HOW TO STUDY PHYSICS

College-level physics strikes fear in the hearts of many students. They tend to be overwhelmed by the many new terms and equations they encounter. Moreover, many students have not had extensive experience with problem solving courses and tend to get lost when trying to apply information from the text and lectures to an actual physics problem.

Difficulties often arise when students "think small" and get overly involved in memorization of specific details without understanding the underlying principles or without perceiving how to apply specific knowledge to the problems.

GETTING AN OVERVIEW

It is of utmost importance to recognize that physics is a problem-solving discipline. A physics instructor will stress major themes and principles; his or her goal is for you to learn to understand and solve problems. Your approach to the study of physics, during the time spent in lecture, reading the text, or reviewing for exams should focus on solving problems.

An overview of your course can help you organize your efforts and increase your efficiency. Comprehension and retention of specific data or formulae are enhanced when you perceive underlying principles or connecting themes. Furthermore, in some instances it is inevitable that you will forget a formula, and an understanding of the underlying principle will sometimes allow you to generate the formula for yourself.

Several steps will help you get an overview of the material in a physics course. Take them early in the term so all subsequent material can be integrated into your overview.

1. Examine carefully the information given in the course syllabus or reading list. Look for underlying themes or a pattern on which the course is developed.
2. Preview the textbook: read the introduction, table of contents, "notes to the student," and preface. Check the syllabus to see what chapters are assigned. Are they assigned in the same order as in the table of contents? If not, can you see a reason for your professor's decision to alter the order of presentation?
3. As you preview the course from this perspective early in the term, look for important themes and principles. Glance at some of the problems. How are important themes illustrated in these problems?

EFFECTIVE PARTICIPATION IN A PHYSICS LECTURE

In most introductory science courses, the lecture gives the best indication of the emphasis of the course. You must be well prepared for lecture to fully utilize it for integrating the course material.

Preparing for lecture

1. Prior to each lecture, check the syllabus or reading assignments to see what will be covered. Prepare for the lecture by briefly previewing the sections of the textbook that apply to the subjects to be covered in class. Previewing the text improves your ability to follow the lecture by familiarizing you with the new terminology and by giving you some "signposts" that will help integrate the lectures into an "overall picture."

    a. Read the introduction and the summary of the relevant chapter, and look at the section headings and subheadings. Try to formulate questions in your mind about the subjects to be covered. This question-formulation helps you manipulate and better understand the material.
    b. Examine and try to understand the drawings and pictures to determine which principles they illustrate.
    c. Make notes of new words, new units of measure, statements of general laws, etc.
    d. Do not try to underline since you do not yet know what will be emphasized by the instructor.

2. Another good preparation for lecture is to spend any time available right before class to check over your notes from the last lecture. This will prepare you to listen to the new physics lecture as part of an integrated course and will help you see the broad development of themes.

3. Come early to the lectures and stay to the very end. Often instructors give helpful hints in the first and last minutes of their lectures—just when most people are not listening.

4. Take good notes. Use abbreviations in taking notes so you can keep pace with the lecture. (Be consistent in your abbreviations so you won't have a problem understanding your notes.)

5. When copying drawings, completeness is worth more than careful artwork. It is seldom adequate to simply copy what is on the board. You must also include important points the professor makes verbally about the diagram.

6. If you get behind in your note-taking, it is better to leave a space in your notes and go on. You can fill in your notes later with the help of a classmate or your textbook.

7. If you are prepared for class, have previewed your text, and are attentive, you should not be embarrassed to ask your instructor questions. Many instructors depend on feedback from students to help them set a proper pace for the lecture.

8. Immediately after lecture, or as soon as possible, review and edit your notes. You need not rewrite your notes: rather, you should look for important ideas and summarize these in the margin. It is also important that you use this time to look for relationships among the major topics covered by the instructor.

(As you review your notes, certain questions may come to your mind. In the note-taking format you choose, leave space to record these questions.)

READING YOUR PHYSICS TEXT

Reading the text and solving homework problems can be viewed as a cycle: 1) Raising questions and 2) Finding answers that lead back to "1." More questions. An entire chapter will often be devoted to the consequences of a single basic principle. You should seek out these basic principles. These so-called laws of nature" give order to the physicists' view of the universe. Moreover, nearly all of the problems you will face in a physics course can be analyzed by means of one or more of these laws.

When looking for relationships among topics, you may note that in many instances a specific problem is analyzed in great detail, then the setting of the problem is generalized into more abstract results. When such generalizations are made, you should refer back to the specific case that was previously cited and make sure you understand how the general theory applies to the specific problem. Then, see if you can think of other problems to which the general principle would apply.

Here are some suggestions to help you get more out of your physics reading:

1. Make use of the preview you did prior to the lecture. Again, quickly look at the major points of the chapter. Think back to the points stressed in lecture.
2. Read the homework problems first, if you have them. Critically assess what principles seem to be the most significant in the assigned chapter. Based on your brief review of the lecture and your examination of the assigned problems, try to generate questions you want to answer.
3. Read actively with questions in mind. A passive approach to reading physics is wasting your time. If you find that you are not reading actively, take another look at the problems and lecture notes. Read to learn, not to cover material.

4. Stop periodically and pointedly recall the material you have read. Often, repeating material aloud will successfully demand use of your "recalling" and "retention" processes.
5. During your reading you will notice sections that apply directly to assigned problems. After you have read such a section, stop and analyze its application to a homework problem.
6. The interplay of reading and problem solving can help you gain insights that are not possible by careful reading alone. When you read passively, you simply follow the chain of thought presented by the text. Your mind is not exploring the possibilities of what is being said. By actively combining the questioning inherent in problem solving with your reading, you can enhance both your concentration while reading and your ability to recall and apply material.

PROBLEM SOLVING IN PHYSICS

Two things are important to remember when solving physics problems. First, a physicist seeks problems that can be modeled or represented pictorially or schematically. This means that almost any problem you encounter in a physics course can be illustrated with a drawing. Moreover, such a drawing usually contains or suggests the solution to the problem. Second, a physicist seeks to find unifying principles that can be expressed mathematically and applied to the broad classes of physical situations. While your physics textbook contains many specific formulae, the broader so-called "laws of nature" must be understood in order to grasp the general overview of physics. This broad conceptualizing is vital if you are to solve those problems that may embody several different principles. Virtually all specific formulae in physics are combinations of "the basic laws."

1. Read the problem and make sure you understand all the terminology used. Look up the meanings of any terms you do not know.
2. Make a drawing of the problem. In your drawing, you should:
   A. Identify the quantity you are seeking.
   B. Identify the given values of the parameters (variables) on which the solution depends.
   C. Identify unknown parameters that must be calculated from other information in order to find the desired solution.
   D. Make sure all quantities in the problem are expressed in the same unit of measure.
3. Establish which general principle relates the given parameters to the quantity you are seeking. Usually your picture will suggest the correct formulae. However, at times, further information will have to be generated before the proper formulae can be chosen. This is especially true of problems in which the solution you seek must be calculated indirectly from the given information.

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