Survival Guide for Physics 115

Study Tips

Many first-year students find that the academic requirements at university are higher than what they have been used to in high school. Some, who studied little in high school but nevertheless obtained good marks, will now have to study on a regular basis in order to keep up. Good study habits are a key to success. They will allow you to learn the material more quickly and easily as well as provide that extra time to enjoy campus life. What follows are some general study tips for making your year efficient and productive.

Remember that it is up to you to motivate yourself to do the extra work – outside of the lectures, labs, and tutorials – that is necessary to be successful in this course.

1. Go to your classes.

This one seems obvious but there will be several times during the year when you will be tempted to skip a class. Try to resist the temptation. Your notes are as personal as you are and you cannot depend on someone else's; some items will seem obvious to you but not to another classmate. Errors in someone else's notes are a definite hazard. Lecturers also have a habit of adding material which may not be in the textbook. In any case, just being in the class and hearing the lecture means some of it will be familiar to you when you are reading the textbook, reviewing your notes, or doing an assignment.

2. Set aside blocks of time for Physics 115 every week.

The pace of this course is quite fast and it is very easy to fall behind. This is extremely dangerous, since with a full course load it can be very difficult to catch up. We recommend that you reserve blocks of time for Physics 115 every week without fail: the blocks should total at least 5 hours, and more if you can manage it. During this time, you should do the following:

- Prior to each lecture, read the corresponding sections of the textbook. Read it over several times, more thoroughly each time, until you have a good grasp of the material. Repetition will help you to retain what you read. If applicable, remember to do the online reading quiz!
- Review your lecture notes. This way you can spot possible errors while the lectures are still fresh in your memory. (Ideally, you should do this following each lecture rather than once a week.)
- Do the online and written homework assignments for the week.
- Do the online labatorial pre- or post-test for the week.
- Read ahead in the textbook through the sections for the upcoming week.
- Work on some additional problems. See next item.

3. Practice by solving additional problems – LOTS of them.

Solving problems is the only way to really learn physics: it will reinforce concepts you have read in your notes and in the text, and is also good practice for the tests. You may have read over the textbook and think you understand the concepts, but you can never know for sure unless you do as many problems as you can. The more questions you do, the better your grasp of the material will be. As the old saying goes, “practice makes perfect”. It sounds corny but it's true.

Practice always helps, and the more you practise the better you will get. Steve Nash didn't just step onto the floor and become a great basketball player; he practised over many years to develop his skills. People in all fields of endeavour, whether sports, the arts, business, medicine, or science, benefit from practice. No matter how gifted a person is, he or she will not realise his or her potential without dedication and practice.

Don't just practice doing problems that require the calculation of an answer. You need to hone your understanding of the basic physics principles. You also need to practice recognising which are the important physics principles that are relevant to a particular situation. The multiple choice and conceptual questions in the text book are excellent for this purpose. Questions of this kind also develop your critical thinking skills which will be useful in areas other than physics.

The textbook contains a range of problems at the end of every chapter, and the answers to the odd-numbered problems are given in the back so you can check your work. If you run into difficulty with the problems, you should seek assistance – see next item.

4. Make use of the university resources.

When you need help, don't forget there are many resources available to you. Sources of assistance for Physics 115 are listed in the following section. Information regarding help of a more general sort, such as study skills classes, is available from Student Learning Services: **https://library.usask.ca/studentlearning/** .

5. Prepare for tests well in advance.

In this course we try to test your comprehension of physics, not your memory. It is impossible to acquire a thorough understanding of the subject by cramming in the last few days before a test. You should prepare in advance by reviewing your lecture notes, reading the textbook, reviewing the homework assignments, doing more problems, and trying some multiple choice questions. This leaves you time to get help if you need it and also helps to build confidence.

Where to Find Help

The printed custom textbook can be purchased from the Bookstore and Enhanced WebAssign includes an electronic copy of the textbook.

Students who encounter difficulties with the course material should avail themselves of the following resources.

- There is a First-Year Physics Help Desk. See below for details. Whether you are having trouble with a specific problem or with a general concept, drop in when it is open and ask a tutor for help. The tutors are graduate students in physics and will be able to assist you. We pay them to sit there, so make use of them!
- Whether you are having trouble with a specific problem or with a general concept, feel free to contact your instructor for help. We are always happy to meet our students. Please come with specific questions prepared.

Dr. M. Ratzlaff:	TBD	email for an appointment
Mr. A. Qamar:	TBD	email for an appointment
Mr. B. W. Zulkoskey:	Rm 113 Phys	available most weekdays, email for an appt.

- Various graduate students and senior undergraduates offer private tutoring. The current rate is about $30 per hour. A list of potential tutors can be obtained from the Physics Office or the Physics 115/117 Resources webpage.

First-Year Physics Help Desk

Hours of Operation:	Tuesdays	1:30 pm to 3:30 pm	Rm 125 Biology
	Wednesdays	1:30 pm to 3:30 pm	Rm 128 Thorvaldson
	Thursdays	1:30 pm to 3:30 pm	Rm 1B77 Engineering

The Help Desk will be staffed by a tutor who is a physics graduate student. You may "drop in" at any time for assistance with any question or problem arising from Physics 115. The tutor will be familiar with the course material and with the homework assignments, and should be able to help you.

