AP Physics Summer Assignment - 2009

The selected questions represent the types of problems we will be working on this year. These are problems that we will be covering early on in the school year, but the problem solving format you should use to solve these will be used universally throughout the year.
DUE DATE: The assignment is due at the beginning of class on the first day of school.
SHOW YOUR WORK: To receive credit you must show a clear logical progression of steps leading to the answer. This should include writing down the equations to be used and showing where numbers where plugged in. Answers with no work will not receive credit. Problems should have a clear format:

Sketch -> List Variables -> Select Equation -> Solve -> Check Units

NEATNESS COUNTS: To receive full credit your answer must be neat and easy to follow. This means you may need to copy the answer over after solving the problem.
QUESTIONS: If you have questions over the summer, you can e-mail me, Mr. Meechan: brian.meechan@vbschools.com

REVIEW OF THE PHYSICS COVERED IN THESE PROBLEMS

The problems you must solve in this assignment all involve motion in one dimension (1 D Kinematics). Students who have not taken introductory physics will find this assignment a bit more challenging. That is a good thing, so find a format, be resourceful, and email me if you have questions. Tutorial information you will find useful:
http://www.glenbrook.k12.il.us/gbssci/phys/Class/1DKin/1DKinTOC.html

- Average speed is the total distance traveled divided by the time it took to travel that distance.
- Displacement is the change in position, that is the final position minus the initial position. This can be written as $\Delta x = x_2 - x_1$
- Average velocity is the displacement divided by the time. This can be written as: $v = \Delta x / \Delta t$
- The acceleration of a body is rate of change of velocity.
- If the acceleration is constant the following equations hold true:

$$v = v_0 + at$$

$$x - x_0 = v_0 t + \tfrac{1}{2}at^2$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

$$x - x_0 = \tfrac{1}{2}(v_0 + v)t$$

x_0 = initial position (often zero)
x = some later (or final) position
v_0 = initial velocity
v = some later (or final) velocity
a = acceleration
t = time interval; that is the time between x & x_0 and between v & v_0

PROBLEMS: Use the tutorial website for help. It is very clearly organized and can help you tremendously!

1. Starting from a pillar, you run 200 m east (the +X-direction) at an average speed of 4.0 m/s, then run 280 m west at an average speed of 7.0 m/s to a post. Calculate your a) average speed from pillar to post; b) average velocity from pillar to post.

2. At the instant a traffic light turns green, an automobile that has been waiting at an intersection starts ahead with a constant acceleration of 2.00 m/s^2. At the same instant a truck, traveling with a constant speed of 18.0 m/s, overtakes and passes the automobile.
   a) How far beyond its starting point does the automobile overtake the truck?
   b) How fast is the automobile traveling when it overtakes the truck?
   c) On a single graph sketch the position of each vehicle as a function of time. Take x=0 at the intersection.

3. On a twenty-mile bike ride, you ride the first ten miles at an average speed of 10 mi/h. What must your average speed be over the next ten miles to have your average speed for the total twenty miles be
   a) 5 mi/h
   b) 15 mi/h
   c) Given the average speed for the first ten miles, is it possible for you to attain an average speed of 20 mi/h for the total twenty-mile ride? Why or why not?

4*. The engineer of a passenger train traveling at 25.0 m/s sights a freight train whose caboose is 200 m ahead on the same track. The freight train is traveling in the same direction as the passenger train with a speed of 15.0 m/s. The engineer of the passenger train immediately applies the brakes, causing a constant acceleration of –0.100 m/s^2, while the freight train continues at a constant speed.

   a) Will the cows nearby witness a collision?
   b) If so, where will it take place?

5. Read and comment on "Déjà vu" article (one page typed MINIMUM)

Déjà vu

In the fall of 2003, I had the opportunity to attend and AP Physics workshop given by Josh Schulman. Mr. Schulman distributed the following handout and to my amazement, he had documented my exact philosophies and views concerning the approach to teaching and learning physics. He distributes the handout at the beginning of the year so students will have a better grasp of how to set priorities and approach the class.

I highly recommend you save this handout and keep it in the front of your notebook. Invest the time to read it several times to be come familiar with it contents. You may find it necessary to review it when you begin to feel stressed out and overwhelmed.

One element for doing well in any class is to try to identify and develop an appreciation of what the teacher considers important. In this handout Mr. Schulman has clearly identified what is important to me, your teacher, so you, my student, should try to take to heart the advice that is being offered.

Greg's Preface: How to Approach Your Physics Course

Or, Seven Things My Students Know in June that I Wish They Had Known the Previous September[1]

Physics has a poor reputation. I know this from experience: strange people are often asking what I do for a living, so I tell them "I teach high school physics." Nine times out of ten, the strange person's response is, "Eww. I *hated* physics." I have grown to realize that what these strange people hated was not physics, itself. Rather, they hated their experience learning physics.

What I try to teach my students is not simply the theory and application of physics. Instead, I try to teach them how to approach the process of problem

[1] From *Five Steps to a 5: AP physics* by Josh Schulman and Greg Jacobs, pending publication, McGraw-Hill Companies, Inc. Reproduced with the permission of Greg Jacobs.

solving, how to think like a scientist. Physics is just the medium through which I choose to communicate these abstract lessons in thinking. The students who wrote this book figured out my pedagogic motives early on, and as a result, each found his first physics course to be a decisively positive experience.

