Exam Technique

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Here I outline some actionable advice on how do your best at exams after you're done studying. The points made here have come about from the experiences of many students, and I ask you to give them some thought before any exam. Both as a student and as an examiner, I've seen too many catastrophes that could have been easily averted.

Before the exam

- Get some sleep! You need at least 8 hours of good sleep if you want your thoughts to flow smoothly. Every hour of sleep you miss out on will make you more prone to trivial errors during the exam. You will also work much slower than usual, and you won't be aware of this between peeking at the clock. I assure you that the damage you will do by sacrificing sleep outweighs any benefits from going through a few extra problems. If you need to cram, you are already doomed. You might luck out and still do well, but you could be doing even better.

  You cannot make up for sleep through coffee or energy drinks. These wake you up for a couple of hours, after which there comes a crash, and the fatigue is back with a vengeance[1]. If you're having trouble with sleep like myself, you should, in order of decreasing importance, take melatonin, exercise, turn down the heat, avoid blue light, and wear earplugs.

- Don't do problems right before the exam. This will leave your subconscious focused on a few select topics, and it will be more difficult for you to recover anything you've studied before that. In other words, you are likely to forget more things than you memorise. Apart from that, studying under stress doesn't lead to real understanding.

  You can follow this only to a degree. Some choose not to do any reading at all in the day before the exam, while some will spend an hour or two revising before bed. There's also one exception to this piece of advice, which is exams that require rote learning. One example is the observational round of IOAA, where you need to know the common names of hundreds of stars, among other trivia. In that case, it's best to memorise the stuff right before the exam, and promptly forget it afterwards.

- Remember to bring all your stationery. The most important thing is your scientific calculator. As long as it's non-programmable, there are few limitations on the model you choose. If you want something cheap, I like the Citizen SR series. Otherwise, I use a Casio fx-991EX (which I know is banned in a few exams). Anyway, make sure you know how your calculator works, especially how to store intermediate results in the memory, as well as how to call the more complicated operations (inverse trigonometric functions, logarithms with any base). The manuals should be available online.

  You will also need an analogue watch. Often there is no clock at the exam venue, but keeping track of the remaining time is absolutely essential. Finally, bring a long transparent ruler, a protractor, and a compass. They won't weigh you down. Even when there isn't any graph plotting to do, neat diagrams are always appreciated.

During the exam

- The *first thing* to do is to read through *all* of the problem statements carefully. Your goal is to maximise your marks, and it's best to know your options upfront. Also, sometimes there might be crucial information contained within single words (such as 'smooth' implying no friction), and if you miss those, you simply can't solve the problem. You will need a way to gather this information on the go. Some people use coloured highlighters, I draw diagrams and scribble on them, do whatever works for you, but it should involve writing. Writing things down forces your brain to actually parse them.

[1] Though if you're already an addict, you will need the coffee.

Another point to be aware of is that it's not unusual for problem statements to be nearly incomprehensible. Going through the full text will always help, because now you at least know what your end goal is, and it might become clearer what the aim of Part A is after you've seen Part D.

- Make use of everything you're given in the problem statement. If you've reached a dead end, the best question to ask yourself is "Which bits of information have I still not used?". In order to be clear on how each piece matters for the problem, think about what would change were the setup a bit different. In general, try to think as if you were the one designing the problem.

  You should also pay attention to how the marks are distributed between the subparts of a problem. Assuming that the distribution is fair, it provides hints about what's easy and what's difficult. If you're spending lots of time on something worth 2% of the total, start over. If it's unrelated to the rest of the problem, drop it.

- Again, your one and only goal is to solve everything. Do not spend time on long essays. You do need to show that you understand what the problem is about, but be very succinct. Diagrams can save time when you want to make a point.

- Your working should at least be legible. Number your pages, make sure that the flow of the logic can be followed, and put a big box around your final answers like $\boxed{\text{this}}$. If your handwriting is messy, use block capitals for the key phrases. Note that if it's really bad, the examiner will get the urge to mark you down, and maybe act on it unconsciously.

