

How to Ace Physics

This Semester

11 Easy Things You Can Do
This Semester
to Ace Your Physics Course

by Scott Redmond

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Scott

Preface

Over the years, I've worked with hundreds of students and, as I'm sure you realize, most students taking introductory physics don't actually love physics. Most people just need the academic credits to meet their program requirements. Physics can be tricky because students need to understand in order to succeed; it's not something you can get through with memorization. That's hard enough when it's a subject that you love. For the rest of us who just want to get through it, physics can be very daunting.

This guide contains tips and tricks that I've found myself repeating to students of all levels, from those struggling to pass to those struggling for the last 2% to boost their application to medical school. Some of these may seem obvious, but we often don't fully appreciate obvious things until they're explicitly spelled out and then we can say, "Oh yeah – that's true!"

The purpose of this guide is to help you succeed in your physics course, however you define your own success.

Good luck!

Scott

1. Go to Every Class

Your professor is the expert in your physics course, including how assignments and tests are graded, what's on exams, and how to set up problems to get full marks. Even if your prof doesn't seem to understand physics, you still learn a lot about your course by going to class.

If your prof is truly unintelligible, bring your notes and study physics in the back row. Don't work on something else; work on physics. You'll be there to hear juicy tidbits about the upcoming exam, and for any active learning activities. If your prof realizes that you're working ahead, she might actually be pleased and give you tips to help you learn even faster *and save you time*.

Aim for perfect attendance, no matter how good or bad your professor is.

Go to your labs too; **labs are like free marks**. You'll usually get a grade of zero if you're absent, so you need to be there anyway, and it's another opportunity to ask your professor and/or teaching assistant(s) for one-on-one help with other questions.

2. Master Vectors ASAP

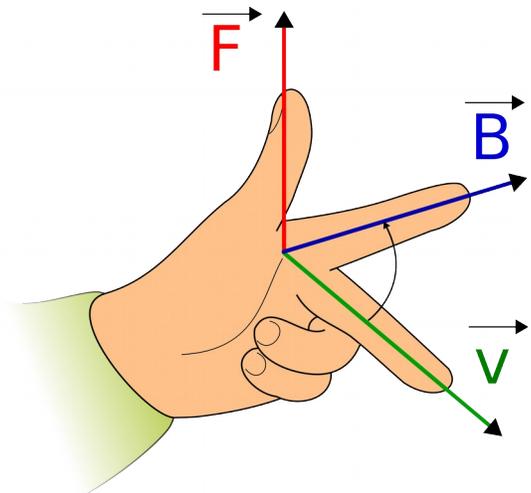
Vectors, and vector math, are used throughout physics. **The sooner you master vectors, the sooner your grades go up.**

You probably don't think much about how to use your pencil. You want vectors to be like that; straightforward and familiar so you don't have to think about them.

Key Vector Skills

- Given magnitude and direction, find a vector's components
- Given a vector's components, find its magnitude and direction
- Notation - when do you need an arrow on top?
- Vector addition
- Vector subtraction
- Unit vectors

Practice every day if you need to. This is the number one skill, and mastering vectors early makes the rest of the course much easier.



3. Tackle the Tricky Concepts Early

Some ideas need extra time before they click, so prepare to spend extra time working on these. Try to learn about these concepts early in your semester so you see them before they come up in class.

Especially Juicy Concepts in Introductory Physics

Mechanics: Torque*

Waves, Optics, and Modern Physics: Wave Interference**

Electricity and Magnetism: Electric Potential***

* This a twisting motion, like a force for rotation. What makes it tricky is the calculations and direction; if you've mastered vectors, learning how to calculate torque isn't difficult. The directions, clockwise or counterclockwise in 2D, are unusual at first though.

** Wave interference is based upon wave superposition, which by itself isn't very difficult. What's tricky is understanding how different factors affect wave interference. Review the high-level ideas early, even if they don't make perfect sense right away, so you already have a framework for understanding them when they come up in class.

*** Electric potential is by far the trickiest concept in E&M. It's not energy; you'll need to be able to explain the difference between electric potential and electric potential energy in your own words. This concept usually comes up fairly early in the course on its own, and keeps coming back as the course progresses. Briefly review it before you see it in class, and then be sure to fully understand it as early as you can.

4. Read Ahead – For Only 3 Minutes

“But sir, the textbook doesn't make any sense!”

You're right. It doesn't. Although authors try to make it simple, you often get a textbook that is really hard to read. Luckily *it doesn't have to be easy to read*.

I'll say it again: your textbook doesn't have to be easy to read. Even if your class got the absolute worst physics textbook ever written, the main ideas will still be described by figures, equations, and tables.

