Physics I: Forces and Motion (with Lab)

(4 Credits)

Class Times
Lecture/Discussion: Monday/Thursday 10:00am – 11:50pm
Lab: Wednesday 8:30am – 12:10pm

Me
Hugh Crowl *Office:* Dickinson 104
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Office Hours: Tuesday 9:30am-11am, Thursday 1pm-2:30pm, *or by appointment*

Text: *Essentials of College Physics*, by Serway & Vuille

Course Description: Physics is the study of what Newton called ″the System of the World.″ To know the System of the World is to know what forces are out there and how those forces operate on things. These forces explain the dynamics of the world around us: from the path of a falling apple to the motion of a car down the highway to the flight of a rocket from the Earth. Careful analysis of the forces that govern these motions reveal countless insights about the world around you and enable you to look at that world with new eyes.

Course Goals:
- An understanding of how forces affect motion.
- An ability to use physics to describe the world around us.
- Development of quantitative problem solving skills.

Course Homepage: Course materials will be posted at: http://crowl.bennington.edu/physics-i/

Problem Sets: You will be assigned problem sets roughly weekly. Problem sets are due by the date/time indicated on the problem set sheet, but I will accept any problem set as "on time" if it is in to me by the time I start grading that problem set. They can be turned in either *in person to me* or *to the tray on the wall outside my office door*. In general, I will not accept late work. Please see me in extraordinary circumstances *before the problem set deadline*. Failure to turn in one problem set will significantly affect your grade; failure to turn in more than one may result in you failing the class.

Problem sets in this course are intended to give you a chance to work with the (generally quantitative) aspects of the course. They are also designed to allow you to demonstrate to me that you understand the material. As such, **you are required to show your work** on the problem sets. This allows me to know that you understand the steps you took to reach the answer. Given that the answers to the odd numbered problems are in the back of the book, getting the correct answer is unimpressive; demonstrating ***how*** to get to the correct answer is critical.

In addition to the group problems, some problem sets will contain *Individual Problem(s)*. These problems should be done without collaboration from your classmates (although questions to me are, as always welcome).

A note on collaboration: With the exception of the Individual Problems, collaboration on problem sets is ***strongly encouraged.*** *One of the best ways to learn something difficult is to work through it with others. I recommend that you work on problem sets together and write them up individually. This serves the dual purpose of collaborating with your colleagues to truly understand the problems, but then proving to yourself that you actually understand by writing up your own answers. The goal of the problem sets is to make sure you understand the material and this work method is one of the best ways to ensure that.* ***As with any work you do, it is important to acknowledge colleagues that contributed to the work. For this reason, please list your collaborators on your problem sets.***

Quizzes: You will have five quizzes throughout the semester. These quizzes will check if you're keeping up, but generally will not be as rigorous as problem sets or the exams. These should serve as a spot check for both you and I as to how you are doing.

Exams: Exams will be composed of several short answer questions and multi-part quantitative problems. Generally, the problem sets should give a good clue of the types of questions I like to ask. I will provide a few sample problems before the midterm exam. **Please note the date of the final exam before making holiday travel plans.**

Class Participation: There is a large amount of educational research showing that lecture alone is ineffective in ensuring a deep understanding. In the last few decades, interactive lecturing has found its way into large lecture classrooms. We're really lucky here at Bennington that we don't need to figure out how to learn in 200-person classes, but it still makes sense to employ many of the techniques used for those larger classes.

Voting Cards: I will give you a card at the beginning of the term, which allows you to represent one of four choices. Most days, there will be several opportunities to vote and confer with your neighbors. These discussions and participating in class voting are an important part of your class participation grade.

Quantitative Group Problems: While the Voting Card Questions largely build your *qualitative* understanding of important ideas, you will also occasionally have the opportunity to work on *quantitative* problems in class, to help build those skills. We will work on these problems in small groups, then share our progress with the larger class. These problems will not be graded but, again, your engagement with these problems counts towards your class participation grade.

Please note that *class attendance is mandatory*. Missing even one class can seriously affect your class participation grade. Missing more than one class during the term may result in you failing the class. Please see me in extraordinary circumstances.

Please **don't use laptops, phones, etc**. in class. Taking physics notes using a keyboard is close-to-impossible and laptops can be a distraction. I welcome individual exceptions where appropriate; please come talk to me.

Labs: As part of lab, I will expect you to keep a dedicated, bound *lab notebook (Note: I will provide you a notebook to work in at the first lab)*. I will collect these as "spot checks" a few times throughout the term, so you are responsible for making sure they stay up to date. At these spot-checks, I will give a V (good work; keeping up), a V+ (great, meticulous work), or V- (deficient in some significant way). In addition to my own observations of your work in lab, your lab notebooks will be how I evaluate your lab performance.

Resources for Help: Building a quantitative understanding of physical principles can prove challenging. It is likely you will need help. There are a number of options for getting help:

- *Work with a classmate:* On all the non-quiz, non-test parts of this class, I expect you will collaborate. You are strongly encouraged to *work with your classmates* to help build a deep understanding of the problem set material.
- *Come to Office Hours*: If you're having difficulty that Slack can't solve, please make a plan to attend my office hours. While I have set office hours during the week (see beginning of syllabus), I am happy to meet with you at other times that work for both of us; send me an email.
- *Go to the Math Tutors*: There are (free!) Math Tutors that are happy to help you with any troubles you've been having with the more mathematical side of things. The details of the tutors are still being sorted out, but there are usually at least a couple who have significant physics experience.

Academic Accommodations: Bennington College provides reasonable accommodations to students with documented disabilities when such accommodations are requested and necessary to ensure equal access to College programs and facilities. If you believe you are entitled to an accommodation speak with Academic Services, about any disability-related needs. If approved, you will receive a memo detailing your specific accommodations; it is your responsibility to provide me with the memo and discuss the implementation of accommodations. Note that I will not be aware of your needs if you do not share this memo with me. Accommodations are not retroactive, so the sooner we meet to discuss your needs, the better. Also, students experiencing mental and/or physical health challenges that are significantly impacting their academic work are encouraged to speak with their faculty advisor and member of Academic Services (academicservices@bennington.edu or 440-4400) about the impact and to connect with resources through health and psychological services (440-4426 or 440-4451).

Evaluation/Grading:
Problem Sets: 25% Class/Lab Participation: 25% Quizzes: 15%
Midterm Exam: 15% Final Exam: 20%

Tentative Schedule (likely to change)

Week of	**Topic**	**Reading**	**Lab**
September 1	Foundations + 1D Motion	Ch. 1 & 2	*First Week - No Lab*
September 8	1D Motion + 2D Motion	Ch. 2 & 3	Motion
September 15	2D Motion (cont.)	Ch. 3	Projectiles
September 22	Newton's Laws	Ch. 4	Newton's Laws
September 29	Newton's Laws (cont.)	Ch. 4	Friction & Forces
October 6	Work & Energy	Ch. 5	
October 13	*Review + Midterm Exam*		
October 20	Work & Energy (*No Monday Class*)	Ch. 5	Energy
October 27	Work & Energy (*No Thursday Class*)	Ch. 5	Ballistic Motion
November 3	Momentum	Ch. 6	*Plan Day – No Lab*
November 10	Angular Motion	Ch. 7	Momentum
November 17	Angular Dynamics	Ch. 8	Lab Project
November 24	Angular Dynamics *(No Lab or Thursday Class)*	Ch. 8	*Thanksgiving – No Lab*
December 1	Angular Dynamics (cont.)	Ch. 8	Lab Project
December 8	Review: December 8 Final Exam: December 10		**Final Exam During Lab Period**