AP Physics C – 2015 Summer Assignment

College Board (the people in charge of AP exams) recommends students to only take AP Physics C if they have already taken a 1st year physics course and are currently taking or have completed Calculus (either AB or BC is fine). If you have successfully completed AP Physics 1 and are currently in either AP Calculus course, then you should be comfortable with AP Physics C. But this course will still push you and will require about 45-60 minutes of work a night to stay on pace. You must be able and willing to dedicate that time if you want to do well in this course.

**Supplies:** There are a couple of supplies you need to get.

On the AP Physics C test you can use a scientific or graphing calculator. You will need this calculator every day in class for labs, assignments, and tests. Usually the calculator you use for math class is fine.

Everyone will need a copy of 5 steps to a 5 AP Physics C by Greg Jacobs. The 2016 edition won’t be released until August. This test has not undertaken a major redesign like most AP science courses, so an older version should be okay. Those who wait until the last minute have a hard time finding any book. Take care of this early. Many students have found it is a useful tool preparing for unit tests through the year and not just in reviewing for the AP test in the spring. A little extra help as we go through that information can really make a difference.

**AP Physics C: Mechanics Exam**

Please attempt the attached multiple choice section of the released 1998 AP Physics C: Mechanics Exam. I hope you are presently surprised to discover you can do 23 of the 34 with just your knowledge from AP Physics 1. I have attached the answers and an equation sheet. Below are the question numbers I think you should be able to answer after the completion of AP Physics 1. If you cannot figure out how to get the correct answer to these questions, please ask me for help. I will be at the high school almost every day for cheerleading practice over the summer, so if you would like to meet for a tutoring session that can be arranged.

Question Numbers you should be able to do: 1, 2, 5-8, 10-15, 18-25, 28, 30, 31, 35

The full exam can be found at the link below. You only need to look at pages MC Exam p. 125-135. Equation Sheet p. 150-152, Answers p. 171.

**How will AP Physics C Transfer?** Check the websites of colleges you are considering going to and see what test score they require to earn credit for AP Physics C. Use that information to help you set a goal for what score you want to get on the AP Physics C test on May 9, 2016. I also want you to calculate how much money that will save you. Use the website to see how much each credit hour costs and multiply it by the number of credit hours you get for AP Physics C. Then subtract the $91 the AP Physics C test costs. The amount left is the savings of doing well this year.

This may get confusing as there are 4 AP Physics tests. Do not look at AP Physics 1 or AP Physics 2 tests. We are preparing for the AP Physics C: Mechanics test. If you would also like to take the AP Physics C: Electricity & Magnetism test I can help you study outside of class time.

**Goal for my score on the AP Physics Test May 9, 2016:**

**Savings calculations:**

- School used as a reference: ____________________________
- Number of credit hours I can earn by doing well on the test: a. ______
- Cost per credit hour: b. $_____
- \(a \times b = $____ - 91 = $______\) total savings by doing well and preparing for the AP Physics C Test
Will this course count toward my major? Locate a 4 year course plan or degree requirements listing the course you need to take for your major on the college website of your choice. If you are majoring in science or engineering verify the physics course number that the test counts as credit for matches the course number for the class you have to take for your major. If this course doesn’t count towards your major, you will still need the knowledge of this course to prepare you for physics for engineers and science majors.

School used as a reference: __________________________________________

Academic Major: ____________________________________________________

Is physics required for this major? ____________

- If yes, what is the course code of the physics course required for your major? (example: Physics 2750)

- What is the course code that AP Physics 1 receives credit for (example: Physics 1210)?

- If no, what general science is required for your major? (Example: Must include 9 credits in these sciences: biological science, physical science, and / or mathematical science)

Select one of the following options.

a) My major requires physics and this course meets that physics requirement.

b) My major requires calculus based physics, but this AP test will not be accepted at credit for that course.

c) My major doesn’t require physics specifically, but does require general science credit and this course fulfills the general science requirement.

d) This course won’t help me towards my degree, and I probably should change my high school schedule.
Content Review from AP Physics 1

1. Categorize the following as a “vector” or a “scalar”: Acceleration, velocity, work, force, speed, distance, mass, momentum, displacement, kinetic energy

2. Given the velocity of an object, how do you tell which direction that object is moving?

3. A ball is thrown straight up. It then returns to the same height it started.
   i. Was is the direction of the velocity on the way up? Is the magnitude of the velocity increasing, decreasing or constant?
   ii. Was is the direction of the velocity on the way down? Is the magnitude of the velocity increasing, decreasing or constant?
   iii. Was is the direction of the velocity at the highest point? What is the magnitude of the velocity?
   iv. Was is the direction of the acceleration on the way up? Is the magnitude of the acceleration increasing, decreasing or constant?
   v. Was is the direction of the acceleration on the way down? Is the magnitude of the acceleration increasing, decreasing or constant?
   vi. Was is the direction of the acceleration at the highest point? What is the magnitude of the acceleration?

4. For the following, is the object speeding up, slowing down or moving at a constant speed. An object has:
   i. A positive acceleration and a positive velocity.
   ii. A positive acceleration and a negative velocity.
   iii. A negative acceleration and a positive velocity.
   iv. A negative acceleration and a negative velocity.
   v. A zero acceleration and a positive velocity.
   vi. A zero acceleration and a negative velocity.