Students will be seen on a first-come, first-served basis. Students requesting assistance with more than one problem may be asked to wait after the first problem so that other students may be assisted.

Desks are available where students may work before or after receiving assistance from the tutor.

A few tips to make your visits to the Help Desk productive:

- If you have a question about a concept or about the course material, try to have a specific question in mind.
- If you are requesting help with a specific problem, make an honest attempt to solve the problem before visiting the Help Desk. The tutor will usually begin by asking how you went about your solution: he/she can then tell you if you have taken the right approach to the problem. If you have your work with you he/she might also be able to point out any specific mathematical errors.
- If you have no idea how to start a problem, or if you got started but took the wrong approach, the tutor will try to point you in the right direction. Once you get the problem started, the tutor will ask you to try to complete the solution yourself. **Do not expect the tutor to give you the complete solution to the problem.**
- Do not leave it to the last moment. Bear in mind that the Help Desk may get busy just before an assignment is due and prior to a test or exam, so you might have a long wait. Also remember that the Desk could be closed at any time due to unforeseen events such as illness, snowstorms, etc.

THE GREEK ALPHABET:

Alpha	Α	α	Nu	Ν	ν
Beta	Β	β	Xi	Ξ	ξ
Gamma	Γ	γ	Omicron	Ο	o
Delta	Δ	δ	Pi	Π	π
Epsilon	Ε	ε	Rho	Ρ	ρ
Zeta	Ζ	ζ	Sigma	Σ	σ
Eta	Η	η	Tau	Τ	τ
Theta	Θ	θ	Upsilon	Υ	υ
Iota	Ι	ι	Phi	Φ	ϕ
Kappa	Κ	κ	Chi	Χ	χ
Lambda	Λ	λ	Psi	Ψ	ψ
Mu	Μ	μ	Omega	Ω	ω

Physics 115 Problem Solving Technique

Many students acquire bad problem solving habits in high school, which get them into trouble in university. It is important in this course to adopt good problem solving technique at the outset, since it will come in very handy later in the year. The technique to be used in Physics 115 is described below, with an example.

1. **Read the problem carefully**. This may sound obvious but it is easy to read the problem quickly, and misunderstand it – especially if you are under the pressure of writing a test. You should read the problem at least twice, visualise the situation, and identify what is being asked for.

2. **Make a sketch**. You should always try to do this, although there will be some situations in which a sketch is not relevant. On tests and examinations, marks will be deducted for diagrams which are missing or incorrect; sometimes you will get part marks for a diagram even if your solution is totally wrong. It doesn't have to be a work of art, just good enough to indicate what's happening.

   Many problems require that positions be mapped using a coordinate system. You should indicate your chosen coordinate system on the diagram. You can choose any coordinate system you like as long as you stick to it throughout the solution. Often the most convenient choice of coordinate system will be obvious, but sometimes you will have to choose one according to your personal taste. Whatever system you choose, indicate it clearly on your diagram: this will reduce errors and will also make the solution easier to mark.

3. **Identify the given information and the information being asked for**. Write a list of the known quantities: some of these are explicitly stated in the question, others are implied in the question (e.g., initially at rest), while still others may result from your choice of coordinate system (e.g., initial position). Be sure that the signs of these quantities are consistent with your coordinate system. You may wish to convert the units of some of the known quantities if they are inconsistent. Put symbols on the diagram corresponding to each of these quantities where appropriate. Finally, identify what quantity you need to determine and what symbol you will use.

4. **Identify the physical relationship between the variables**. This is frequently the hardest step. You should think about the question, examine the diagram, and identify which physical principle determines what will happen in the given situation. There is no ``trick" to this other than understanding the course material. Then write down the appropriate equation or set of equations, and verify that you have an equal number of equations and unknowns. If you have fewer equations than unknowns, then you need another equation; you must find another relationship between the variables.

5. **Solve the equation(s) algebraically for the unknown quantity**. You should always solve the equation algebraically first: do not substitute numbers at this stage. This may be contrary to what you are used to from high school, but there are two reasons for doing this: first, it will reduce the number of errors you make; and second, sometimes quantities will cancel out. Solve the equation to get the unknown quantity alone on the left hand side, and a combination of known quantities on the right hand side.

6. **Substitute the known quantities and calculate the answer**. Substitute the known quantities into the right hand side. Make sure you substitute both the number and the units.

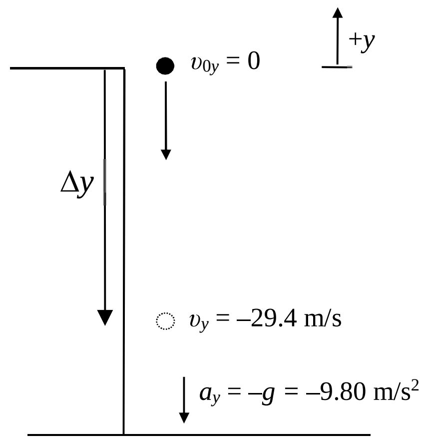
   Work out the units of the answer first. (Remember, units multiply and divide just like algebraic variables, so they can cancel each other when they appear on both the top and the bottom; also, any quantities which are added or subtracted must have the same units.) If the units you get are correct for the quantity you are trying to calculate, then you can have some confidence that your algebraic solution is correct; if not, then you have made an error somewhere. Go back and find it before proceeding. This is a very powerful method for detecting errors, but it only works if you know in advance the correct units for the quantity you are trying to calculate.

