Study Tips for Introductory Physics Students

General tips

- **Keep up with the course.** Once you fall behind it is very difficult to catch up. If you ignore this advice and *do* fall behind, skim the passed-over course material for its most important points and move on to a thorough study of the current course material.
- Do the reading **before** attending the lectures. You will be able to ask questions, follow the demonstrations, discover how the material fits into the overall structure of the course, and gain a conceptual understanding of the material under study.
- Devote a little time to studying physics each day, rather than a large amount of time once a week: this allows the material to sink in.
- Form or find a study group. Use these groups for discussion, problem suggestions, and companionship.
- Attend the course's conference sessions to learn informal techniques that are not well-taught through the lecture method.
- **Do not memorize.** In almost all cases, the temptation to memorize indicates a simple a lack of understanding. In the words of Charles Misner: "The equation $F = ma$ is easy to memorize, hard to use, and even more difficult to understand."

Reading Tips

- **Read aggressively.** The amount of reading assigned in a physics course will be far less than the amount of reading assigned in a literature or a sociology course, but the reading is much denser and your teacher expects you to read it thoroughly, thoughtfully, and critically. Read with pencil and paper in hand and follow the algebra. Keep a list of questions and of points that you don't understand.
- **Take notes in your book**. Mark the most important points and record why they are important.
- Examine the sample problems carefully.
- If the reading is too dense, try skimming it once to get an overview of what's going on, then coming back and reading in detail the second time.
- The active, aggressive reading advocated here is very time-consuming. Reserve it for the most important parts of your textbook.

Lecture Tips

- **Listen aggressively.** Follow the lecture, think about the material, and ask questions.
- Come to the lecture armed with questions for your teacher, developed from doing your reading.
- Review each lecture by making a simple list of the most important topics, and a different list of the puzzling aspects that need clarification. It is best done soon after the lecture.

Weaknesses

If you need help with mathematical background, consult either Arthur Beiser, *Essential Math for the Sciences* (McGraw-Hill, New York, 1969), or Daniel Kleppner and Norman Ramsey, *Quick Calculus* (Wiley, New York, 1985), or Colin Adams, Joel Hass, and Abigail Thompson, *How to Ace Calculus: The Streetwise Guide* (Freeman, San Francisco, 1998).

Problem Solving Tips

- Do the reading and listen to the lectures before attempting the problems.
- Attempt the problems before conference sessions, so that you can ask well-formulated questions there. **Do not** put off the problems until the night before they are due.
- Read the problem carefully to make sure you understand what is being asked.
- Do not rush into solving a problem. Instead, first formulate a strategy for solving the problem. Usually this is as simple as classifying the problem according to its method of solution. Is it a "constant acceleration" problem? A "work-energy" problem? A "Gauss's law" problem?
- If you find yourself writing pages of words or working reams of algebra, then you are off on the wrong track. Stop, reread the problem, think, reformulate, and then start over again.
- **Don't search through your book for "the right equation".** You will not be able to solve your problem by finding an appropriate equation and then plugging numbers into it.
- If the final answer called for in the question is a number, then you will ultimately have to plug numbers into an equation. It is almost always easier and less error-prone to keep the quantities as symbols until the very end.
- Sometimes the problem statement will give you more information than is needed to answer the question. Sometimes it will give you less information than is needed, and ask you not for an answer but for a list of the unknown information required to find an answer. Sometimes the problem will be a short narrative from which you need to extract relevant information. Students often find such problems exasperating, but in fact they develop an important problem-solving skill called **building a mathematical model**. Problems that arise in the world outside of your textbook usually come with more or less data present than needed to solve the problem. The ability to recognize which data are needed and which are irrelevant is an important practical skill.
- Review your problem solutions when they are returned. Why did you make the mistakes you did? How could you have avoided them?

Lab Work Tips

- Skim the lab instructions before coming to lab.
- Don't be afraid to fiddle with lab equipment unless you have been specifically warned away from it.

Exam Preparation Tips

- Keep up with the course. Don't cram at the last minute.
- Get a good night's sleep.
- Prepare a one-page summary of the material being examined.
- Don't memorize. Your teacher expects you to work with ideas and solve problems, not plug numbers into equations.
- Bring to the exam a calculator (fully charged) and several pens or pencils (sharpened).
- As you read an exam problem, place a check mark beside the given data and underline the unknown quantity to be found. This will help you prepare a strategy and help you avoid answering a question that is similar to but different from the one that is asked.
- Make a sketch or graph to familiarize yourself with the situation. Make sure you understand the problem before plunging in.