PHYSICS 11a, Fall 2005
MECHANICS
SYLLABUS
(Preliminary Version, 9/19)

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TEXTBOOK
Physics for Scientists and Engineers, by Serway & Jewett, Volume 1 (6th ed.)
We will cover chapters 1-18.

LECTURES
Tuesday and Thursday, 11:30-1:00, Science Center B.

SECTIONS
Sections (1 hour) meet once each week and are taught by the Teaching Fellows. The purpose of these sections is to work through examples relevant to the homework problems, and to discuss things in a smaller classroom setting. The times and locations are:

Mon:	2-3pm	(SC309)	2-3pm	(SC304)				
Tues:	2-3pm	(SC304)	2-3pm	(SC112)	3-4pm	(SC112)	7-8pm	(SC216)
Wed:	9-10am	(SC216)	1-2pm	(SC304)	1-2pm	(SC309)	7-8pm	(SC216)
Thurs:	9-10am	(SC216)	2-3pm	(SC112)	3-4pm	(SC112)		

Sections will be arranged via the Registrar's sectioning program (available online from class on Tuesday, through 3pm Friday, September 23). Sections will begin on Monday, September 26. Attendance is *strongly* advised.

OFFICE HOURS
We are eager to help you in any way we can in this course. You are welcome to drop by Prof. Hoffman's office in Lyman 344 at any time with questions, or to email to set up a meeting time. The Teaching Fellows will arrange office hours once the sectioning is complete.

THE QUESTION CENTER
The Question Center is located in the Science Center Room 101d. It is staffed by the Graduate Students of the Physics Department including your TF. The hours are Monday, Wednesday, and Thursday from 1-4 PM and 7-10 PM, starting the third week of the semester, and excluding university holidays.

WEB SITE
http://www.deas.harvard.edu/galileo/students/?courseID=852
Problem sets, solutions, lecture videos, announcements, and other useful things will be posted on the web site. You will be responsible for checking the website for post-lecture questions after each class.

HOMEWORK
Homework will consist of brief post-lecture questions, and one weekly problem set.

PROBLEM SETS
There will be one problem set each week, due Friday at 3pm. Solutions will be posted on the website as soon as problem sets are collected. New problem sets will generally be posted on the web on Thursday evenings. To receive full credit on a problem, it must not only be correct, but also written up *neatly*, with clear explanations involving *words*. A good rule of thumb is to ask yourself if a classmate would be able to understand your solution. No credit will be given for a string of equations leading to the correct answer. Except in very unusual circumstances, we will not accept late homeworks. But we will drop your lowest homework score when computing your final grade. Any requests for extensions should be made to Lars Grant, the head TF.

STUDY GROUPS
You are encouraged to work together on problem sets (but the work that you hand in must be your own, of course). To facilitate this, we plan to make a list of study groups for those students interested in being assigned to one.

QUIZZES
A quiz will be given in the middle of each lecture. You may work together on these. They will be checked *for attendance only* and are therefore nothing to be worried about. In fact, you will probably end up looking forward to them, since they provide a nice way to break up the 1.5-hour lecture.

POST-LECTURE QUESTIONS
Following each lecture, the course website will have one or a few brief questions, mainly conceptual, to encourage you to reread and digest the material in your lecture notes before it has totally decayed from your short-term memory. Answers to these questions should be submitted online before the beginning of the next lecture. These

are intended to be your solo work, and should take you no longer than an hour to complete (often much less).

LABS
The lab component of this course will consist of one big project: construction of a Rube-Goldberg machine. Lab sections will meet every other week for 3 hour blocks, 15 hours in total. Your meeting times will be arranged via the sectioning program. The goal is to accomplish some simple task, such as to pick up a hat. But the point is to come up with the most creative machine to do so, using rolling balls, projectile motion, pendulums, springs, buoyancy, etc. This is meant to be fun! You will be graded on your effort and on the quality of your lab notebook, which must show all calculations you carried out en route to your invention. The most creative and well-functioning Rube-Goldberg machine will win a prize and exam bonus points.

In addition to satisfying a near-universal requirement for medical school admission, these labs aim to teach: confidence in tinkering, teamwork, creative thinking, practical calculations, and lab notebook organization.

EXAMS
There will be three midterm exams (during the regular 1.5-hour class) and a final exam (3 hours). The midterms will be on Thursday, October 13; Thursday, November 17; and Thursday, December 15. The final will be on January 21 or 24 (unfortunately the registrar won't tell us which until December).

GRADING
Problem Sets 20%, Post-Lecture Questions 10%, Labs 10%, 1st Midterm 8%, 2nd Midterm 10%, 3rd Midterm 12%, Final exam 30%.

The final exam will be quasi-redemption: it will count for 30% of your final grade for the course, plus the points you have missed on the first 3 midterms. For example, if you have perfect scores on each of the midterms, the final exam will count as only 30% of your final grade. But if you score 60/100 on each of the first 3 midterms, then the final exam will count for 42% of your final grade.

The philosophy behind this is not to encourage you to blow off your midterms. Rather, we expect that you come into the course understanding little physics. Throughout the semester, your understanding will be improving. The ultimate goal of the course is that your understanding of physics will be good by the very *end*. Your ultimate evaluation should not suffer because you were engaged in learning, i.e. had incomplete understanding, *during* the course.

Note: the final grades for this course will *not* be curved. We hope that you will learn as much from collaboration with your classmates as you will from the teaching staff. We don't want to discourage you from helping your peers by turning the grading into a competition for a fixed number of A's.