You get most of the benefit in a surprisingly small amount of time – as little as 3 minutes per lecture. Have you heard of the 80/20 rule? This is the same idea: you get nearly all of the benefit with only a fraction of the effort. **Sometime in the 24 hours before each lecture, take 3 minutes to skim over the material to be covered.**



How to Read Ahead For Only 3 Minutes

1. Identify what will be covered in your next physics class. Get your book ready.
2. Set a timer for 3 minutes. Your phone probably has one; if not, check out <http://www.online-stopwatch.com/countdown-timer>.
3. Start the timer, and skim through the appropriate section. Don't read every word; only look at the high-level information:
figures (skim the captions)
main equations
tables (tables are used to compare things; what's being compared here and why?)
4. When the timer ends, stop reading. If you'd like, jot down any questions that came up while you were reading.

You don't want to fully understand the material at this point. The goal is to create a high-level framework in your mind. Then, when you do see it in class, your professor's presentation and questions will naturally slide into the mental framework you've prepared.

You may not need a timer, but the timer can help convince yourself to start reading. The thought of

reading your physics textbook can be daunting, to say the least. When you know it'll only be for 3 minutes, but you're just exploring the high-level details, it can actually be kind of fun.

5. Steady Wins the Race

Most students want to succeed quickly and easily. Unfortunately, you can only have one or the other; not both, and trying to succeed quickly - via cramming - is very risky. Physics is like a marathon, not a sprint.

Instead, aim to succeed easily. Start early and keep steady - by studying regularly - to learn efficiently. What's easy about that? Efficient learning = less time studying. That's what most students mean: they'd love to spend less time studying.

Being able to study regularly is a valuable skill all by itself, and for most students this skill is probably more valuable than any particular physics concept they learn in the course.

Unfortunately it often doesn't work because of procrastination. Beating procrastination is different for everyone, and learning it works for you is a HUGE skill for success in any area of life; you're learning how to get yourself to do what you believe is important even when it seems hard.

Tips to Beat Procrastination

Just Start: Getting started is the hardest part; once you do that you've already won.

Pomodoro Technique: Set a timer for 25 minutes, and study until the timer goes off; then take a 5 minute break. Try to get up and move for those 5 minutes, or at least stand up and stretch a bit. Repeat. It's very important to take the breaks. Your mind may resist sitting down to study physics for hours, but 25 minutes isn't so bad. For it to work, your mind needs to trust that you will actually take the breaks.

For more information, see <http://pomodorotechnique.com>.

Structured Procrastination: Find something else that you don't want to do and study physics instead of doing that. If you're going to procrastinate anyway, at least you can procrastinate by doing something useful, like studying regularly so you can have more free time.

For more information, see <http://www.structuredprocrastination.com>.

Form a Study Group (see more info in tip #8) and hold each other accountable for studying.

Knowing that someone else will be there with you helps motivate you to study. You can help each other take breaks, too, which is healthy for everyone.

6. Practice, Practice, Practice!

You can't learn to play soccer just by sitting on a couch and reading a book; it doesn't matter how good the book is, at some point you need to actually kick a ball. Then, if you want to get better receiving passes, you have to practice receiving passes.

With sports, that's obvious; it's a no-brainer.

What most people don't realize is that it's the same with physics. If you just "study" by reading the book, or by looking at a problem and then reading the solution, you can fool yourself into believing that you're studying physics but I'm sorry to say that it won't help you.



If you want to do better in physics, you need to practice solving physics problems. You need to practice the problem-solving steps that your teacher wants to see. Write out the given and unknown information, draw the diagram, etc...

Resist the part of your mind that wants to skip this part and just start plugging numbers into your calculator. If you do this, your tests and exams will be so much smoother!

7. Visit Office Hours and Tutorials

Your prof probably has office hours for helping students with the course. This is free personalized help from the one person who is an expert in *your* physics course.

If your prof doesn't have office hours, check to see if your physics or science department has a study area in which professors help students with a regular schedule. The other profs can also offer great tips for your course, since they have probably taught it too.

How to Maximize Office Hours

- Follow up on lost quiz, lab, and exam marks by asking what you should learn from any mistakes.
- Ask for high level strategies for solving problems.
- Ask about the problem solving structure your prof wants to see in your solutions. Your prof is the one grading your exam, and setting up your his or her way helps you get the most marks and finish sooner.

Tutorials, especially before exams, can also be very helpful. If your prof is the one giving the tutorial, you might even get some extra tips about what's on the exam. If it's a teaching assistant, you can still get a nice summary of important concepts and some time for personalized help with your particular questions.

8. Start or Join a Study Group

Join a group of friends and study together. It's simple and very effective. Just divide the topics so each person is responsible for teaching their topic to rest of the group. You get to learn the concepts from your peers, who - let's face it - understand you better than your prof possibly can. Your friends can use examples from everyday life, and having physics explained in your everyday terminology helps you understand.



This also gives you a chance to learn your own topic by teaching it to your friends. Teaching something is an amazing way to learn because it uncovers details that you just don't think of by yourself. Don't worry if you don't have all the answers; your questions will guide you about what to learn, and answering them will lock in the ideas so they're readily available during the exam.

