Generic top tips for Physics success

Dr Andrew French. December 2021.

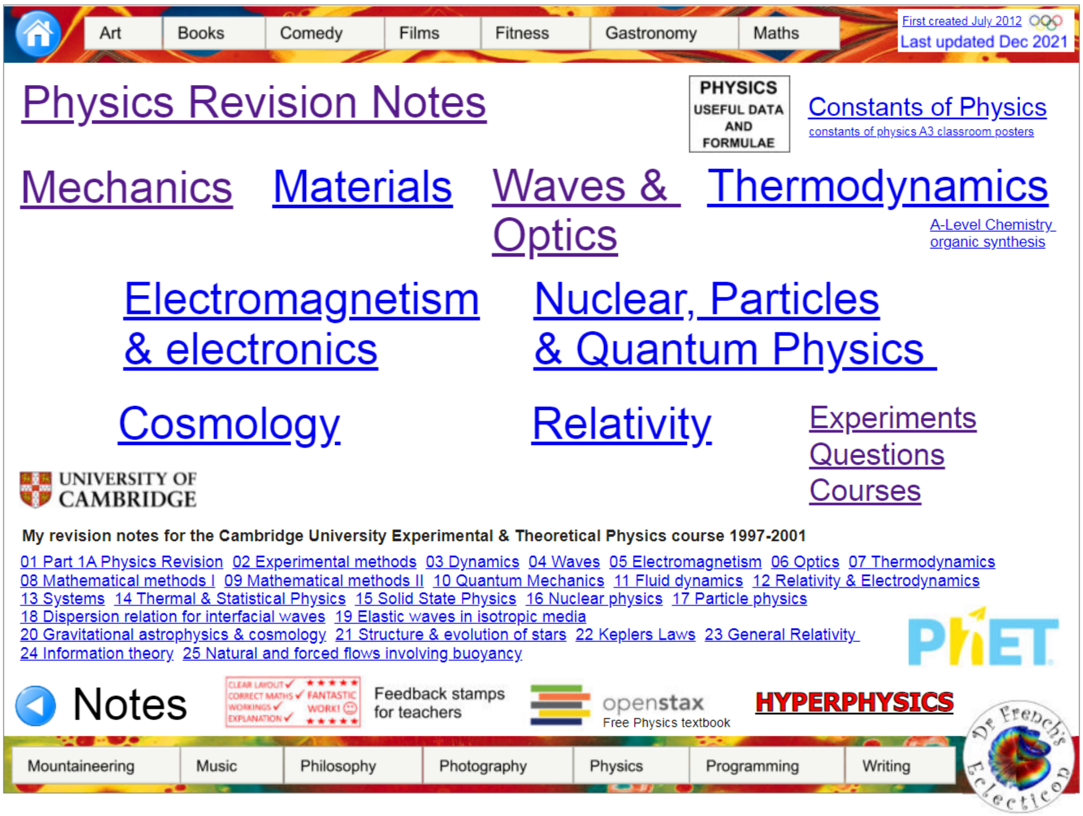
1. Keep mind-mapping your subject knowledge. Do this regularly, particularly when you finish a topic

Compared to many disciplines, Physics is relatively light on content. However, understanding of this content (*mathematical models of physical processes*) and its *experimental context* is deep and highly interconnected.

In http://www.eclecticon.info/physics_notes.htm and http://www.eclecticon.info/physics_revision.htm the key topics are:

Mechanics, Waves & Optics, Electricity & Magnetism, Thermal Physics, Atomic Physics

Every course (JP/MP, IGCSE, Pre-U, University.....) you will encounter *all* of these topics, but the depth and sophistication will obviously increase. Choose the notes appropriate to your level. (See the Revision notes in particular).



2. Learn your definitions, and key equations. There are not too many, but you need to *really* know them. Learn them as words, then as algebra. Test your recall daily, just like language vocabulary.

e.g. http://www.eclecticon.info/index_htm_files/IGCSE%20Physics%20formulae%20to%20memorise.pdf

