Physics 11 — Spring 19

Lectures: Tuesdays and Thursdays, 12:00 - 1:15, Robinson 253 (in the SEC)

Discussion sections and Labs: The complete schedule is posted on SIS.

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Teaching Assistants

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Help hours: TBA.

If you need an individual meeting, with any of us, just ask. Send your TA e-mail, and for me (David) please check my calendar of times I'm available for appointments.

What you need:

1) A clicker: "i>clickers" are available at the bookstore. All you actually need is the clicker itself; we won't use the REEF system. Feel free to buy it used, including the old version (isbn: 9780716779391).
We'll be using clickers from the first day of class.
If buying a clicker presents a financial difficulty for you, please let me know.

2) FlipItPhysics: I'll assign 20-minute video "prelectures" and "checkpoint" conceptual questions, typically one of each before each lecture. **The Course Access Key is gojumbos**.
And again, if buying FlipIt is a financial difficulty, let me know.

3) Piazza: Students suggested using Piazza as the forum in course evaluations a few years ago, mainly because it allows anonymous posting, which Canvas doesn't. It's made some students more comfortable to ask questions as well as to complain or make suggestions about the course. Click on the link to get to our course, and the access code is, again, **gojumbos**. *Piazza is free*.

That's all you need to have for the course: a clicker, FlipIt and Piazza.

I also recommend you get a conventional textbook. Buy old editions to save money! Physics 11 has typically used Giancolli, *Physics for Scientists and Engineers.* Other old standards are Tipler (same title) and Halliday & Resnick *Fundamentals of Physics*. And then there are some others I think improved on the old standards. One is Cummings, Laws, Redish and Cooney, which never caught on, but there are used copies for sale cheap. Another is Etkina, Gentile, and van Heuvelen, but it's much too expensive.

Those are all calculus-based; for a "conceptual" supplement, try Hewitt's Conceptual Physics. Again, go for old editions, buy it used.

About the course

“The whole of science is nothing more than a refinement of everyday thinking.”
Albert Einstein, 1936

This course is about forces and motion. The first, most important thing to realize is that you already know an awful lot about pushing and pulling and hitting things, how they move or don’t, and you’ll need to use it. I don’t mean your prior physics course, if you had one. I mean stuff every ten-year-old knows: that it would hurt to kick a bowling ball, that you can’t throw a balloon across the room, how far you go in 3 hours if you’re driving 30 miles/hour, and so on. That’s all common sense, or “everyday thinking” as Einstein called it, and it really and truly is the beginning of physics.

It’s only the beginning, though, because while it’s so important and useful, it’s also inconsistent. Here’s a quick example: Part of common sense says that covering something keeps it warm, such as your hand with a mitten or a blanket. Another part says that covering something keeps it *cool*, such as your hand with an oven mitt or a potholder. An idea can be really obvious in one situation, and the opposite of that idea can be really obvious in another.

Now here’s a question: If you wrap an ice cube in a nice, thick blanket, will it melt faster or slower than if you leave it unwrapped on the table? You’ll think it’s faster if you use the “keeps it warm” part of common sense, and you’ll say “slower” if you use the “keeps it cool” part. Trying it in this case would give you a very clear answer which is right, and it’s interesting how often people predict it wrong. That’s why we need to refine everyday thinking.

The second most important thing to realize is that the work of the *refinement* involves finding the flaws in reasoning that goes wrong. Whatever you predicted for the ice cube, if you were thinking about it honestly based on what you know about the world, you were being sensible and intelligent. If your prediction was wrong, and you want to learn, you need to go study that reasoning to figure out why it didn’t work. You need to figure out what about that reasoning needs repair.

Learning in science isn’t just about acquiring information and finding out the right answers. It’s about building and assessing and repairing a network of connections among ideas, designing a system of thinking that’s stable and reliable. It will help to think about what ten-year-olds know, what works about it and what needs refining. It will also help to get evidence from the physical world, from experiments and experience, as well as to think through and argue about different lines of reasoning. It will help to *be wrong* and then go figure out that wrongness and try again.

The third most important thing is how useful *mathematics* is for reasoning. You might think of math as separate from common sense; you might think of learning physics as memorizing formulas and when to use them. But math is about ideas, and it’s an invaluable part of refining everyday thinking. We’ll use it to express ideas, but very precisely. And we’ll use it to derive implications of ideas, including to arrive at new ones. I’ll save my examples for lecture.

What's required and why

1. Attendance

Please attend lectures, sections, and labs. They will all involve your participation, including talking with other students sitting nearby, responding to questions on behalf of your group or just for yourself, and, certainly, asking questions of your own.

Lectures will involve a lot of your answering and talking with others about multiple-choice "clicker questions." You don't have to get them right; the idea is to get you thinking, tapping into and revising your everyday thinking. Clicking any answer gets you a "participation point" as a small incentive. (There'll be some of the same kinds of questions on exams, but on exams you'll have to get them right.)

Some students object to participation points in lectures. If you're one of them, come speak to me to see about the possibility of calculating your grade only by problem sets, lab reports and exams.