A+	97-100	B+	87-90	C+	77-80	D+	67-70	E/F	<60
A	94-96	B	84-86	C	74-76	D	64-66		
A-	90-93	B-	80-83	C-	70-73	D-	60-63		

SYLLABUS

We will cover Chapters 1-18 of the textbook, plus applications to other sciences as detailed in the lectures.

- *Kinematics* (Chapters 1-4) Strategies for solving problems, units, vectors, 1-D and 2-D kinematics, circular motion.
- *Force, Energy, Momentum* (Chapters 5-9) Newton's laws, work, kinetic and potential energy, conservation of momentum and energy, collisions.
- *Rotations* (Chapters 10-12) Angular momentum, conservation of angular momentum, torque, rotational kinematics, moment of inertia, statics.
- *Gravitation* (Chapter 13)
- *Fluids* (Chapter 14)
- *Oscillations & Waves* (Chapters 15-18) Simple harmonic oscillators, wave motion, sound waves, superposition and Fourier's theorem.

Lec	Date	Suggested reading	Class topic
1	20-Sep	1.1, 1.3-7, 2.1-3	intro, course goals, dimensional analysis, order of magnitude estimation
2	22-Sep	2.5-7, chapter 3	1D motion, velocity & acceleration, calculus, vectors
3	27-Sep	chapter 4	2D motion, projectiles, circular motion
4	29-Sep	5.2-5.6	Newton's laws, force
5	4-Oct	5.7-5.8	Newton's laws, pulleys, gravity, friction
6	6-Oct	6.1-6.4	Newton's laws, circular motion, relative motion
7	11-Oct	7.1-4, 7.6-7	work, dot product
8	13-Oct		**MIDTERM (chapters 1-6)**
9	18-Oct	chapter 8	conservative & non-conservative forces, kinetic & potential energy
10	20-Oct	7.8-9	power, energy conservation
11	25-Oct	9.1-9.4	momentum, impulse
12	27-Oct	9.5-9.7	momentum conservation, 1D & 2D collisions, center of mass, rockets
13	1-Nov	10-1-10.5	comparison of linear & angular quantities, moment of inertia
14	3-Nov	10.6-7, 11.1, 12.1-3	torque, cross product, static equilibrium
15	8-Nov	10.8-9	torque, work, power, energy, rolling, pulleys
16	10-Nov	11.2-4	angular momentum, conservation
17	15-Nov	13.1-3, 13.5-6	Newton's gravity, gravity as a potential & field
18	17-Nov		**MIDTERM (chapters 1-12)**
19	22-Nov	14.1-7	fluids: pressure, buoyancy, fluid dynamics
	24-Nov		**THANKSGIVING**
20	29-Nov	15.1-5	harmonic oscillators
21	1-Dec	15.6-7, 18.4	damped oscillations, forced oscillations, resonance
22	6-Dec	16.1-16.3, 12.4	waves: velocity, harmonic waves, elasticity, properties of solids
23	8-Dec	16.4-5	waves: boundary conditions, energy & power
24	13-Dec	18.1-3, 18.7-8	waves: superposition, beats, Fourier's theorem
25	15-Dec		**MIDTERM (chapters 1-16)**
26	20-Dec	chapter 17, 18.5-6	sound, decibels, Doppler effect, shock waves
	Jan 21, 24		**FINAL (chapters 1-18)**

MATH
Physics 11a will not be very math-intensive. It will require single-variable calculus: you should be comfortable integrating and taking derivatives. Vector manipulation, including dot and cross products, will be covered during the class. Many students have asked about replacing math 21a with math 19. This is fine for physics 11a.

However, physics 11b will be more math-intensive. If you take math 19, you will miss the treatment of Stokes' and Green's theorems in math 21a, so you should commit to learning these independently. For a good treatment of these theorems, see Edward Purcell's *Electricity & Magnetism*, chapter 2. Sections 2.7-8 cover Green's theorem, and sections 2.13-14 cover Stokes' theorem.

PHYSICS 1a vs. 11a vs. 11c vs. 15a
Some of you are still deciding which physics course to take!

Physics 1a is a course designed primarily to satisfy the medical school admissions requirements.

Physics 11a is a course designed primarily for scientists. Nominally, the topics covered in 1a and 11a are the same, but physics 11a will cover them in more depth with a little more math, and more applications. The philosophy of physics 11a is to help you learn quantitative skills and physical intuition that you can apply on a daily basis in all of your science classes.

Physics 15a also covers roughly the same topics, but with even more in-depth treatment, harder problems, and an additional section on special relativity. There is no clear-cut criterion for deciding, but one consideration is that of time. Physics 11a will take a substantial amount of time. But physics 15a will take more.

If you think there is any chance that you will take physics 15a, then you should start out there. In the event that you wish to switch to physics 11a, we promise to make the transition a hassle-free one. Furthermore, if you are someone who is thinking of taking physics 15a, then the first few physics 11a lectures will probably be mainly review, so you have little to lose by trying out physics 15a.

Physics 11c is a specialized course in fluid dynamics and thermodynamics as applied to biological systems. It is recommended for those who have taken physics 11a or the equivalent in high school, who have an interest in biology, and who wish to be challenged in a more applied environment.

Any of these four courses (physics 1a, 11a, 11c, or 15a) will satisfy ½ of the pre-med physics requirement. The second semester (physics 1b, 11b, or 15b) will complete the requirement.