, but when exam time came, I didn't.*”) So I want to do a better job in guiding what you think about—and in what order—as you study on your own time. That's my over-arching goal—but I'm reviewing/preparing/posting material as we go, so bear with me.

Come to class. This should go without saying, but I need to say it. I will often post the class notes prior to lecture, certainly afterward. But that will be the only record I leave with you as to what happened in class—you really gotta be there, in other words. Do I recommend you take notes during class? That's up to you, of course—everyone learns differently—but just realize that the format of what we do in “lecture” won't really be traditional lecture. I won't often stand up there and dispense physics content to you in the conventional format of a lecture. The main reason we all get together in one room is to practice our reasoning and communications skills. Yes, the topic will be physics, but the agenda is really learning to communicate scientific and technical understanding—to other human beings. So don't try to play stenographer of all the conversations—you'll be too busy recording it to participate fully yourself. And it's in the participation where the concepts will sink in—take them home *in your mind already*, not just on paper.

Be an active listener and learner. Don't believe anything I say or anything you read (or hear/see) until you've checked it out for yourself—until you've confirmed it. That's how you learn—by re-creating (re-teaching) it to yourself—even if it's just mulling it over in your mind and restating it after someone else has stated it. The aphorism is absolutely true: “*You don't really learn a subject well until you try to teach it to someone else.*” Active learning means, essentially: Be your own teacher. It works. It has to work. Nobody can teach you a subject like physics (or math, or most conceptual topics, for that matter). You can hear the story first from someone else, but then to really grasp its meaning, you have to re-tell it to yourself. Obviously, our class format—lots of discussion and small- and large-group debates—are meant to encourage you to use your own words a lot. Take that idea and generalize it to your study sessions, too: Talk to the wall, your roommate, your parakeet, whatever—just force yourself to form words to express your ideas and understanding of the physics. *It works*.

One good step on the road to self-teaching, of course, is to encounter the material and ideas multiple times—from different angles and perspectives. Every term, I get comments that the material made so much more sense when the TAs explained it later (after you worked through my materials, went to class, worked Prep problems, did the HW assignments, etc.). **Yes. That's exactly how it works.** You'll need to hear this stuff multiple times. That's *normal*.

Use the clicker questions as they're intended: to help prompt your thinking and get the words flowing both ways—to you and from you. I purposely ask some clicker questions which may not seem fully clear (or have too much extraneous information), or sometimes where the best answer is among the most common wrong answers—*the common mistakes and misconceptions*. I don't do this to be “tricky” or annoying. I do it so that you can monitor whether you're really getting it or just think you're getting it—that's the point. Many concepts and definitions in physics are easy to confuse if you're not careful. That's what I'm trying to let you detect early—so that it doesn't show up later (on the exam). So treat each clicker question as a true challenge. No matter whether it's a concept question or a conversation starter, don't just buzz in with some random answer just to get credit for being there. That's being penny-wise and pound-foolish. Counting clicker credit and the reasoning you must show on all HW and exam problems, **fully half the points available in this course are for conceptual reasoning and for defending that reasoning**. Don't overlook this. And consider: You can get really good at the concepts and communicating them even if you never get the hang of write-out problem-solving; but you won't get far on the write-out problems if you don't know the concepts behind them. (Aha!)

Read each lab before you come to the session—with these labs especially, you don't get a lot of specific instructions; essentially you design your own experiments. The labs are often lengthy, so if you spend too much “get-up-to-speed” time, you won't finish, and then arranging a make-up lab time is a hassle. *A word to the wise.*

Use the take-home portions of the labs as they're intended: These are essentially **worksheets** where you can really crystallize and check your understanding—shore it up before diving into Prep/class problems (let alone the HW sets and exams).

