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How to Solve Problems

The objective of this course is to (1) introduce a few fundamental concepts, and (2) show you how to apply these general principles to specific physical situations. In a nutshell, you're going to learn how to solve problems. Problem solving is not a skill most of are born with; it's a skill we must learn. Developing a systematic approach for solving even the simplest problems will greatly improve your ability to solve the more difficult ones. The procedure described here includes the essential steps you should apply to most of the problems you tackle, whether it be on a homework set, a quiz, or an exams.

Understand the problem

1. Read the problem carefully.

2. Draw a simple picture of what is happening.

3. Using the appropriate symbols, write down what you are given. Remember that not all of the information in the problem will be useful.

4. Using the appropriate symbols, write down what you must find.

Set up the problem

5. Pick a useful coordinate system, typically with one axis parallel to any acceleration.

6. If forces are involved, draw a free-body diagram for each object in the problem. You might find it useful to draw a diagram for different stages in the problem.

7. Write down the relevant equations.

This is probably the most difficult step. With experience with a given concept, you will learn to recognize when that concept applies to a problem. If you find yourself scanning through the textbook for equations with the right variables, then you don't understand the concepts you need to apply. When reading the textbook, identify and focus on the most important equations. This doesn't mean memorizing them; it means understanding what each variable in the equation represents and what it does. That way, when you are presented with a problem, you will be able to identify the concepts at work and the equations you need.

Solve the problem

8. Use the relevant equations to obtain an algebraic solution for the quantity you must find.

9. Once you have completed the algebra, substitute numerical quantities, *with units*, for the algebraic variables and calculate the answer.

Never substitute numbers for variables until you have completed the algebra. You will often find that many quantities cancel, simplifying the final equation and making your final calculation less prone to error. You will also find that the algebraic solution gives you a feel for how the answer will change if the given values change. Note that partial credit will never be given for solutions past the point numerical calculations replace algebra.

10. Write down and indicate your answer clearly, with units and the correct number of significant figures.

Check your work

11. Does the answer seem reasonable? Many errors will result in outlandish answers that this check will catch.

12. Do the units work out? Check the units of your algebraic solution. If it doesn't produce units the answer must have, then you know you've made a mistake. This check will catch most algebraic errors.

13. Reread the problem to make sure you did what was asked.

General comments

It might help to emulate the methods used when your instructor or TA solves problems in class.

Many students find solving problems to be a frustrating experience, at least until they start to catch on. That's OK. When you start the problems based on a particular section of the text, the first thing you learn is that you still aren't comfortable with the concepts involved. The problems just point you back to the material you need to spend a little more time with.

As you work through a problem set, you will gain experience with the concepts covered and grow more skillful at applying them. When you have completed the problems for a given chapter, you should be pretty comfortable with them. If so, you are ready to tackle problems on quizzes and exams. If not, you should pick additional problems to solve and try them, too.

The key to developing your problem solving skills is to *practice, practice, and practice some more*. For each chapter, keep trying problems until you get good at them. Then you'll be ready for the exams.

This handout is based on *Problem solving guidelines* written by Dr. Dale Long.