If you're feeling more adventurous, give each topic to two people and then present it together – or debate it in front of the rest of the group and heckle each other for fun!

9. Solve Problems the Easy Way

When solving physics problems, students often have no idea where to start. Some textbooks focus on problem solving recipes, with a different recipe for each specific type of problem. It is far more helpful to use a general problem solving strategy that applies to any problem and can even be used for problems in real life. For example, “How can I change the layout of my kitchen so that I don't confuse the dog food with my kids' breakfast cereal?”

Easy Problem Solving Strategy: Given, Unknown, Sketch

1. Identify the given information (usually specified in the problem statement)
2. Identify the unknown information (what's asked for by the problem)
3. Draw a sketch, showing as much of the given and unknown information as you can.

During an exam, if you find a problem that you simply don't know how to start, try this: write what's given, write what's unknown, and draw a sketch. Try to show the given and unknown information on your sketch. This gives your brain a way to relate the different bits of information; often just doing this part gives you enough hints to take the next step.

If you still don't know what to do next, check your units. What are the given units? What are the units for the unknowns? You can manipulate the units mathematically to go from what's given to what's unknown.

10. Ask for Help in Online Forums

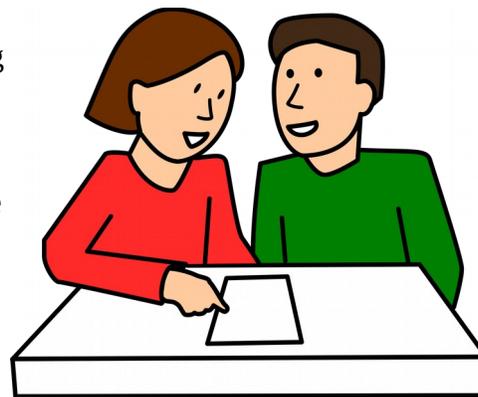
Online physics forums can be extremely helpful because you can ask about a topic you're struggling with and get custom advice from experienced people all around the world. It's not as quick as a Google search, but the responses are tailored to your needs.

The best forums require you to structure your questions so you need to think about the problem before asking for help. This is a good thing because you will learn far more than if someone just gives you the answer. The trick is to give yourself time – at least a few days – to sort out the solution, and then check the forum each day and spend a few minutes thinking about the help you've received and what you would try to do next.

11. Try Tutoring

Tutoring is an amazing way to hone your skills. The best tutoring for you is actually to tutor someone else, just like when you're in a study group. Teaching is amazing for helping you learn because it forces you to think about the subject and get into details that you might not have considered without being asked by the people you're tutoring.

Don't worry about getting things wrong. Just be honest and open to improvement. I saw this while working at the Canadian Space Agency; new engineers who weren't afraid to ask potentially “dumb” questions learned new skills faster *and were promoted sooner* than other engineers who didn't ask when they had questions. If you keep at it, you will improve.



If you'd rather get tutoring than give it, check to see whether your school offers peer tutoring. If so, this can be an inexpensive way to get one-on-one help with physics, because the tutor fees are often subsidized by the school. This typically involves an upper-year student who has done well in your course being available to answer your questions and give advice. Ask your professor about peer tutoring programs at your school.

Private tutoring is another option. Private tutoring can be expensive, so it works best for people who have more money than time. If private tutoring prevents you from having to repeat a semester then it can actually save you a lot of money. Plus, there are a few easy things you can do to save both time and money.

How to Save Time and Money with Private Tutoring

- **Meet regularly:** once or twice each week, or whatever works for you.
- **Share your course outline with your tutor** so he or she knows what you'll be working on.
- **If you have specific questions, send them to your tutor** in advance so he or she can prepare for your session.
- **Start tutoring early** in the semester. Don't wait until the last minute. If you do, you'll need far more time with your tutor just to touch the surface of the material.

Thank You for Reading!

Thank you for reading this guide! I really appreciate the time you've taken out of your busy day to read this guide. I've always loved helping people learn and grow, and I sincerely hope that this guide can help you ace your physics course this semester. If you have an extra minute, I would love to hear what you think of this guide.

Please leave feedback by email to scott@redmondphysicstutoring.com.

Although this guide is available to you at no cost, I invested a lot of time and money into it. Please respect my investment by not sharing or distributing this guide to anyone else without my permission. If you would like to share this with someone else, please send them to <http://www.redmondphysicstutoring.com>, where they can download their very own complimentary copy and check out everything else that's available on my website.

Thanks again! I wish you great success in your physics course!

Scott

About the Author

Scott Redmond is a former physics professor from Vanier College in Montreal, who left full-time teaching in 2014 to spend more time with his young family. Scott established Redmond Physics Tutoring in late 2014, and started actively tutoring CEGEP physics students locally and online in early 2015. When he's not tutoring physics students, Scott enjoys playing with his children, practicing aikido, and spending time outdoors hiking and cycling. For more information, see www.redmondphysicstutoring.com/about.