   If the units are OK, then proceed with the numerical calculation to find your answer.

7. **Check your answer**. Having already checked the units in step 6, you should always check your answer in whatever ways you can think of. Is the sign correct? Is the magnitude roughly correct? This is not always easy to judge, but you should be able to recognise when an answer is wildly out. On one examination, for instance, we asked students to calculate the speed of protons passing through an electrical device. The correct answer was 1.38×10^{6} m/s, but we had answers ranging from 7.22×10^{-7} m/s to 3.46×10^{15} m/s. It should be obvious that an answer less than 1 m/s or greater than the speed of light is very wrong, in which case you know to go back and look for your error.

Example: a one-dimensional, constant acceleration problem.

Question: A stone is dropped from the top of a tall building. Air resistance is negligible. Calculate the vertical displacement of the stone when its speed is 29.4 m/s.



***Step 1**. Read the problem carefully and visualise the situation. The problem is talking about the motion of a stone from when it is dropped to when it reaches a certain speed. The stone has clearly moved between these two positions, which we will call the initial and final positions.*

***Step 2**. Draw a diagram indicating the initial and final positions of the stone. The initial position is at the top of the building and the final position is the stone's location when its speed reaches 29.4 m/s. The final position must be somewhere below the top of the building but above the ground. Then choose a coordinate system: in this case we choose to put the origin at the top of the building (the initial position of the stone) and y positive upwards.*

***Step 3**. One item of information is given explicitly in the problem: the speed of the stone at the final position; we call that υ_y. Two quantities are implied in the problem: first, the stone is "dropped", so its initial velocity υ_{0y} is zero; second, since air resistance is negligible, the acceleration is of magnitude g, directed downwards. List all three of these quantities. We also mark these on the diagram. List also the quantity being asked for: the displacement Δy (the difference between the final and initial positions).*

Given: $\upsilon_{0y} = 0$
$\upsilon_y = -\ 29.4$ m/s
$a_y = -\ g = -\ 9.80$ m/s^2
$\Delta y = ?$
$t = ?$

Note that the velocity and the acceleration are both negative because both are in the negative direction, downwards. Note also that Δy points downwards. (This means that we expect that our final answer for Δy should end up being negative, since we chose +y to be upward.) Note also that the time t is the time for the stone to go from the initial position to the final position. The problem tells us nothing about this, nor does the problem ask us to obtain it, but we list it for completeness.

***Step 4**. The relevant physical principle is straightforward: the stone moves with constant acceleration since it falls straight downwards near the surface of the Earth with negligible air resistance. Look up the four constant acceleration equations in your notes, in your textbook, or on the formula sheet, and pick out the appropriate one. To find the displacement corresponding to the given initial and final velocities, find the equation containing Δx, a and υ_0 and υ, but not t. Replacing x with y for vertical motion, it is:*

$$\upsilon_y^2 = \upsilon_{0y}^2 + 2a_y\Delta y$$

We have one equation, with one unknown: Δy.

***Step 5**. Solve the equation for* Δy. *Note that* $\upsilon_{0y}^2 = 0$. *Drop this term, substitute* $a_y = -g$, *then divide both sides by 2g:*

$$\upsilon_y^2 = 2(-g)\Delta y$$
$$\Rightarrow \frac{\upsilon_y^2}{2g} = -\Delta y$$
$$\Rightarrow \Delta y = -\frac{\upsilon_y^2}{2g}$$

Note that the unknown quantity, Δy, *is alone on the left hand side of the equation, while the quantities on the right hand side are all known.*

***Step 6**. Substitute the numbers and the units on the right hand side:*

$$\Delta y = -\frac{(-29.4\ \text{m/s})^2}{2(9.80\ \text{m/s}^2)}$$

Check the units first. Since the velocity is squared, the units in the numerator are m^2/s^2. *The units in the denominator are* m/s^2.

$$\frac{\text{m}^2/\text{s}^2}{\text{m/s}^2} = \frac{\text{m}^2}{\text{s}^2} \times \frac{\text{s}^2}{\text{m}} = \text{m}$$

So the answer will be in m. Since we are calculating a displacement, these are the correct units. Now proceed to calculate the answer using a calculator:

$$\Delta y = -\,44.1\ \text{m}$$

***Step 7**. The units have already been checked in step 6. The sign is also correct, since the displacement must be negative; see the diagram. Finally, the answer does not seem to be either too large or too small: for the stone to acquire a speed of 29.4 m/s, the stone must travel more than 1 m but less than the height of a tall building. We conclude that the answer is reasonable.*