Stockbridge High School
Summer Assignment 2017-2018
Advanced Placement Physics 1
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AP Physics is a college level course. This means it will be fast paced and challenging. To make sure that you are adequately prepared I am requiring all prospective AP students to complete this summer review sheet. By completing this review, you will reinforce your understanding of important concepts problem solving methods.

Welcome to AP Physics 1! It is a college level Physics course that is fun, interesting and challenging on a level you've not yet experienced. This summer assignment will review all of the prerequisite knowledge expected of you. There are 7 parts to this assignment. It is quantity not the difficulty of the problems that has the potential to overwhelm, so do it over an extended period of time. It should not take you any longer than a summer reading book assignment. By taking the time to review and understand all parts of this assignment, you will help yourself acclimate to the rigor and pacing of AP Physics 1. It is very important that this assignment be **completed individually**. It will be a total waste of your time to copy the assignment from a friend. **The summer assignment will be due the first week of class. Good Luck!**

You are welcome to contact me by email (dpatel@henry.k12.ga.us) over the summer if you have get stumped or have questions about how to proceed.

"How to Handle the Rigors of Physics"

Physics is a difficult course. Unlike most other courses, a lot of time spent studying does not always translate into great success on exams. That is because, in addition to learning physics concepts, students are taught how to approach the process of problem solving, how to think like a scientist.

This mean there are struggles, frustrations, times when problems seem hopeless. I suggest that *any* worthwhile endeavor involves some sort of tribulation. 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 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 he 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?"

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.[1] 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.

I know that physics teachers have a reputation as mean or unapproachable, not that you could ever get that impression from me; 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 cricket team should not give up because they allow too many runs in the early overs. 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 cricket team should not celebrate victory because it scores a half century in the first 6 overs. 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.

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

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 own 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.

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 AP Physics 1

The exercises below are a review of the prerequisite math skills that you need to succeed in AP Physics 1. Make sure to read all directions throughout the packet. All work must be completed on the pages below in the area provide. Calculators should not be used. Final answers can be in fractions and in terms of mathematical constants (π, *e*, *i*, etc.).

Your work must be legible and linear, and I must be able to follow it easily. Please no incoherent jumping around the page. Mark your final answers by either circling or boxing them.

Significant Figures and Scientific Notation Review

1.) How many significant figures do the following numbers have?

a.) 6.001 Answer: _____ d.) 27.00 Answer: _____

b.) 0.0080 Answer: _____ e.) π Answer: _____

c.) 206,000 Answer: _____

Directions: Find the following. Final answers should be in scientific notation with the correct number of significant figures.

2.) $(5.0\times10^{-8})(2.9\times10^{2})$

3.) $\left(3.25\times10^{4}+7.4\times10^{3}\right)$

4.) $6.000\times10^{-11}\dfrac{1.00\times10^{26}}{2.00\times10^{7}}$

5.) $\dfrac{8400}{1.2\times10^{7}}$

Unit Conversions Review

6.) Finish the SI prefix table below. Follow the example of the centi- prefix. You will need to memorize these.

Symbol	Name	Numerical Equivalent
n		
μ		
m		
c	Centi	10^{-2}
k		
M		
G		

7.) 16.7 kilograms is how many grams?

8.) 560 nm is how many meters?

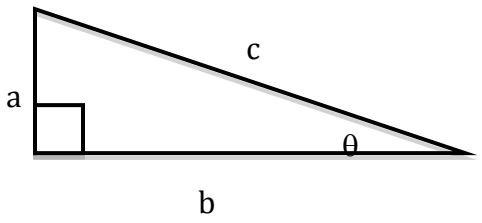
9.) 15 years is how many seconds?

10.) 8.99×10^9 seconds is how many years?

11.) 2.998×10^8 m/s is how many kilometers per hour?

Trigonometry Review

Directions: Use the figure below to answer problems 15-25. Simplify as much as you can.



12.) Find *c* if given *a* and *b*.

13.) Find *a* if given *b* and *c*.

14.) Find *a* if given *c* and θ.

15.) Find *b* if given *a* and θ.

16.) Find c if given b and θ.

17.) Find θ if given b and c.

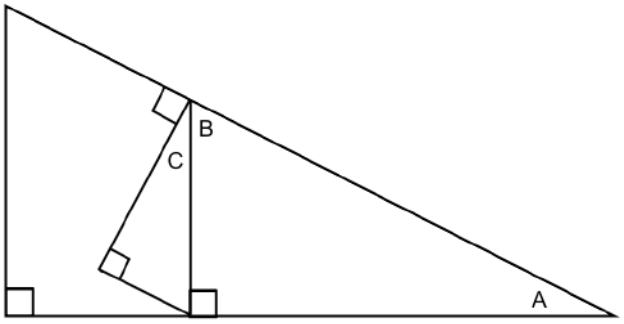
18.) Find θ if given a and b.

19.) If $a = 2.0$ and $c = 7.0$, what is b?

20.) If $c = 10.0$ and $\theta = 60°$, what is b?

21.) If $a = 12.0$ and $\theta = 30°$, what is b?

