Physics 11 — Spring 13

Lectures: Tuesdays and Thursdays, 10:30 - 11:45, 253 Robinson Hall
Discussion sections: Please see your course schedule
Lab sections: Room 353 Robinson, except as announced.

Instructor: David Hammer — david.hammer@tufts.edu

Teaching assistants:

Vesal [redacted]
Audrey [redacted]
Jen [redacted]
Dave [redacted]

Help hours: Room 309 Anderson, except as announced.

The discussion section TAs and I will be available on Monday afternoons, from 12-4. It'll be Vesal 12-1, me 1-3, and Jen 3-4. If you need to see me or the TAs for private matters, it's usually possible during that time — we step into another room — but you could also e-mail to set up an appointment or grab me after lecture.

What to buy:

1) A clicker. We'll be using "iclickers," available at the bookstore and online. (Its ISBN number is 9780716779391)

2) smartPhysics: There are two parts to this. First and most important is the online system, with 20 minute video "prelectures" I'll assign, about two per week. The second is a small paperback textbook, with corresponding material in print. We tried it out last year, and most students found it useful and recommended it for this year.

The book and a card for access to the site are going to be sold at the bookstore, for a total price of $57 (ISBN 9781429295024). But, full disclosure, you don't really *have* to have the book. You could just buy online access, at www.smartphysics.com for $30.

3) It might also be helpful to buy a conventional textbook. The standard choice for Physics 11-12 is Giancolli, *Physics for Scientists and Engineers*, which will probably be the textbook you use for Physics 12. But for now you could use whatever you like—and if you buy an old edition, you can get them for much less than the current editions. For standards, look for Sears and Zemansky, or Halliday and Resnick, or Tipler. (If you want to try one that's a little different, I like Cummings, Laws, Redish and Cooney.)

About the course

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

This is mainly a course in how and why things move. You already know an awful lot about that, just from living in the physical world: Everyday thinking about motion is pretty reliable. (If it weren't, we'd never survive!) So the starting point for this course is that everyday thinking, much of which already works perfectly; we'll only need to make it more precise, write it down, and follow its implications. What makes things harder is that more of everyday thinking about motion works well in some circumstances but not in others. It's inconsistent, and the big challenge of learning physics is in identifying and sorting out the inconsistencies. That's how we'll refine everyday thinking, by tuning and tweaking it to make it more consistent.

What's required and why

1. ***Attendance***

You are required to attend lectures, "recitation" sections (not a very good name for what will happen) and labs. These will all involve your participation, including talking with fellow students sitting nearby about questions the TA or I pose, responding to questions on behalf of your group or just for yourself, and, certainly, posing questions of your own.

In lectures, a lot of your participation will involve clicker questions. In a typical lecture, I'll ask at least a half-dozen questions, and you'll click your answers. Every time you answer a clicker question you get a "participation point," a small incentive for you to (1) remember to bring your clickers and keep their batteries fresh, and (2) pay attention and think along with the lecture. I use clickers for several reasons. For one, they get students thinking. They also give me during-lecture data about what everyone is thinking, which I can use in deciding whether and how to proceed. They also give an effort-based contribution to course grading, to make up for rather difficult exams.

Some students object to the obligation of attending 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. But, of course, **under no circumstances should your clicker attend class without you!** That would be a violation of academic integrity.

For my part, having required attendance I take responsibility for making lectures worth your time. If you find that they aren't, or if you have ideas for how they could be better, please let me know! (No kidding: I need and appreciate that kind of feedback from students, and it's hard to get.) The same goes for the recitation sections and labs.

You'll also attend recitation sections, one every week. You'll hear more about how your section will run from your teaching assistant, but please expect to participate and discuss, not just to listen and not, certainly, to "recite." It would be great for you to bring questions on things that aren't quite clear to you; the TA may give you new problems to work on.

Finally, you'll attend labs. As with recitation sections, **you'll attend lab every week.** The purpose is for you to get some experience designing and conducting and analyzing data from experiments. You won't find clear instructions about how to do everything; part of your job will be to *come up with* those instructions, the methods for making measurements. You'll also need to figure out how good those measurements are — how much do you trust them?

2. Assignments

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

The videos are 20-minutes long, which you'll watch in advance of each lecture, developed by folks at the University of Illinois, Urbana Champaign. (The voice you hear is Professor Gary Gladding.) The idea is to have an alternative to textbook reading assignments, which don't seem to be very effective. So, the mini-lecture is in lieu of a reading assignment. Each one comes with a series of what they call "checkpoint" questions about the physics of the lecture, which you'll answer online. Every prelecture comes with a little set of "checkpoint" questions, about 30 minutes of your time in all. You'll get participation points for watching prelectures and answering checkpoint questions. Log on at www.smartphysics.com.

Problem sets will be due **before lecture on Tuesdays**. I'll post them as pdf files to the Assignments folder on Trunk. You'll hand in your solutions on paper (unless you make other arrangements with your TA), and they must be legible and on time. I'll assign five problems every week, and they're often going to be pretty challenging. Please expect to spend an average of 4-5 hours or so on them each week.

Now, it's important to understand the purpose of problem sets. In many courses, you might expect, the purpose would be for you to practice solving problems using some technique. A problem I assign would be similar to one I've shown in lecture, and the idea would be for you to practice the technique, to develop speed and efficiency with it.

