

Advanced Placement Physics C

Summer Assignment

Mr. Sckalor

Congratulations on your decision to enroll in Advanced Placement Physics C for the 2011-2012 school year. The two parts of the AP Physics C course are the counterparts to the mechanics and the electricity and magnetism portions of the introductory calculus-based physics course sequences in college, designed for students who plan to study science or engineering.

The Physics C examination consists of two parts, each one and one-half hours long. One part covers mechanics, the other electricity and magnetism. A student may take either or both parts (at our school we take both), and a separate grade is reported for each. Each part has a 45-minute multiple-choice section with 35 questions, and a 45-minute free-response section with 3 questions. Like the AP Physics B exam, reference tables and calculators will not be permitted in the multiple-choice section of the exams, but will be permitted in the free-response sections. At the end of the course, students will have adequate preparation for both exams.

The content of the C course is much more thorough and intense than the B course and also more mathematically rigorous. Derivations of expressions and applications of calculus are the norm. Finding the determinants of matrices, derivatives and integrals (definite and indefinite) are used throughout the course. As such, calculus is a required co-requisite, while those students who have already completed calculus will have a significant leg up coming into the course. These mathematical concepts will be covered to the extent needed in the AP C course as well, so having learned the material beforehand is not a requirement.

The summer assignment is below and is strictly a mathematical, although extremely important, study of vectors and derivatives. Please answer the problems attached. The assignment may be a bit challenging, but with a little time and effort, it should be manageable. The assignment will be collected and graded when the school year begins so please have them completed before the first day of class to avoid any penalties. You are also expected to do this work on your own; any evidence of plagiarism will be dealt with severely. If you have *any* questions on the assignment or the course, please send an e-mail to apphysics@verizon.net and a reply will be sent.

ASSIGNMENT

The assignment involves gaining an understanding of vectors, vector algebra and introductory calculus, specifically derivatives and integrals. Most of the information needed to complete the assignment can be found around the Internet and you are encouraged to gain the required information from various sources. One suggested source is listed below: (there are many around the internet)

- <http://tutorial.math.lamar.edu/sitemap.aspx> (check out vectors, derivatives and integrals)

If you lose the assignment, go to www.gnsphysics.com and click on the Physics C summer assignment link.

You must show all work and explain all answers for full credit on any question.

You are expected to do this work *on your own*.

DUE: WEDNESDAY, SEPTEMBER 7

(classes begin Tuesday, September 6)

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[\mathbf{A} (bold) is a vector, A (normal) or $|\mathbf{A}|$ is its magnitude]

1. Under what *specific* conditions is the magnitude of $\mathbf{A} \times \mathbf{B}$ equal to $\mathbf{A} \cdot \mathbf{B}$?
2. Define a unit vector.
3. Can a scalar (dot) product be a negative quantity? If so, under what conditions, if not, why?
4. If $\mathbf{A} = 5 \mathbf{j}$, $\mathbf{A} \times \mathbf{B} = -5 \mathbf{i}$, and $\mathbf{A} \cdot \mathbf{B} = 30$, find \mathbf{B} .
5. Prove that two vectors must have equal magnitudes if their sum is perpendicular to their difference. (hint: two vectors are perpendicular if their dot product is zero)
6. Given $\mathbf{A} = \mathbf{i} + 2\mathbf{j}$, $\mathbf{B} = \mathbf{i} - \mathbf{k}$, $\mathbf{C} = 3\mathbf{i} - 2\mathbf{j} + 5\mathbf{k}$, find
 - (a) $\mathbf{A} \times \mathbf{B}$
 - (b) $\mathbf{C} \cdot \mathbf{A}$
 - (c) $\mathbf{A} \cdot (\mathbf{A} \times \mathbf{B})$
 - (d) find the angle between \mathbf{B} and \mathbf{C}
7. Given vector \mathbf{A} in the $+x$ direction and vector \mathbf{B} in the $+y$ direction and the scalar quantity d .
 - (a) What is the direction of $\mathbf{A} \times \mathbf{B}$?
 - (b) What is the direction of $\mathbf{B} \times \mathbf{A}$?
 - (c) What is the direction of \mathbf{B}/d ?
 - (d) What is $\mathbf{A} \cdot \mathbf{B}$?

Some of the problems above involve a lot of steps, be sure to show all steps and work clearly to receive full credit!

8. Find the derivatives (with respect to x) of the following functions and simplify (where possible):
- (a) $y = x^5 + 5x^3 - 10x^2 + 6$
 - (b) $y = 3x^{1/2} - x^{3/2} + 2x^{-1/2}$
 - (c) $y = (1 - 5x)^5$
 - (d) $f(x) = (3x - x^3 + 1)^3$
 - (e) $\theta = (3x + 2)/(2x + 3)$
 - (f) $y = \ln(x + 6)^2$
 - (g) $y = (\sin 3x)(\cos 5x)$
 - (h) $y = 3e^{-4x}$
 - (i) $y = x^2e^{-x/6}$

The following questions deal with integrals. If you have already completed calculus, you know how to do these and this is a required part of the assignment. If you are taking calculus this year, this part of the assignment is optional but *highly recommended* (use the suggested website to learn how to do these)

9. Find the area under the curve $y = 1/x$ (and above the x axis); between $x = 3$ and $x = 7$

10. Evaluate the following indefinite integrals

- (a) $\int [1/(6x)] dx$
- (b) $\int \cos 4x dx$
- (c) $\int (x - 2)^{5/2} dx$
- (d) $\int (3x - 1)^{1/2} dx$
- (e) $\int (x^5 + 5x^4 - 10x^2 + 6) dx$
- (f) $\int 3e^{-2x} dx$

11. Evaluate the following definite integrals

- (a) $\int_1^4 x^3 dx$
- (b) $\int_1^5 x^{-1} dx$
- (c) $\int_0^{\infty} e^{-3x} dx$