Use all the human resources we have available. The TAs and I have a lot of Office Hours each week (and by definition, Office Hours are open—no need for an appointment—the door will be open, and you can just drop in). And remember that I am just the lead “story-teller” and main “discussion facilitator” in this course. And I know that hearing a story just once seldom does it in physics (it sure didn't for me). So I'm not hurt or insulted or anything to know that you're going to get things clarified by one of the many excellent TAs we have. I know these folks. Of those returning with experience, I've specifically asked them to work with me in this course. I count on them to offer you different explanations, different words and pictures. They are terrific, as I hope you'll soon discover—and you should feel welcome in their office hours (and of course, mine). Do not ever forget: We together—the TAs and I—are your biggest fans. *We want you to do well.* We want everyone to get an A, in fact (yes, that's possible). And we're the ones who write and score your exams (not some faceless bogeyman with a red pen somewhere), and we're rooting for you all—every one of you. Of course, we're not going to give points away without you showing you know your physics, but we're certainly going to look beyond goofy arithmetic errors, for example, to appreciate what you really do to demonstrate that you grasped the physics. So if you're having difficulties, come on in to office hours and “think out loud” with one of us (and with other students who are in the same boat—often the best sessions are when you work together in small groups and bounce the ideas around). *You teach each other*—better than I could ever do.

How to monitor your progress:

The key in all this is to monitor where you are—and what you're not getting. Use colored pens, sticky notes, whatever—make a point to come in during office hours to check your solutions and your thinking and to iron out the rough spots, so that the HW problems come more easily. They are your “dress-rehearsal” for the exam problems (and lab and lecture are designed to sharpen your physics comprehension and reasoning/communications skills. And if you're doing all of the above, you'll have no trouble creating a meaningful and useful sheet of exam notes sheet—which is the first, best way to study for each exam. The students who did the above regularly did better and better all term—and all year. *They learned how to learn and communicate physics.*

Successful students also monitor their progress and standing in the course, **so that they aren't worried/distracted by it**. The link below takes you to an example calculation sheet you can use to estimate fairly closely where you stand during the term. ***Only YOU are responsible for knowing where you stand in the course.*** So be sure to keep accurate records of all your scored work—including your clicker questions answered in class—regardless whether you were right or wrong.

Your TAs should hand back your lab assignments a week after you handed them in. Then, with all your scores in front of you, you can readily calculate your standing and progress in the course at any particular time you wish. The best explanation of how to do that is to see an example—[click here](#) to download that. Then either do the arithmetic on paper (a worksheet template is provided), or [click here](#) for an Excel spreadsheet that will accomplish the same thing (and notice the other information offered by the spreadsheet).

Personal integrity:

This section of the Syllabus is included because of a few incidents, both large and small, that have occurred over the years in this course. Let me assure you that I am very well aware—and very appreciative—that most of you don't need this reminder. If I thought otherwise, I simply wouldn't do this work. But I want everyone to read this.

We (the very dedicated TAs and other staff and I) choose this course, despite the long hours, mainly because of the quality of people in it—that's you. Working with students like you is the best job I've ever had. But I'm very well aware, too, of the pressure of this course—of grades and of the majors and credit loads you're all working under. I've been there, too—and so has every TA and every member of this department. And I'm here to tell you that nothing—*nothing*—is worth the price you pay if you buckle under that pressure and give in to the temptation to take shortcuts. For the sake of a few points, or an increase in a grade, you risk your future career, the trust of your friends and colleagues, your own integrity—and your self-respect. Good trade? No way. That's math we can all do.

Nevertheless, a pattern has emerged in university academics over the past few years. It's a pattern of thought, of assumptions about what should be adjusted when things go wrong. The right assumption is that your actions/habits should be adjusted. The wrong assumption is that the rules should be adjusted. I am here to caution you not to slide toward that wrong assumption. Let me give you some examples of past instances in this course—again, not many, but enough for this concern and caution:

Cheating rarely starts with someone thinking, *"I'm going to cheat!"* Rather it starts with, *"I know this is against the rules, but—this one time—I really need to be an exception!"* In other words, it starts with the idea that one need not bear the full consequences of one's actions if one can just figure out how to duck those consequences. That's what troubles me most—it's that start of a really insidious habit, a way of thinking: "sliding by" is somehow OK, as long as you can get away with it.