Discussion sections meet once a week. SIS calls them "recitation" sections, but please don't expect to be reciting. The idea is to have time for more extended, in-depth discussion and collaboration.

L**abs also meet once a week**, starting the first week, except as noted. Their purpose is to give you experience designing, conducting, and analyzing data from experiments. You won't find clear instructions about how to do everything; part of the challenge will be to figure that out.

2. Assignments

There are three kinds of assignments for credit: (1) Online smartPhysics "prelecture" videos and "checkpoint" questions, (2) problem sets and (3) lab reports.

FlipIT prelecture videos are about 20 minutes long, and you'll watch them in advance of each lecture, so typically twice a week. **Checkpoint questions** accompany the videos. You'll get participation points for watching prelectures and answering checkpoint questions. Log on at www.flipitphysics.com.

Some students prefer to read from a textbook over watching the FlipIt videos. If you're one of them, come speak to me about only counting the Checkpoint questions.

There are also problems on FlipIt that some professors assign for homework, but I don't. I used to remove them from the course site, but some students asked that I leave them available. That's why they're there, and I marked them as Not Assigned. You don't have to do them!

Problem sets are due before lecture every week on Tuesdays.

My problems are different from what you might expect. In many courses, I'd show you a technique for solving a kind of problem, and then for homework you'd do that kind of problem, to practice the technique. That kind of thing used to be important, to train people in performing routine calculations. Now we have computers, and they're much better at routine calculations than people can ever get to be.

And that kind of training tends to result in "brittle" knowledge. If I assign those kinds of problems, then for you it becomes more valuable to rehearse solution strategies than really to understand why those strategies work. That's ok if you only have to solve that same kind of problem, but it doesn't prepare you to think about other kinds. I write problems with different goals in mind, including (1) for practice in *being confused* and learning to manage it, maybe even to enjoy it, and (2) to press for the sort of real, robust understanding that comes out of recognizing and grappling with confusion.

If you're stuck, it's great to talk with other students, your TA, or me. Post a question to Piazza, or look for what others have posted already. Even if you're not stuck, it's great to work with others, to check your thinking against theirs—maybe there's something they've thought of that you haven't. But, please don't ask anyone, or even *permit* anyone, to just tell you "how to do it."

We score these assignments mainly for good, sensible effort. If your TA or grader can follow your thinking and see a reasonable sense to it, you'll get at least partial credit. On the other hand, if you get the right answer but the TA can't follow your reasoning, you won't get any credit.

Being right on a problem is of no value at all if you haven't understood what you were doing. Being wrong in a thoughtful way is almost always of value.

Finally, **labs and lab reports**. Most labs last two weeks. In the first week, you'll get a challenge, and you'll start working with your lab partners to design an experiment. We won't structure the experiment for you; you'll come up with ideas for yourselves. In the second week, you''ll present your findings to others in the section, hear about their work, and finish writing your report. All of the work for labs happens during lab meetings.

3. Exams

There will be two exams during the semester, which I'm scheduling for Feb 21 and March 30. The third exam on May 8, 8:30-10:30 AM, scheduled by the A&S deans.

Most of what we'll look for in the exams is that you've been successful in learning. That means giving points differently from the way we give points on clicker questions and problem sets. On exams, we want to see that you've made genuine sense of the ideas, so it does count to answer questions correctly. One kind of question is multiple choice, like clicker questions, and one is answers with explanations, like the homework. On exams as on homework, I try to write questions so that memorization without understanding won't work.

There's always one question, though, (#11) that's on something so new or challenging that I can't reasonably expect you to get it right. For that one, I'm more looking to see that you can articulate the essence of the problem that needs solving, and you can get full-credit without getting what I think is the correct answer.

Some advice on how to study and work in the course

Cramming to memorize equations the night before won't work! Here's advice on what to do instead.

Use problems in the weekly assignments to help you discover gaps and confusions in your understanding—that's the point of problems. Don't shy away from confusion—*look for it*, and try to pin down a specific question. That's not easy, but it's important.

I can't emphasize this enough: All learners encounter confusion—including and especially professional learners. In a way, learning how to identify and deal with confusion is the heart of it all. The worst is if you don't even notice. It's way better to notice something's missing or amiss, and better yet if you can pin down and articulate precisely what it is. That's a lot of the hard work for you in this course, as in science: figuring out what questions to ask.

Anyway, here are particular points:

1) Don't just find a way to solve the problem. Master it, to the point that all you need is a blank piece of paper and a pencil, to recreate the solution. AND to the point that you can explain it to someone else in simple understandable language—I mean language that would be accessible to an intelligent 8th grader. Don't let fancy terminology hide confusion.

2) Think about what someone like that intelligent 8th grader might ask you about what you've explained. Imagining "What question might someone have here?" can be a great way to identify gaps in your own understanding. For this, of course, it's good to work with other people, because they might ask those questions.

3) Be able to explain what's wrong with reasoning that leads to different answers. It often happens that one line of reasoning takes you in one direction and another takes you in a different direction. It's not enough to know which direction is right; you need to be able to explain why the other direction is wrong. Here too, it helps to work with other people, who will come up with other ways of thinking.