This doesn't mean there weren't struggles, frustrations, times when problems seemed hopeless. I suggest that *any* worthwhile endeavor involves some sort of tribulation. (For example, I don't know any actor who doesn't curse tech rehearsals the week before the performance of a play; yet not one of these actors would consider giving up the stage because of the difficulty of these unbearable rehearsals.) When I look back on physics class, it is the good times, the camaraderie, the "eureka!" moments that I remember.

It usually takes one to two months for physics students to get the hang of the class. It is in this initial portion of the school year that most of the frustration occurs. Every year I find myself wishing that my new students knew some fundamental, inalienable truths about how to approach a physics course. Of course, I understand that some of these things can only be learned by experience. But here's my list of instructions. Read them, try to take them to heart, and maybe at the end of the year you'll see what I was talking about.

I. Ignore your grade.

This seems to be the most ridiculous statement you've ever read. You probably are asking, "Are you *sure* you're a teacher?" But this may be the most important of these here ten suggestions. You should not ask yourself or your teacher "How could I have gotten more points on this assignment?" or "Are you going to grade this?" You'll worry so much about giving the teacher merely what she wants that you won't learn physics in the way that's best for you. Rather, whether your score is perfect or near zero, ask, "did I really understand all aspects of these problems?"

Remember, the AP exam tests your physics knowledge. If you understand physics thoroughly, you will have no trouble at all on the AP. But while you may be able to argue yourself a better grade in your physics *class* even if your comprehension is poor, the AP graders are not so easily moved.

If you take my advice, if you really, truly ignore your grade and focus on physics, your grade will come out in the wash – you'll find that you got a very

good grade after all, because you understood the subject so well. But you *won't care*, because you're not worried about your grade!

II. Don't bang your head against a brick wall.

My meaning here is figurative, not literal.[2] Never spend more than 10 minutes or so staring at a problem without getting somewhere. If you honestly have no idea what to do at some stage of a problem, STOP. Put the problem away. Physics has a way of becoming clearer after you take a break.

On the same note, if you're stuck on some algebra, don't spend forever trying to find what you know is a piddly mistake, say a missing negative sign or something. Put the problem away, come back in an hour, and start from scratch. This will save you time in the long run.

And finally, if you've put forth a real effort, you've come back to the problem many times, and you can't get it: relax. Ask the teacher for the solution, and allow yourself to be enlightened. You will not get a perfect score on every problem. But you don't care about your score, remember?

III. Work with other people.

When you put are struggling with a problem, it always helps to discuss that problem with others. Form study groups; have a buddy in class with whom you are consistently comparing solutions.

Though you may be able to do all your work in every other class without help, there is no student I have ever met who is capable of solving most physics problems completely on his or her own. It is not shameful to ask for help. Nor is it dishonest to seek assistance – as long as you're not copying, or allowing a friend to carry you through the course, group study is permitted and encouraged in virtually every physics class around the globe.

IV. Ask questions when appropriate.

[2] Though there are benefits to taking this advice literally, as well.

I know that physics teachers have a reputation as mean or unapproachable; but in reality, we very much want to help you understand our subject. If you don't understand something, don't be afraid to ask. Chances are that the rest of the class has the same question. If your question is too basic, or if the teacher can't spend the class time to answer, he'll tell you so.

Sometimes the teacher will not answer you directly, but will give you a hint, something to think about so that you might guide yourself to your own answer. Don't interpret this as refusing to answer your question. You must learn to think for yourself, and your teacher is helping you develop the analysis skills you need for success in physics.

V. Keep an even temper.

A football team should not give up because they allow an early field goal. Similarly, you should not get upset at poor performance on a test or problem set. No one expects you to be perfect. Learn from your mistakes, and move on – it's too long a school year to let a single physics assignment affect your emotional state.

On the same note, though, a football team should not celebrate victory because it scores an early touchdown. You might have done well on this test, but there's the rest of a nine month course to go. Congratulate yourself, then concentrate on the next assignment.

VI. Don't Cram.

Yes, I know that you got an "A" on your history final because, after you slept through class all semester, you studied for 15 straight hours the day before the test and learned everything. And yes, I know you are willing to do the same thing this year for physics. I shall warn you, both from my and from others' experience: *it won't work*. Physics is not about memorization and regurgitation. True, there are some equations you need to memorize. But problem solving skills cannot be learned overnight.

Furthermore, physics is cumulative. The topics you discuss in December rely on the principles you learned in September. If you don't understand basic vector analysis and force diagrams (a.k.a. free body diagrams), how can you understand the relationship between an *electric* field (which is a vector quantity)

and an *electric* force? Or the multitude of other vector quantities which you will eventually study?

So, the answer is to keep up with the course. Spend some time on physics every night, even if that time is only a couple minutes, even if you have no assignment due the next day. Spread your "cram time" over the entire semester. The night before a major exam, I have always told my students not to study after 5 or 6 P.M. If they have done all the homework, understood all the quizzes, and gone over what they missed on minor tests, they will do fine on the big one. This is why my classes have a wild[3] party each year on the eve of the AP exam.

VII. Never forget, physics is phun.

The purpose of all these problems, these equations, the exams, is to gain a knowledge of physics, a deeper understanding of how the natural world works. Don't be so caught up in the grind of your coursework that you fail to say "Wow!" occasionally. Some of the things you're learning are truly amazing. Physics gives insight into some of humankind's most critical discoveries, our most powerful inventions, our most fundamental technologies. Enjoy yourself. You have an opportunity to emerge from your physics course with wonderful and useful knowledge, and unparalleled intellectual insight. Do it.

[3] Defined as "involving copious amounts of pizza and highly-caffeinated soda."