- I have heard from those asking for partial/full credit for non-partial-credit items (*"see, if I'd only used the right units or read that part of the question, I'd have answered it correctly"*). (Yes, but you didn't, so it's wrong.) There are plenty of portions of this course—about half the total points—where judgment is called for and for which partial credit is awarded. But some parts are either right or wrong. As long as the questions are worded clearly (and I do throw them out when I fail at that) either you answer it right and get all the points, or you don't get any. Every one of you is a professional in training. And professionals don't get partial credit for their screw-ups where it's important to get it exactly right. Professionals admit their mistakes, fix them, take full responsibility, and then work hard to figure out how not to do it again.
- I have heard students making excuses for missing deadlines, assignments—or even exam times (*"I wrote it down but lost my notes"* or *"my web access went down"* or *"I couldn't find it on the web site"* or *"I couldn't be in class that day"*). It's some version of trying to blame other parties/circumstances—anything except their own failures to stay on top of their responsibilities, to manage their time, and to verify or to otherwise have a Plan B for all crucial times/dates. Any version of that blame-deflecting is very unprofessional. This isn't high school.
- I have heard from those who forgot to write their names on their papers, who put them in the wrong TA boxes, who forget to bring clickers or calculators or ID or pencils/eraser. (In some cases, TAs came to the rescue, but even then, a few went so far as to ask also for leniency in grading *"because of the distraction/time lost"* trying to find/replace their missing items).
- I have heard from those who lost their exam notes sheet (or otherwise didn't have time to prepare the allowed ONE sheet of handwritten notes—what part of that is unclear?), so as quick replacement notes they brought multiple sheets into exams, expecting the rules to look the other way because it was an "emergency."

You get the idea. In each such case, the bad choice when things go wrong is to look for another way out—rather than to simply stand up, admit it and face the music. Can't remember your TA's name or section # or box #? Forget your notes sheet or your calculator? Do your best without it (or with just one sheet of whatever you can write down in 30 minutes)—it will remind you to prepare better next time. The same goes for learning to always put your calculator (and leave your clicker!) in your backpack—and to tape a copy of the course calendar and your TA's info in your notebook. In other words, the right choice is to take the consequences for not yet having adopted the responsible habits of a professional.

See, it's the hope/assumption that one can arrange to be forgiven—to be an exception to the rules which link actions to their full consequences—that's the real danger here. Not only does avoiding the consequence let you avoid learning to do better in this particular instance, but that way of thinking becomes a habit in itself—it's a mindset that is very destructive. All regulations somehow start to look negotiable—or evadable. And sooner or later it boils over into outright cheating—taking rules into one's own hands (*"these don't need to apply to me in this case"*) and setting them aside.

Is this so bad—cheating against "arbitrary" or "artificial" rules in an academic setting? What's really at stake, after all? It's just a few marks on a paper or transcript, right? Sure—and it's also just a few marks on a ledger, a research data sheet, a design spec. You're training to become the next generation of physical scientists and engineering professionals. Whom would you rather have researching your future—or building your cities, or advising your government? Someone who is in the habit of bending rules and "sliding by"—or someone who is in the habit of "sweating the details" to make sure to get them right? That's the difference between mediocrity and excellence—between making things a bit worse or a bit better.

Forming good habits for excellence starts with assuming that the responsibility is on you to change, to adjust. Most laws and rules that you encounter in life don't come with clear, simple explanations as to why they're good and necessary. But most—including those in this course—do have good reasons behind them. I've gone to some lengths in this Syllabus to explain those reasons. But whether or not you've read those—or agree with them—is really beside the point.

The point is, this is not a game. A college degree is not just an artificial hoop you have to jump through in order to qualify to pursue a profession. There is real content here—and it's not just the stuff in the textbook. This course is tough, no question about that. Its pace, its subject matter—everything—is very demanding. But as such, it functions, too, as a sort of “boot camp”—for all sorts of professional and life skills that have nothing to do with physics, but which are very important: Communication, time management, attention to detail, logical/analytical thinking, clear and accurate reading, setting priorities, active learning, self-discipline and self-monitoring of understanding and capacity. It may be a course called physics, but all these aspects end up being there as a necessary sub-curriculum all the same. In fact, those skills will stick with you much longer—and serve you and everyone you serve much better—than understanding Newton's Laws or Archimedes' Principle, or anything else about physics itself.

