Tips for Honors Exams

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These tips emphasize physics honors exams set by an external examiner, but some of them are more widely applicable.

Studying for the Written Exam

You are used to taking exams written by your instructor and tightly tied to your instructor's perspective on the class material. The whole point of external examination is to break this mold. The exam will *not* be tightly tied to your instructor's perspective, so you might find it intimidating. Don't panic! Just do your best.

I can't make any guarantees about what will be on your exam, because I didn't write it. But the usual situation is that the exam tests general physics knowledge and problem-solving skills, rather than specialized obscure points.

With that in mind, the best way to study for the exam is *not* to run over the most recondite points in your most advanced texts. Some students find it useful to go back and reread their introductory textbook. Others prefer to look at introductory material from a more advanced viewpoint. I think the first route is most effective, but if you want to take the second route, I recommend these books:

Classical mechanics: David Morin, *Introduction to Classical Mechanics* OR Daniel Kleppner, Robert Kolenkow, *An Introduction to Mechanics* OR A.P. French, *Newtonian Mechanics*.

Electricity and magnetism: Edward M. Purcell, *Electricity and Magnetism* (volume 2 of the Berkley Physics Course).

Quantum mechanics: Leslie E. Ballentine, *Quantum Mechanics: A Modern Development*.

Thermodynamics: Enrico Fermi, *Thermodynamics* (uses some old-fashioned terminology and notation, but extraordinarily clear).

Statistical mechanics: I don't know of any book that fills this role for this subject.

Relativity: Edwin F. Taylor and John Archibald Wheeler, *Spacetime Physics* OR Daniel F. Styer, *Relativity for the Questioning Mind* followed by "Notes on Relativistic Dynamics" at
http://www.oberlin.edu/physics/dstyer/Modern/RelativisticDynamics.pdf

(I would appreciate your thoughts on this list. Additions or subtractions are welcome!)

I *don't* recommend reading the Feynman Lectures to prepare for your exam. These books are wonderful, and if you study them it will help your general development as a physicist, but they are so idiosyncratic that they are unlikely to prepare you well for your honors exam.

Taking the Written Exam

Read through the exam first and classify problems as (1) I know how to do these; (2) I think I can figure out how to do these; and (3) I'm clueless. Work on problems in class (1) first. Don't waste time on problems in class (3) and then run out of time with problems of class (1) still unanswered.

Do what you can on the problems. Even if you know you can't finish, try to start. It's not unusual for examiners to set problems that are unsolvable; the examiner wants to see how you start off on a problem that you can't finish. In particular, if you find that you can't solve part (c) of a problem, you should nevertheless continue and work as much of part (d) as you can. This advice has been repeated since Jesus's time as "Don't hide your lamp under a bushel" (Matthew v.15).

Taking the Oral Exam

You are not going to impress your examiner by dressing in elegant "dress for success" fashion. Wear comfortable clothing that will not fall off when you're writing on the chalkboard.

Most oral exams involve three parts:

(1) The examiner discusses your thesis with you and asks questions concerning parts s/he found puzzling. To study for this part, know your thesis cold. If you've done additional research after completing your thesis, the examiner will be impressed.

(2) The examiner discusses your written exam with you and asks questions concerning problems you've missed. To study for this part, go over your written exam answers with special emphasis on your mistakes.

(3) Wide-ranging physics questions.

You will be asked questions for which you will not know the answer off the top of your head. Your examiner wants to see *how* you approach the problem. Some students ruminate silently until they hit upon the answer. Bad idea, since this doesn't show the examiner how you're approaching the problem. Instead, say your ruminations out loud, and write them on the board. In particular, it almost always helps to (1) first sketch the situation and (2) then write down the major ideas you'll use to solve it ($F = ma$?, Gauss's Law?, Energy conservation?, Momentum conservation?, Equipartition?)

Oral exams are tailored to your performance. If you're doing poorly, the examiner will give you hints. If you're doing well, the examiner will generalize the problem to make it harder. A consequence is that you're always a bit out of kilter. This can distress students who are used to being confident. Just realize that it's going to happen and that being out of kilter is not a bad sign.

You will probably be asked to summarize your thesis. Have a three-minute summary in mind. You will be interrupted with questions before you get to the end of your summary, but that's okay: it means your examiner is interested in what you say.

You will be asked questions about your thesis: "What is the physical significance of the function $r(x)$ defined in equation 4.21 on page 71, and plotted in figure 4.3 on page 82." Bring a copy of your thesis.

If you say something obviously wrong, correct yourself and move on. Everyone makes stupid mistakes, but only the stupid get stuck defending their stupid mistakes.

Don't be defensive and don't argue with the examiner. (On the other hand, if you have a panel of examiners you might want to get them arguing among themselves. This happened during my Ph.D. dissertation defense.)