Zen and the art of doing physics problems

Zen Physics: Guide to problem solving

1. Read the question *carefully*, and then *reread it*. In physics problems there are usually **keywords** that hint at the **physics principles** which are applicable to the problem. In addition, there are often **modifiers** that change what the question means. (It is ironic ☹, but often physics students have more difficulty with the *English* of a question than with the *Physics*.)

2. Draw a **picture** of the situation described. It is surprising how often this simple step makes you realize you must **reread** the question *again* to clarify an important detail of the situation. (Sometimes you'll need multiple diagrams!)

3. **Label** the picture with *all* relevant information that you know. Write both **symbols** and **numbers** (*with* **units**) – if you know them. E.g. $y_1 = 1.81$ m. You'll often need to decide on an **origin** and a **coordinate system**.

4. Write down what you want. I.e. what **variable** or **parameter** is the question asking for. E.g. $\vec{F} = ?$

5. Write down **relationships** between things you know and want. This means writing **equations** that include some or all of the variables you identified in steps **3.** and **4.** that go with the picture. This may sometimes introduce more **unknown** variables ☹, which means you'll need to put them in your picture and maybe find *more* equations. The total number of **independent** equations you need *must be* equal to the total number of **unknowns** in the problem. The things in these equations should *all* be labeled in your picture. If they are not, then you'll need to add stuff to (or redo) your picture. Using **pencil** for physics is *good*!

6. Derive a *new* equation (**algebraic** or **calculus**) for the answer in terms of things you know. This should be done with symbols – no **algebra with numbers** (**AWN**)!

7. **Plug** in the numbers for the things you know into your equation for the answer. You *must* include units!

8. **Chug** through your equation and calculate the *numerical* answer and the *units* of the answer (figure out the units *from your equation*).

9. **Sanity check**: **(i)** units; **(ii)** magnitude; **(iii)** sign and **(iv)** significant figures …of your answer to make sure that they *all* make sense. (i) If your answer has the *wrong* **units**, then you probably made a mistake with your algebra ☹. If this happens, go back and check your working. (ii) This is a reality check for your answer. If the **magnitude** (size) of the answer doesn't make sense, then you probably made a mistake. (iii) Check that the **sign** (**direction** for a **vector**). A vector *without* direction is just *pointless* ☺. (iv) If you got everything else right, you wouldn't want to lose points for **sig. figs.** – would you?

10. Indicate your **final answer** with a **box** or **underlining**. If you got the correct answer, wouldn't you want the grader to be able to *find it*? ☺

Zen Physics

Physics is *NOT* about **memorizing** a whole bunch of facts and formulas. It's about learning to **think** about the physical world in a quantitative way. During **Zen Physics** problem solving, you may even *forget* the original question – this is a sure sign of **enlightenment** in problem solving!

When we're working a problem in class, your task is *NOT* to memorize how to do the problem. Your goal is to solve the problem yourself as we work on it together. The idea is for *you* to **understand** *how* to solve the problem by yourself **from scratch**, figuring out (for yourself) what to do next, *at each and every step*. This means you need to know **why** we chose to do each step. If it's not clear to you *why* we did something – then please ask in class – *don't wait till later!* You won't be the only person with questions.

Homework grade for "attempts"

The purpose of the **homework** is to *help you do well* in the course. The only way to succeed is for you to work on the homework *by yourself*. The assigned problems are usually *very difficult*. The idea is for you to **think** about them yourself as you work through the **problem solving method** discussed above and in class. Therefore, when you are working on a homework problem, you should always read the question and then work through the problem *as far as you can* **by yourself**. When you **get stuck**, you should write out a short sentence explaining **where** you are in the problem solving process (i.e. which **step number** you got stuck at) and **what** you think you might need to keep going (e.g. a relationship between force and acceleration). If you do this for *homework*, you'll receive **full credit** for correctly **attempting** the problem if you get to step **5.** or higher.

If you're still stuck, consulting with others on your homework is acceptable and *encouraged*. However, you must write up and turn in your own solution that must include your **individual attempt** following the procedure outlined above.

Midterm Tests and Final Exam graded for "correctness"

The Tests and Final Exam will be graded for **correctness** rather than (attempt) effort. **Partial credit** will be given for each **conceptual portion** of your problem solution that is correctly worked out **algebraically**. *No partial credit* will be given for doing "*algebra with numbers*" (**AWN**). Numerical errors (with the correct units) will only result in a moderate deduction. However, an important part of physics is to understand your answer, and to satisfy yourself that it is reasonable. No credit will be given for a skipped problem or for providing an answer to a numerical problem without showing the work required to obtain the answer (unless it's a multiple choice question).