4) Come up with problems yourself. They might be new questions based on a problem you've solved: What if there is friction, what if the rock is moving *up,* what if the two cars had equal mass, whatever. That's a lot of how I come up with questions for exams: I look at problems we've solved, and I think of variations. Even better, I hear the variations students come up with, and I use them. Not the same problem with new numerical values, a variation that needs new reasoning.

About grades

Each category gets its own points — so a point for participation won't equal a point on problem sets, labs, or exams. I'll add them up in each category and then scale them to count as follows for the total grade.

Participation: 15%. Most of this will be clicker points, prelectures and checkpoints. But there will be various other pieces along the way. For example, you'll get participation points if you catch me making a mistake—the worse my mistake, the more points.

Problem sets: 20%. As I said, the first thing we're looking for is honest, sensible effort — does what you're saying and doing make sense? We start with everyday thinking, but ask the semester goes on, we'll want to see you taking up ideas from the course. In other words, when you're working on problem set 4, we'll want to see you using ideas from problem sets 1-3.

Labs: 15%.* As with the problem sets, we don't grade labs by whether "you got it right." We grade for honest experimental inquiry, insight and ingenuity. (*However, by department policy, you must complete at least 4 labs to receive credit for the course, regardless of the weighted total of your grades.)

Exams: 50%. I hate do-or-die finals, so the three exams will count equally in calculating the exam total. (During the course, I'll announce some "deals" to reward improvement.)

Adding them all up: For each category of grading, I decide what I think should be the cut between an A and a B, a B and a C, and so on, and I use those totals to find the overall cuts. You could think of Alice Brown scoring exactly on the A/B line every time; Bart Cooper on the B/C line, Charlie Darwin the C/D. If your total is more than Alice's, you get an A; less than Alice's but more than Bart's, you get a B. When you're just above a line, say just a little above Bart, then it's a B–. If you're just below Bart, it's a C+.

For participation points and problem sets, Alice gets 90%, Bart 80%, etc. But I want my exams to be harder, and I try to write them so that Alice would get 80%, Bart 70%, etc. I aim for an average of 65%. (In college as on AP exams, grades are not typically defined by percentage. 65 does not mean "D"!)

If it happens that the average comes out better than that, wonderful! I do not raise the grade cuts if the class does well. So if the average on some exam came out to 85 points, most people would get As. But if the average comes out worse than I was aiming, I will lower the grade cuts. So, Alice might get 75% or even 70%, Bart 65% or even 60%. I set those cuts after every exam.

Excuses

If you have a valid excuse for missing an exam, lab, or problem set, see me to arrange what to do about it, beforehand if at all possible. Sometimes it's not possible, of course, but see me as soon as you can. You probably have a sense of what valid excuses are — emergencies, illnesses, congressional testimony. When I'm in doubt, I ask your dean. (Not family vacation, no.) And you must see *me*, not your TA.

I don't give make-up exams except in truly extraordinary circumstances. If you're excused from an exam, then we'll calculate your exam total from the remaining two exams.

Academic integrity

The policy at Tufts "requires faculty members to report all instances of suspected violations of academic integrity to the Office of the Dean of Student Affairs." It's good policy, and I'm committed to following it.

Copying or paraphrasing someone else's problem solution or lab, from your friend or the web or wherever, is a violation. Anytime you present someone else's work as if it's your own, or you make it look as though you did work you didn't, it's academic dishonesty. That certainly would include sending your clicker to class without you.

Accommodations and special circumstances

Please let me know right away if you need particular accommodations for a documented disability, or if there are any other special circumstances that might affect your learning and experience in the course.

The initial plan for the semester, which can change as we go. (E.g. for snow!)

Dates	Topics	Prob set	Prelec	Labs
Jan 17	Course introduction			
Jan 22 Jan 24	1-d kinematics 2-d kinematics	1	1 2	Lab 1 start
Jan 29 Jan 31	2-d kinematics Newton's Laws	2	3 4	Lab 1 finish
Feb 5 Feb 7	Newton's Laws Friction	3	5 6	Lab 2 start
Feb 12 Feb 14	Kinetic Energy Potential Energy	4	7 8	Lab 2 finish
Feb 19 Feb 21	**Exam 1** No lecture (Monday schedule)			No lab
Feb 26 Feb 28	Conservation of energy Center of mass	5	9 10	Lab 3 start
Mar 5 Mar 7	Conservation of momentum Collisions	6	11 12	Lab 3 finish
Mar 12 Mar 14	Energy of system of particles Rotational kinematics	7	13 14	Lab 4
Mar 18 - 22	Spring break			
Mar 26 Mar 28	Catch up and review **Exam 2**	8		No lab
Apr 2 Apr 4	Torque Rotational dynamics	9	15 16	Lab 5 start
Apr 9 Apr 11	Rotational statics I Rotational statics II	10	17 18	Lab 5 finish
Apr 16 Apr 18	Angular momentum I Angular momentum II	11	19 20	Lab 6 start
Apr 23 Apr 25	*Fluid statics* *Fluid dynamics?*	12	*21* *22*	Lab 6 finish
May 8	**Exam 3**			