Yes, it's possible to get through this course, staying within all its rules, without fully developing such professional and life skills. If you do, you're cheating yourself (and you probably won't score very well, either)—it's up to you. But if you try to actually “navigate” around the course rules, too, you're cheating everyone—and not just here and now, but down the road, when you apply that same mindset, that same habit to your future work (i.e. to all of us).

This is not going to happen on my watch—not if I can help it. I don't like to play security cop; I like to assume the best of intentions by all, and usually that is the case. But I want to be very clear: If we (I or any TA or other instructor) do detect and can verify any of the following, the least that will happen is a zero or reduced credit for that assignment or part of the course:

- Bringing and using other students' clickers (or otherwise impersonating them) in class. If I see this, I will note all IDs involved, notify all parties, and all those parties will receive a zero for clicker for the entire term.
- Taking exams for someone else, or copying on exams—via wandering eyes or other methods or devices (including changing answers while waiting in line to turn in exams). If they see this, proctors will confiscate the exam(s) in question—depending on the complicity of the “copyee” (some may be unaware). Any exam so confiscated will get a zero score and prompt further investigation.
- Using illegal notes or illegal calculators/computers/communication devices during an exam. Again, a zero will be scored for that exam.
- “Doctoring” a scored (returned) exam, then appealing it. Let me be clear: I am very happy to review the scoring on your exams. We truly want you to look them over and demonstrate any points that you earned but were mistakenly omitted. Not only do we want you to have the points you deserve, but it's a great time to learn/review the material. But I do ask you not to write on your scored exam for this very reason (and the [exam appeals process](#) describes what you need to do). And people generally follow this with no problems. In my time at OSU, I believe I have detected two cases of this sort of dishonesty. At those times, I couldn't prove it, but it is now much more easily documented (***we now photocopy the scored exams before returning them***). As outright fraud, this is especially egregious.

Learning is all about making mistakes. This is a place of learning, so it's a place especially full of mistakes. I ought to know: I make a bunch of them every day. We all do. Nobody is here to ridicule or hammer on you for making honest mistakes, no matter how careless or boneheaded. We all get tired, distracted, frazzled. What I'm trying to say is that NO mistake of that kind is unfixable—in fact, that's what we're here in large part to do: to figure out what's going wrong and make it right—not to pretend that it didn't go wrong.

So it's far better to just say quietly, “*I messed up—and I want to learn to do better.*” And as part of that, you must accept the consequences of that mistake. If you don't feel the consequences, you won't learn to avoid them the next time. But those consequences are always less than what comes of trying to avoid them (trying to put the blame elsewhere or hiding the error). And there is nothing more important, more vital, than having been unsuccessful at something first, but then—through MUCH effort and frustration—honestly working it out and finally getting it right. Nothing feels better—*or is better*. I don't care what your transcript says, that's the definition of a winner and a success—and that quality will take you a lot farther in life than any GPA. If you doubt me, just live a few more years. But meanwhile, please, don't bargain away that quality in yourself. That quality is really what you're here most to develop and polish—and why I so enjoy working with you.

Last comments:

There are many of you and just one of me, and I regret not being able to spend more time with each of you. I do try to learn names, and (over the course of three terms), I do get to know many of you, and truly, that's the best part of the course for me. And I don't get tired of telling this story—I learn something new every time. This is the “grand tour” of physics—a long and event-filled “bus ride.” I'm your driver and tour guide—welcome aboard.

What will be the best part of the trip for you? I don't know—I just want to make sure that there is a best part for you. I know that physics often looms up as simply a huge mountain of work and struggle for students. But it's really heartening how often they will say to me at the end of the course that even though it was hard work, they enjoyed it and found at least some topics really interesting. That makes it all worthwhile. Amidst all the work and hectic pace, my personal goal is not only to convey the material to you but to help you find some meaning in it for yourself. For all your time spent in this course, I really hope you'll take something with you more enduring than just a grade on a transcript. It's an incredibly beautiful universe we find ourselves in, and the story of that beauty starts with physics.