AP Physics C Summer Assignment

This summer assignment is designed to review many of the topics you learned in Honors Physics or introduce you to the major course topics if you have not taken physics previously. You should complete the assignment on your own and take the time to ensure that you understand all of it. If needed, you can use your textbook or internet sources to aid you in completing the assignment. The assignment will be collected upon your return to school this fall.

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_o. 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?

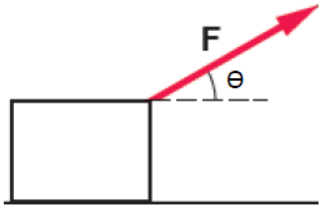
10. An object has weight W. How would you calculate the mass of that object?

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 Θ.
   ii. The force has vector components of 40 N to the right and 30 N upward. Calculate the magnitude and direction (Θ) of the force.

15. A block of mass *m* rests on a plane with an incline of angle Θ.
   i. Draw a picture of the box and plane. Label the angle "θ".

   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 Θ.

   iv. What is the component of weight perpendicular to the incline? Solve in terms of m, g and Θ.

   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, μ. What are the units for μ?

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 $x(t) = -16t^2 + v_o t + x_o$ 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_o of the diver is 16 feet per second.
    i. Plug in x_o and v_o 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 ω is the angular speed of 2.0 radians per second.
    i. Plug in A and ω 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 $a(t)$.