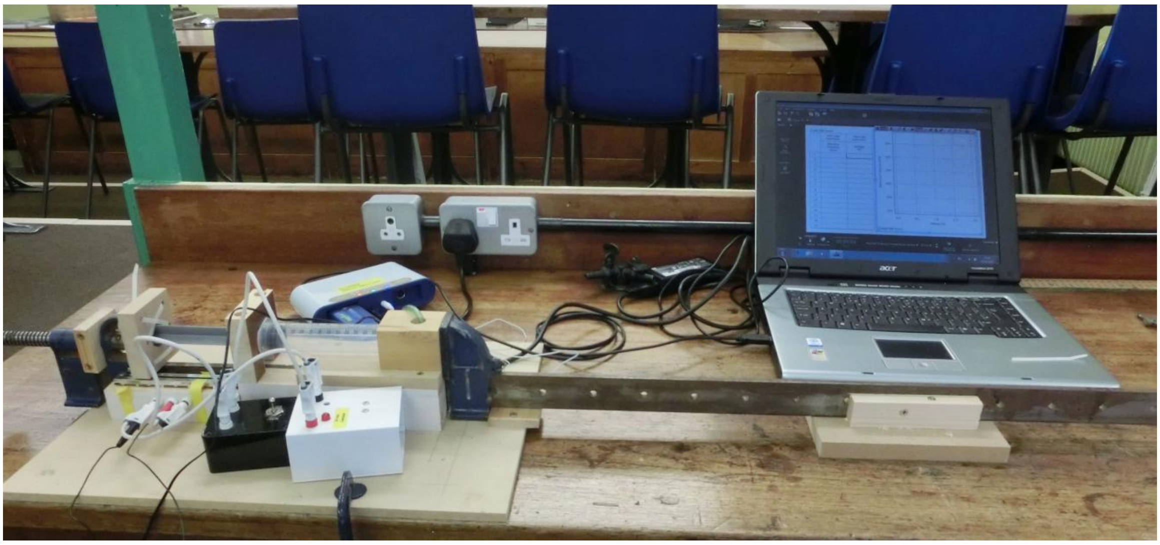
3. Pre-empt what will be taught

Read your notes and textbook that refer to what is coming next. Over a year an entire textbook can be read in quick five-minute bursts before a lesson. You will be primed to take in much more if you already have some confidence based upon your own reading.

4. Recall Physics ideas *in the context of an experiment*

e.g. when thinking about Boyle's law (pressure × volume = constant), recall the 'Boyle-o-meter' gas syringe experiment (ideally the data logger version with the huge clamp and the potential divider to relate syringe movement to potential difference). Visualize the lack of air loss (i.e. number of moles = constant) and the slowness of plunger pushing (i.e. so temperature remains constant).

http://www.eclecticon.info/physics_experiments.htm



5. *Solving Physics problems* is the royal road to competence, and should form about 80% of your revision time, perhaps more

A generic 'recipe' is as follows:

I. Really read the question, twice! Define any quantities mentioned with letters (e.g. T for temperature, x for displacement, v for velocity etc).

II. **Draw a diagram**, even if the question doesn't ask you to. **Relate/define all the quantities above mentioned, *in your diagram*.** This is now your 'Physics Universe.' Nothing else exists! Most topics have a certain type of diagram that is regularly used (e.g. lenses and mirrors in geometric optics, forces on a particle, 'before and after' momentum problems etc). Make sure you are familiar with these. Think 'immediate, cognitively easy, recall.'

III. Write down **equations** that relate the quantities defined in your diagram, based upon laws of Physics (e.g. conservation of energy, Newton's Second Law etc) or some geometrical property in the diagram (e.g. there might be a right angled triangle so some trigonometry or Pythagoras may be needed, or a circle etc)
Use *words* to annotate, explain equation parts. You are now in Maths land. Use all the skills you have learned in Flint court.

IV. Rearrange, combine, substitute etc to get the quantity the question asked for. *This is now pure Mathma*. Use as many steps as necessary. *"Ink is cheap, thought expensive"*. Align the equals signs. New line for each algebraic manipulation. **Try not to substitute any numbers yet** - this will break the structure (and reduce precision).

V. Once you have an *algebraic* expression that gives you what you want (e.g. temperature from pressure, volume, number of moles of gas, molar gas constant), **then finally substitute numbers, and their units.**

VI. Treat the **units** like *any other piece of algebra* e.g. $1000\text{kgm}^{-3} = 10^3 \times \frac{10^3\text{g}}{\left(10^2\text{cm}\right)^3} = 1\text{gcm}^{-3}$

VII. Write your final answer to an *appropriate level of precision*, ideally in **standard form.** If doing experimental work, **add an uncertainty too**. Look at the number of significant figures of the input parameters to give you an idea of the precision of the answer e.g. $x = \left(1.23 \pm 0.04\right) \times 10^{-5}\text{m}$

a. If all parameters are to 2.s.f., then your answer is obviously to 2.s.f..

b. If parameters are a mixture of 2.s.f. and 3.s.f. then 3.s.f. is usually OK. 'Lowest s.f. + 1' is an acceptable convention, for mixed precision.