22.) Using the properties of triangles, prove that $\angle A \cong \angle C$ in the drawing below.



Answer:

23.) For what angles (in degrees) does sin $\theta \approx \theta$? Describe why mathematically.

24.) Complete the table below without using a calculator.

θ	0°	30°	45°	60°	90°
sin θ					
cos θ					
tan θ					

25.) 360 degrees = _____ radians.

26.) 4.5 revolutions = _____ radians.

27.) Find the length of an arc with a radius of 6.0 m swept across 2.5 radians.

28.) Find the length of an arc with a radius of 10.0 m swept across 100 degrees.

Algebra Review

Directions: Solve the following equations for the given variable and conditions. Simplify if needed.

Example: $2x + xy = z$. Solve for x.

$$x(2+y) = z$$

$$\boxed{x = \frac{z}{2+y}}$$

29.) $v_1 + v_2 = 0$. Solve for v_1.

30.) $a = \frac{v}{t}$. Solve for t.

31.) $v_f^{\,2} = v_i^{\,2} + 2ad$

A.) Solve for v_i.

B.) Solve for d.

32.) $d_f = d_i + v_o t + \frac{1}{2} a t^2$

A.) Solve for v_o.

B.) Solve for t, if $v_o = 0$.

C.) Solve for t, if $d_i = d_f$.

33.) $F = m \frac{v_f - v_i}{t_f - t_i}$

A.) Solve for v_f, if $t_i = 0$.

B.) Solve for t_f, if $v_f = 0$ and $t_i = 0$.

34.) $a_c = \frac{v^2}{r}$. Solve for v.

35.) $mg \sin\theta = \mu mg \cos\theta$. Solve for θ.

36.) $\frac{1}{2}mv_f^2 + mgh_f = \frac{1}{2}mv_i^2 + mgh_i$

A.) Solve for h_f, if $h_i = 0$ and $v_f = 0$.

B.) Solve for v_f, if $h_f = 0$.

37.) $Ft = mv_f - mv_i$. Solve for v_f.

38.) $m_1v_{i,1} + m_2v_{i,2} = (m_1 + m_2)v_f$. Solve for $v_{i,2}$.

39.) $m_1v_{i,1} + m_2v_{i,2} = m_1v_{f,1} + m_2v_{f,2}$. Solve for $v_{f,2}$ if $v_{i,1} = 0$.

40.) $(F_1 \sin\theta)r_1 + (-F_2 \sin\phi)r_2 = 0$. Solve for r_2.

41.) $-kx + m(-g) = 0$. Solve for m.

42.) $F_g = G\frac{m_1m_2}{r^2}$. Solve for r.

43.) $L - L\cos\theta = \frac{v^2}{2}$ Solve for L.

44.) $\frac{mv^2}{R} = G\frac{Mm}{R^2}$. Solve for v.

45.) $T = 2\pi\sqrt{\frac{L}{g}}$. Solve for g.

46.) $\frac{1}{2}mv_f{}^2 + \frac{1}{2}kx^2 = \frac{1}{2}mv_i{}^2 + mgh_i$. Solve for x if $v_f = 0$.

47.) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$. Solve for R_T.

Miscellaneous

Directions: Simplify without using a calculator. Remember to show all of your work.

48.) $\frac{1}{4}+\frac{1}{6}$

49.) $\frac{1}{3}+\frac{1}{18}$

50.) Consider $z=\frac{x}{y}$, $c=ab$, $l=m-n$, or $r=\frac{s^2}{t^2}$.

a.) As x increases and y stays constant, z _____.

b.) As y increases and x stays constant, z _____.

c.) As x increases and z stays constant, y _____.

d.) As a increases and c stays constant, b _____.

e.) As c increases and b stays constant, a _____.

f.) As b increases and a stays constant, c _____.

g.) As n increases and m stays constant, l _____.

h.) As l increases and n stays constant, m _____.

i.) If s is tripled and t stays constant, r is multiplied by _____.

j.) If t is doubled and s stays constant, r is multiplied by _____.

Systems of equations

Conceptual Question:

51.) How many equations are needed to solve…?

a.) for 1 unknown variable? _____

b.) for 2 unknown variables? _____

c.) for 3 unknown variables? _____

Use the equations in each problem to solve for the specified variable in the given terms. Simplify.

52.) $F_f = \mu F_N$ and $F_N = mg\cos\theta$. Solve for μ in terms of F_f, m, g, and θ.

53.) $F_1 + F_2 = F_T$ and $F_1 \cdot d_1 = F_2 \cdot d_2$. Solve for F_1 in terms of F_T, d_1, and d_2.

54.) $F_c = ma_c$ and $a_c = \frac{v^2}{r}$. Solve for r in terms of F_c, m, and v.

55.) $T = 2\pi\sqrt{\frac{L}{g}}$ and $T = \frac{1}{f}$. Solve for L in terms of π, g, and f.

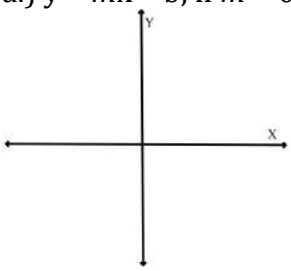
Graphing Equations

56.) If $r = c - x*t$ was graphed on an r vs. t graph, what would the following be?