5. Compare the velocity and acceleration of an object slowing down.
6. A ball is thrown upward with an initial velocity \( v_0 \). The ball reaches height \( h \) in time \( t \). What is the acceleration of the ball at the highest point?

7. How do you find position from a velocity/time graph?

8. How do you find acceleration from a velocity/time graph?

9. How do you find velocity from a position/time graph?

10. An object has weight \( W \). How would you calculate the mass of that object?

11. An object has a weight of 980 N. Calculate the object’s mass.

12. When is the gravitational force on an object \( mg \)? When is the gravitational force \( Gm_1m_2/r^2 \)?

13. A satellite orbits the moon far from its surface in a circle of radius \( r \). If a second satellite has a greater speed, yet still needs to maintain a circular orbit around the moon, how should the second satellite orbit?
14. A force is applied to a block resting on a horizontal surface.
   i. What is the vertical and horizontal components of force in terms of \( F \) and \( \theta \).
   ii. The force has vector components of 40 N to the right and 30 N upward. Calculate the magnitude and direction (\( \theta \)) of the force.

15. A block of mass \( m \) rests on a plane with an incline of angle \( \Theta \).
   i. Draw a picture of the box and plane. Label the angle “\( \Theta \)”.
   ii. Draw a free body diagram (a.k.a. a force diagram) of all the forces acting on the box. (Hint: Do not draw a box, we consider the box to be a point like object, so draw a single point. Do not draw force components.)
   iii. What is the component of weight parallel to the incline? Solve in terms of \( m \), \( g \) and \( \Theta \).
   iv. What is the component of weight perpendicular to the incline? Solve in terms of \( m \), \( g \) and \( \Theta \).
   v. Write an equation for the sum of the forces parallel to the incline.
   vi. Write an equation for the sum of the forces perpendicular to the incline.
16. What is the equation for the coefficient of friction, \( \mu \). What are the units for \( \mu \)?

17. A 500-g block on a flat tabletop slide 2.0 m to the right. If the coefficient of friction between the block and the table is 0.1, how much work is done on the block by the table?

18. What is the direction of the net force on an object that moves in a circle at a constant speed?

19. Describe the direction of the velocity and acceleration of an object in uniform circular motion?

20. How is work related to force? How is work related to energy? Use the equations to help explain.

21. A ball falls on to a vertical spring, the spring compresses and then stretches shooting the ball into the air. What are three types of energy the ball has during the whole time interval and what are the equations for these energies?

22. A block has 1500 J of potential energy and 700 J of kinetic energy. Ten seconds later, the block has 100 J of potential energy and 900 J of kinetic energy. Friction is the only external force acting on the block. How much work was done on this block by friction?

23. How is impulse related to momentum? How is impulse related to force? Use the equations to help explain.
24. In what type of collision is momentum conserved? In what type of collision is kinetic energy conserved?

25. In an experiment a student swings a clay pendulum into a board and a rubber pendulum into a board. Which pendulum experiences a greater impulse?

26. Two carts of different mass collide. Is it possible for the momentum of one cart to change? Use conservation of momentum to explain.

27. In an experiment a student wants to calculate the frequency of oscillations. What variables need to be measured? How would the frequency be calculated from those variables?

28. An object of mass $m$ oscillates on a horizontal spring of constant $k$ with no damping. Similarly, an object of mass $m$ oscillates on a vertical spring of constant $k$ with no damping. Compare the potential energies of the objects when they are at maximum amplitudes.
Content Review from Pre-AP Calculus + a little more

1. The equation $x(t) = -16t^2 + v_0t + x_o$ represents the position function for free-falling objects. At time $t = 0$, a diver jumps from a platform diving board that is 32 feet above the water, $x_o$. The initial velocity $v_0$ of the diver is 16 feet per second.

   i. Plug in $x_o$ and $v_0$ and write the position function.

   ii. When does the diver hit the water? The position of the water is $x = 0$, so set the function equal to zero and solve for $t$.

   iii. Derive your answer to part (i) with respect to $t$.

   iv. The derivative of the position function is the velocity function. Substitute $x'(t)$ with $v(t)$.
      (Just rewrite part iii but set it equal to $v(t)$ instead.)

   v. What is the diver’s velocity at impact? You will need to plug in $t$ as found in part ii, however, you should have found two answers, one positive and one negative. Since we can’t have negative time, chose the positive answer and plug it into the $v(t)$ equation, then solve.

   vi. Was your answer to the previous question positive or negative? Which direction is the velocity? Does your answer make sense?
2. A particle moves with position \( x(t) = A \cos \omega t \) where \( A \) is the amplitude of 1.5 meters and \( \omega \) is the angular speed of 2.0 radians per second.

i. Plug in \( A \) and \( \omega \) and write the position function.

ii. The derivative of the position function is the velocity function. Derive your answer to part (i) with respect to \( t \). Substitute \( x'(t) \) with \( v(t) \).

iii. The derivative of the velocity function is the acceleration function. Derive your answer to part (ii) with respect to \( t \). Substitute \( v'(t) \) with \( a(t) \).