- Rough work is a lie that they teach you in middle school. Writing things twice is just a waste of time. Even if there's something correct in your rough work, you won't be getting any marks, because it's in the best interests of the examiners to spend as little time as possible on marking. You should submit everything you've written for grading, and if you've made a mistake, simply cross it out.

- Work on all of the problems even if you're unable to fully solve them. If you have absolutely no idea on how to proceed, you can still write down a few formulae that are pertinent to the problem. In most physics exams, points can only be awarded, not deducted. You should use this to your advantage. Write down all your thoughts without any fear that you will embarrass yourself. The marker doesn't care. They have hundreds of other papers to go through, and they'll spend a few minutes at most on each.

- If you feel that the exam is unusually difficult, it's likely that everyone else feels the same. Keep calm in the face of sheer terror, and work on everything nonetheless.

- Whenever there are many variables in the problem, it's advisable to keep track of the dimensions (i.e. whether the units on both sides of your equations are the same), because it's easy to omit a letter when copying from one line to the next. Similarly, check the dimensions of your final answer. To that end, it pays to remember how the more complicated units interact. For example, henries times farads is simply seconds squared.

- You should verify your answers using special cases. If the problem has a special case where the answer is obvious, then your formula must recover that answer under the parameters of the special case, or else it's wrong. Let's say you're asked to find the centre-of-mass acceleration of a homogeneous ball rolling down a plane that makes an angle α with the horizon. If you got $a = \frac{5}{7} g \cos\alpha$, you can quickly see that this is incorrect, because you expect $a = 0$ for $\alpha = 0$, whereas your formula predicts $a = \frac{5}{7} g$. The real answer, $a = \frac{5}{7} g \sin\alpha$, would have survived the check.

- Do not leave the exam early. There doesn't exist a scenario where this is in your favour. Going into dark arts territory, you can usually get a few extra minutes while the exam invigilators are busy collecting other students' papers.

Acknowledgements

When compiling this, I stole some bits from Andrej Karpathy's study tips that I liked.
I also thank Nikolai Beluhov for reading a previous version of this document.

Some extra thoughts

I felt it necessary to adopt a stern tone here, because students often come to me with a 'I should have listened to this!' when it's too late. This had me ponder on why students do what *they* think is best, even though the teacher has their best interests at heart (one hopes).

Well, it isn't obvious that students should be malleable to begin with, and one line of thought is that people's views crystallise surprisingly early in general. My experience is that by 17, you're working with more or less a finished product, and you won't be effecting any radical change. Students who first meet physics at that age can still make rapid progress, but in those cases there always seems to be some foundation lying underneath, as in a framework of thinking that has been trained through something else like maths puzzles.

But I rather wanted to highlight how gifted students seem to be even less receptive to generic advice compared to your average class, preferring to update their ruleset by themselves. I figure that this is because they've had a period in their life where this has served them well. There's a very real possibility that you reach a point where you know more maths than your maths teacher. More importantly, your teachers might have missed out entirely on the experiences that you're now going through. Their advice is no longer helpful to you, so you learn to function on your own.

Nevertheless, authority figures are good! Exceptional people arise out of exceptional surroundings, and you will this feel this in your blood from very early on. There's a reason why everyone wants to go to MIT (sometimes based only on ⋆vibes⋆), and nobody wants to fade away in some small town. And similarly, when you run out of mentors in your immediate milieu, you should not remain on your own, but rather search further out. There's the entire Internet to keep you company.

Some very accomplished individuals have taken the time to share what they know, and you should do your best to find their writings. Even if you don't agree with everything there, you will be getting an incredible bargain. It takes minutes for you to read what they've spent days on to write. I'm reluctant to prescribe anything in particular, but there are good and bad places to start (e.g. try Substack, not Reddit).

Last updated: 29th December 2024
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