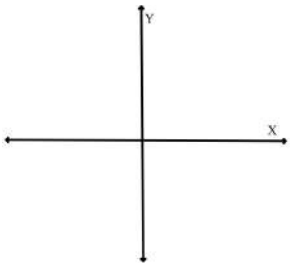
Slope: _____ y-intercept: _____

57.) On the y vs. x graphs below, sketch the relationships given.

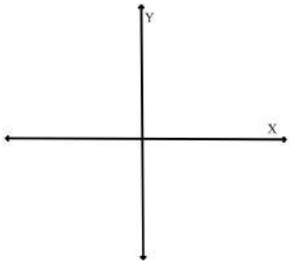
a.) y = mx + b, if $m > 0$ and $b = 0$.



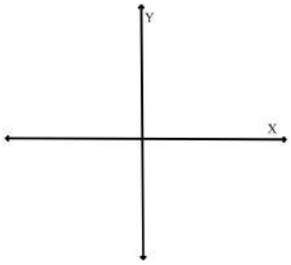
b.) y = mx + b, if $m < 0$ and $b > 0$.



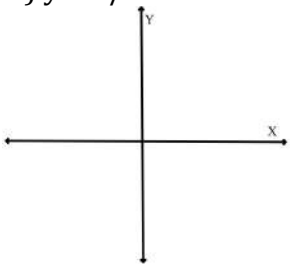
c.) $y = x^2$



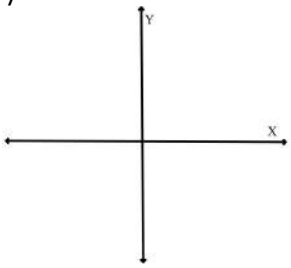
d.) $y = \sqrt{x}$



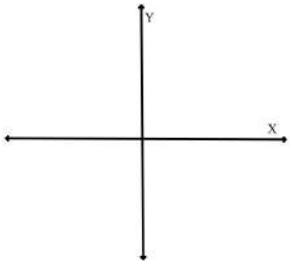
e.) $y = 1/x$



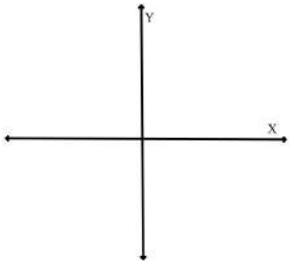
f.) $y = 1/x^2$



g.) $y = \sqrt{\frac{1}{x}}$



h.) y = sin(x)



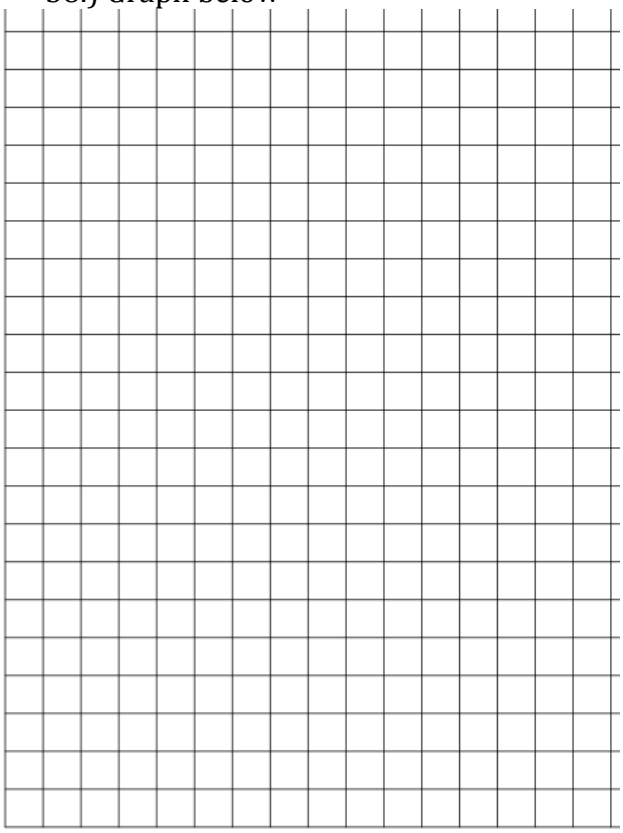
Marbles in Cylinder Lab

You received a graduated cylinder with three identical marbles and an unknown amount of water already in it. You placed extra identical marbles in the cylinder and obtained the data below. Use the data to graph a best-fit line showing the relationship between the water level and the number of marbles. The y-intercept should be visible on the graph. Label your axes and include units.

From the graph, determine a mathematical formula for the water level for any number of marbles. Lastly, give an explanation of your formula in words. Make sure to give an explanation of the slope and y-intercept of your formula.

Number of Marbles in Water	Water level (mL)
3	58
4	61
5	63
6	65
7	68

58.) Graph below



59.) Formula: _____

60.) Explanation of the formula in words: (Include the meaning of the slope and y-intercept.)