I don't give those kinds of assignments, because doing things that way tends to result in "brittle" knowledge: Students rehearse solution strategies without really understanding why they work, and if a problem is a little different from what they've rehearsed they're stuck. So I write problems to press for understanding, not efficiency with algorithms. That is, when I write a problem, I'm hoping it's a *problem*; I don't want it to be something I've already shown you how to do.

If you're stuck, it's great to talk with other students, your TA, me. 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 "show you how to do it." Get help at the level of the ideas, not at the level of instructions in the solution.

For our part, we need to give credit on these assignments for good, honest effort. If the work you've done *makes sense* to the grader, if she or he can follow your thinking and see a reasonable sense to it, you'll get at least partial credit. That's the first order of business for us, to be sure you're working to make sense of what's going on, and we'll grade assignments primarily with that in mind. On the flip side, if you get the right answer but the grader can't follow your reasoning for how, 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.

I'll post solutions to the assignments on Tuesdays, after you've handed in the assignments (which is why assignments have to be on time!). Please read the solutions carefully, and as you still have questions post them online or come ask in person.

Finally, **lab reports** will be due every other week, for a total of six reports over the semester.

The basic plan is for each lab to last two weeks (except for the zeroth lab, which will be one week only). The first week of the first lab, you'll get a challenge, and then you'll set about working with your lab partners to design an experiment. We won't be structuring the experiment for you; you'll be coming up with ideas for yourselves. You'll talk with each other about how to handle it, and you'll need to come to an agreement over how to proceed. By the end of the period you'll have designed an experiment and collected data. The next week, you'll analyze your data, present and compare your group's findings with other groups', and finish writing up the report. The plan is for labs not to take up any time outside of the lab periods.

3. Exams

There will be two exams during the semester, which I'm planning for Feb 19 and March 28, and then the final is on May 9, 8:30-10:30 AM (by the University's schedule).

I try to write exams so that memorization without understanding doesn't succeed. The best way to be ready for my exams is to keep up with the course, staying on top of the ideas, asking questions to make sense of them, all along the way. Cramming to memorize equations the night before won't work.

So, here's what I advise to study, but really this is for all along the way in the course. Use problems in the weekly assignments to help you discover gaps and confusions in your understanding—that's what they're for! Don't shy away from confusion—*look for it*, pin it down, and work it out. Don't just find a way to solve the problem; figure it out until you *own* it. Get so that you can explain what's going on in simple understandable language—I mean language that would be accessible to an intelligent 8th grader.

More: Be able to explain why other ways of solving the problem that lead to different answers don't work. It often happens in physics problems 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. For this in particular, it's important to work with other people, because they'll come up with ways of thinking you didn't.

Finally, you should be able to solve variations of that problem. Maybe in some of those variations one of those other lines of reasoning would be the way to go! So, pose yourself new questions—what if there were friction, what if the rock was 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. Not, I should say, the same problem with new numerical values, but a variation of the problem that needs a variation of reasoning.

About grades

Please note that 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%. We want you to be using the problems to build an understanding, and we'll assess it accordingly. Answers alone, without explanation, will receive no credit. (Of course, the explanation may well be expressed in mathematics.) However, evidence of an effort to refine your everyday thinking, even without an answer, will receive at least partial credit.

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.

Exams: 50%. The participation points and problem sets are "easy" ways to get points, which lets me ask hard questions on exams. Again, I try to avoid questions you could answer by memory alone. And I hate do-or-die finals, so the three exams will count the same.

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. So think of Alice Brown scoring exactly on the A/B line every time; Bart Cooper on the B/C line, etc. If your total is more than Alice's, you get an A; less than Alice but more than Bart, you get a B, and so on. 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, and on AP exams, there's not a general correspondence between percentage scores and grades. 65 does not mean "D"!) If it happens that the average comes out better than that, then that's wonderful — I do not raise the grade cuts if the class does well. (So if the average on some exam came out to 80 points, most people would get As.) 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%. That is, if the class doesn't do as well as I wanted, I "grade on a curve."

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 in doubt, I ask your dean. (Not family vacation, no.) And you must see *me*, not your TA.

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 a 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 is academic dishonesty.

Revised plan for the semester

Date	Topics	Prob set	Prelec	Labs
Jan 17	Course introduction			
Jan 22 Jan 24	1-d kinematics 2-d kinematics	1	1 2	
Jan 29 Jan 31	2-d kinematics Newton's Laws	2	3 4	Lab 1 start and finish
Feb 5 Feb 7	Newton's Laws Friction	3	5 6	Lab 2 start
Feb 12 Feb 14	Work and Energy	4	7 8	Lab 2 finish
Feb 19	Exam 1	Exam 1	Exam 1	
Feb 26 Feb 28	 Potential Energy	5	9 10	Lab 3 start
Mar 5 Mar 7	Conservation of energy Center of mass	6	11 12	Lab 3 finish
Mar 12 Mar 14	Conservation of momentum Collisions	7	13 14	Lab 4
Mar 18 - 22	Spring break			
Mar 26 Mar 28	Review Exam 2	8 Exam 2	 Exam 2	
Apr 2 Apr 4	More collisions Rotational kinematics	9	15, 17 16	Lab 5 start
Apr 9 Apr 11	Torque Rotational dynamics	10	18 19	Lab 5 finish
Apr 16 Apr 18	Rotational statics —I Rotational statics — II	11	20 21	
Apr 23 Apr 25	Angular momentum—1 Angular momentum—2	12	22	
May 9	Final exam	Final exam	Final exam	