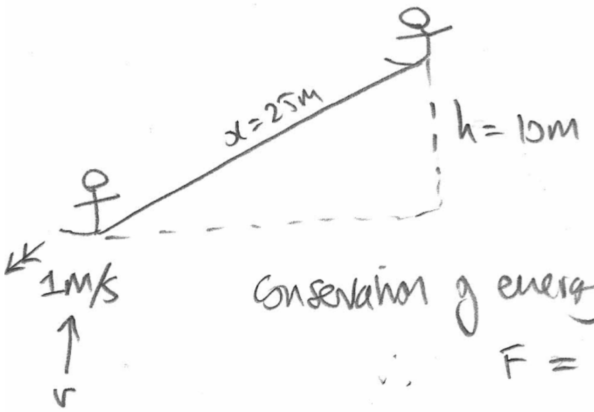
c. Don't forget the unit, otherwise your answer is MEANINGLESS

VIII. Finally, ask yourself: *Does the answer make sense?* If we are talking about atomic dimensions, then something on the scale of 10^{-10}m is about right. If we are talking about the speeds of planets in orbits, then a few tens of km/s is about right. This is where some *factual knowledge of sizes of physical quantities is important.* The first few pages of my **data book** might be a good first step: http://www.eclecticon.info/index_htm_files/Physics%20Formula%20Book%20-%20lower%20school.pdf

↙ mass 50kg

Question 3 Jill slides for 25m down a hill of height 10m, but uses her jacket to provide extra friction. She starts from rest and arrives at the bottom of the hill with a speed of 1ms^{-1}.

Calculate the magnitude of the friction force , assuming it takes a constant value as Jill slides. *(Hint: what is the work done against a friction force of magnitude F. What is the GPE and KE at the top and bottom of the hill?)*



$g = 9.81\text{ m/s}^2$

GPE ↓ ; Work done against friction ↓ ; KE ↑

Conservation of energy: $mgh = Fx + \frac{1}{2}mv^2$

$\therefore F = \frac{mgh - \frac{1}{2}mv^2}{x}$

$F = \frac{50 \times 9.81 \times 10 - \frac{1}{2} \times 50 \times 1^2}{25}$

$= \boxed{195\text{ N}}$

Diagram. Equations. Rearrange. Then substitute numbers. Answer to appropriate precision, with unit. Layout is hopefully **clear** (note vertical line added to make two columns for example).

6. Plan, do, review

This is the *learning cycle.* Plan your homework or classwork, do it to the best of your ability, then rigorously review it and plan your next steps. i.e. 'what do I still not fully understand? I need to come to class with *this* question!'

Annotate your work when we go through it. Use a different coloured pen. If making lots of corrections, choose the bit you understood the least first time round - I'll nearly always make solutions available later. (However - you MUST engage in this initial stage, learning must be active). Use a special coloured pen to work out the marks you would have got had you not made small and easily fixable errors.

Spend a bit of time before embarking on new work to **glance over previous questions, and ideally the section in your notes germane to the topic**. This is where the solutions to new problems will be found in most situations.

Be organized with your resources and folders. For electronic resources, *use hyperlinks and desktop shortcuts* to get to the link you need. Typing into Google or starting from the top level of Firefly *every time* is A COMPLETE WASTE OF YOUR TIME. Spend five minutes getting your links set up, and then save hours (days...!) later. Invest in your own systems of getting to knowledge hassle-free. Make your processes slick and efficient.

7. Manners Makyeth Man

Stop your conversations when you enter a classroom. Get your books, writing kit ready and wait for your Teacher to start the lesson. Write notes down, even if you know you'll get these later, and be active. Be brightly engaged. Take pride in your notes and notebook. Listen to understand. If a question pops into your mind, write it down, and when a natural pause appears, (and if the question has not already been answered to your satisfaction), raise your hand.

If you do get a question answered, (it may not always be possible) consider what has been said and *add to your notes to capture it*. Switching off once you have asked the question will *really* annoy your Don (!), and implies your aren't really interested in the answer anyway. It also means you have actually interrupted other boys learning needlessly. Asking questions for the sake of asking questions is pretension. However, asking what you think is a 'really obvious question of clarification' may on the other hand be *just what all your classmates want*. So be bold. Teachers will thank you for it. Seeking clarity and confirming knowledge/ideas/tasks is the *opposite* of being stupid.

8. Come equipped to class (and any time you practice Physics - *particularly* homework)

Always bring the right tools with you. How about in a dapper rucksack? This means your exercise book, recent notes, homework, timetable, homework diary, pens, pencils, eraser, calculator, ruler, geometry equipment, laptop (charged!), perhaps a textbook.... Quite a lot to think about yes? So how about that pre-packed bag.....

9. Aspire to be a good experimentalist

Experiments are at the heart of Physics. Practical skill in setting things up, taking careful measurements and keeping good, clear, records are as important as sophisticated mathematical analysis, graph plotting and assessment of the validity of models.

For bedtime reading:
http://www.eclecticon.info/index_htm_files/What%20a%20lab%20report%20should%20contain.pdf

AF. 22/12/2021