Answering Problems in Physics

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In answering problems to learn physics, the reasoning behind the answer is usually much more important than the answer itself. This means it is essential that your work shows your reasoning clearly, i.e. there should be **words** amongst the equations and numbers! Here is some guidance about answering physics problems for your homeworks (and examinations), which you are strongly urged to take heed of (it is very important that you do so if you wish to do well in 'A'-level physics). After a while, these good habits will become second nature to you.

The physics

The most important thing to do when answering a problem is to write down and show that you understand the physics of what is going on. It is very often a good idea to write down what is known and what is required. If you are using a physical law or principle, state what it is (e.g. conservation of energy), and write down the general form of any equation you are using before putting any numbers in.

Diagrams

If appropriate, draw a diagram. Remember, a good diagram is worth a thousand words, and is almost always a good start in thinking about and answering a problem.

Working

Always try to work out your solutions in clear, logical steps. This has many advantages, enabling you to quickly check for errors, and follow the reasoning more clearly when you look back at your solutions. Don't try to do lots of algebraic steps at once; take it one step at a time and be careful.

Never submit an answer that is just a bunch of numbers multiplied/divided/added/subtracted. This type of answer makes no sense at all, is not physics, and will only confuse and irritate the reader. In fact, you will find it is much clearer if you try to stay in symbols for as far as possible in your answer.

Units

Always specify the units for all physical quantities (especially in the lines before the final answer as it allows you to make sure the units are consistent and work out to the answer's unit). The value of a physical quantity is equal to the product of a *numerical value* and a *unit*:

$$\text{physical quantity} = \text{numeraical value} \times \text{unit}.$$

e.g. the physical quantity called the wavelength λ of one of the yellow sodium lines has the value

$$\lambda = 5.896 \times 10^{-7}\,\text{m},$$

where m is the symbol for the unit of length called the metre. This may equally well be written in the form

$$\lambda/\text{m} = 5.896 \times 10^{-7}.$$

Using a calculator

You should not normally need to use your calculator much before the last line of a problem, by which time you will have an expression for the quantity you want, and know that it will come out in the right units. Don't be tempted to calculate too early in your answer, or to try anything other than very simple maths in your head.

You need to be able to use data correctly in an equation and get an answer. The units must be consistent (usually in standard SI units). Be very careful with areas. A radius of $2.2\,\text{cm}$ gives an area of $\pi(2.2 \times 10^{-2})^2\text{m}^2$ and $8.1\,\text{mm}$ gives an area of $\pi(8.1 \times 10^{-3})^2\text{m}^2$. (A common mistake is replacing $1.0\,\text{mm}^2$ with $1.0 \times 10^{-3}\,\text{m}^2$ instead of $1.0 \times 10^{-6}\,\text{m}^2$.)

Always give your answer to a reasonable number of significant figures. Just because your calculator gives you answers to 7 figures does not mean that they are all significant. A guide is the number of significant figures in the problem – if the mass of the electron is given as $6.63 \times 10^{-34}\,\text{J s}$ rather than $6.626\,068\,96(33) \times 10^{-34}\,\text{J s}$, it is a good indication that not more than 2 or 3 significant figures are expected in the answer.

Sanity Check!

Once you get an answer, always pause and think about whether the answer makes sense. For example, is the sign of the answer consistent with what you expect? Is the magnitude ridiculous? If you suspect an error, always check your work again. If your work is neat and logical, this should be easy to do.