Tips for writing a test, exam, or homework

In an upper-level class, instructors plan to ask you questions that require thoughtful reasoned responses. We are not trying to teach you formula or cook-book approaches to science. Rather, our goal is to help you to understand some basic ideas, concepts, and approaches to problem-solving that are broadly useful. Tests, exams, and homework problem sets are your opportunity to demonstrate to us that you have achieved that understanding. You need to use those opportunities effectively.

Inevitably, you will encounter formulas and "rules-of-thumb". However, these are not supposed to be ways to bypass critical thinking. In those cases, it is important that you understand how those approximations were derived, i.e. what assumptions were made, so that you can assess whether the formula is applicable (or not) to different situations that you may encounter in problems.

Communication is a large part of any exam or test. You have to communicate to the instructor(s) that you understand the material, that you can formulate a problem, or that you can decide which approximations to make to allow you to find a solution to your problem. Graders are not mind readers. Therefore, at all times you should be thinking about what your reader is going to understand from the marks that you make on your paper, and you should write down enough information so that a reader can follow your thinking.

While finding a correct numerical answer to a posed question is important, your thinking behind your answer is just as important, or even more important. This is where the English language can work to your benefit. Mathematicians may tell you that mathematics is a beautiful language. However, unless equations are accompanied by some words explaining what the equations are attempting to show or do, your communication may be ineffective.

Furthermore, thinking as a grader, it is hard to give partial points where there is nothing written except a wrong answer, whereas it is much easier to give partial points if there is a transparent trail outlining your thought process. In fact, a well-documented but numerically erroneous answer may be worth more than a numerically correct answer that appears as if by magic on the page.

When you set out to answer a question, it helps both you and your readers when you are to be able to write down in words a description of what you are doing, and why.

To give yourself the best opportunity to answer questions successfully, you need to plan each answer. Here are some tips:

- Unless an instructor explicitly invites you to answer questions directly on a test paper, plan to write every answer on a clean page.
- Starting each answer on a new page is a good way to separate ideas and to shift mental gears.

- Decide what ideas you want to communicate to the reader.
- Be sure that you have enough space if you need to jot down or organize your ideas before writing a prose answer.
- Organize your answer in a way that the ideas can flow out logically, and in a way that you can communicate your thinking effectively.
- Leave plenty of spaces in your work. (Paper is cheap. ☺) This lets you fit in other ideas or details that you might have missed at first, and also gives a reader space to jot notes or comments to you.
- When you write an equation, consider writing a short sentence telling the reader why you use the equation, what the equation does, and/or what the terms of the equation mean.
- When writing equations, be careful about how you use "equals" signs. The things on both sides should be equal. Don't just keep extending an equation as you think of more things to do with it. For example, if a = b, and b + c = d, ***don't*** write

  $$a = b + c = d$$

  It is just not true.
- Always check your units. This is a very effective way to discover and correct errors. In equations, be sure that every term has the same units. This will help you to identify missing coefficients, incorrect exponents, etc.
- In numerical answers, carry all units through all your calculations.
  - If the units don't simplify down to the units that you expect, you may have missed a coefficient or an exponent.
  - You can also uncover outrageously large power-of-ten errors. For example, if you have km in your numerator, and mm in your denominator, they are both lengths, but they don't just cancel – km/mm = 10^6, so you could be in error by a factor of a million.
  - You can always multiply any expression by unity without changing its value. To convert 6 km/yr to mm/yr, you can multiply by (10^6 mm)/(1 km) which is equal to 1.

    $$6 \text{ km/yr} = 6 \text{ km/yr} \times (10^6 \text{ mm})/(1 \text{ km}) = 6\times10^6 \text{ mm/yr}$$

  - Failing to notice that you have sec/year $\approx 3.1\times10^7$ left in your units is another common error that is easily avoided.
- Check that you have answered all parts of each question. Discussions about assumptions or limitations are very important.