PROBLEM SOLVING IN PHYSICS

Two things are important to remember in solving physics problems. First, a physicist seeks those problems which can be modeled or represented pictorially or schematically. This means that *almost any problem you encounter in a physics course can be described with a drawing.* Moreover, such a drawing usually contains or suggests the solution to the problem. Second, *a physicist seeks to find unifying principles* which can be expressed mathematically and applied to the broad classes of physical situations. While your physics textbook contains many specific formulas, the broader "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 embody several different principles. Virtually all specific formulas in physics are combinations of "the basic laws."

The following is a general outline of how to approach a physics problem:

1. *Read the problem* and make sure that you understand all the terminology used. Look up the meanings of any terms that you do not know.
2. *Make a drawing of the problem*. In your drawing, you should identify the Quantity you are seeking; identify the quantity you are seeking; identify the given values of the parameter (variables) on which the solution depends; identify unknown parameters which must be calculated from other information in order to find the solution; and make sure that all quantities in the problem are expressed in [consistent units of measure].
3. *Establish which general principle relates the given parameters to the quantity you are seeking.* Usually your picture will suggest the correct formulas. However, at times, further information will have to be generated before the proper formulas can be chosen. This is especially true of problems in which the solution you seek must be calculated indirectly from the given information.
4. *Calculate the solution* (a) by calculating the values of any parameters which were obtained from the given information (if any such parameters were necessary), then (b) by putting the values of all the parameters, both given and calculated, into the main question.
5. *Criticize your solution to see if it makes sense.* Compare your solution to any available examples. Many times an error in a calculation will result in a solution that will be obviously wrong. Check the units of your solution that will be obviously wrong. Check the units of your solution to be sure that they are appropriate. *Examining your solutions will develop your intuition about the correctness of solutions—an intuition immensely valuable to use with problems that you will later encounter on an exam.* When you have completed a problem, you should be able (at some later time) to read the solution and understand it without referring to the text. This means that you should include necessary notation as to which principle you have applied. If, when you read a solution, you come to a step that you do not understand, then you have either omitted a step that is necessary to the logical development of the solution, or you need to write notes in your solution to remind you of the reasons for each step. While it may take more time to write careful and complete solutions to homework problems, you will find that this will be "paid back" by the help in problem solving, as you are prevented from overlooking essential information; it will also provide excellent review material for exam preparation.

EFFECTIVE TEST PREPARATION

If you have followed an active approach to study, similar to the one suggested below, your preparation for exams will not be overly difficult. Let us repeat that *physics courses, and therefore physics exams, involve problem solving.* Therefore your approach to studying for exams should stress problem solving.

Here are some principles:

1. In the week prior to the exam, completing steps (a), (b), and (c) should give you a reasonably good idea of what has been stressed and on what you can expect to be tested. (a) Quickly review your notes and recheck the syllabus. (Your goal at this point is to ascertain what has been emphasized.) (b) Reread quickly your solutions to the homework problems. (Remember that these solutions, if complete, will note underlying principles of laws.) (c)Quickly review the assigned chapters. (Once again, your purpose in this early stage of exam preparation is to ascertain what topics or principles have been emphasized.)
2. From this rapid overview, generate a list of themes, principles, and types of problems that you expect to be covered.
3. Review Actively. Don't mistake recognition of a principle when you see it for actual knowledge that will be available for recall in a test situation. *Try to look at all the possible ways that a principle can be applied.* For example: If velocity and acceleration principles have been stressed, look over all your homework problems to see if they, in any way, illustrate these principles. Then, if you also can anticipate an emphasis on friction and inertia, once again review *all* your homework problems, checking to see if they illustrate, in any way, those principles.

Effective examination preparation involves your developing an interaction between homework problems, the lecture, and the text. If you review actively and "self-test," including creating on your own problems which involve a combination of principles, you are not likely to look back on an exam and say, "I knew ho to do friction problems, it's just that they were asked in a weird way, so I didn't recognize them."