Physics 121 **Name (Print):** SOLUTIONS
Fall 2017
Exam 1
19 Sep 2017
Time Limit: 60 Minutes

This exam consists of 10 multiple choice problems and 1 worked problem. Each multiple choice problem will be worth 6 points and the points for worked problems are included in the problem. The exam is out of 100 points.

You may *not* use your books, notes, or any "device" calculator on this exam. A regular calculator is permitted.

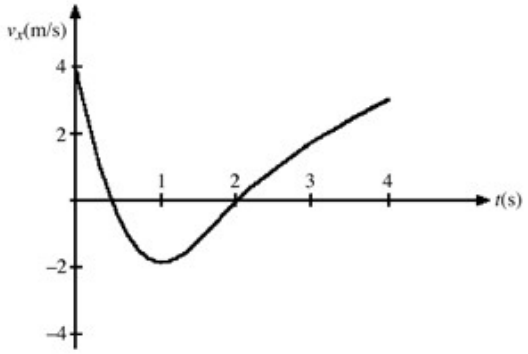
Multiple Choice Problems: Simply write your answer in the space next to the problem number.

Worked Problems: Make sure to show **ALL** of your work. Please write neatly, I can only give credit for things that I can read. State all equations you use before plugging numbers in.

1. ___A___ If the graph of the position as a function of time for an object is a horizontal line, that object cannot be accelerating.
   A. True
   B. False

2. ___C___ When can we be certain that the average velocity of an object is always equal to its instantaneous velocity?
   A. only when the acceleration is constant
   B. never
   C. only when the velocity is constant
   D. only when the acceleration is changing at a constant rate
   E. always

3. ___A___ The figure shows the velocity of a particle as it travels along the x-axis. What is the direction of the acceleration at t = 0.5 s?



   A. in the -x direction
   B. in the +x direction
   C. The acceleration is zero.

4. ___C___ Using the same figure as above, at what value (or values) of t is the instantaneous acceleration equal to zero?
   A. t = 0
   B. t = 0.5 s and t = 2 s
   C. t = 1 s

5. ___D___ A ball is thrown directly upward and experiences no air resistance. Which one of the following statements about its motion is correct?
   A. The acceleration of the ball is downward while it is traveling up and upward while it is traveling down.
   B. The acceleration of the ball is upward while it is traveling up and downward while it is traveling down.
   C. The acceleration of the ball is downward while it is traveling up and downward while it is traveling down but is zero at the highest point when the ball stops.
   D. The acceleration is downward during the entire time the ball is in the air.

6. ___D___ While an object is in projectile motion (with upward being positive) with no air resistance

   A. the horizontal component of its velocity remains constant and the horizontal component of its acceleration is equal to -g.

   B. the vertical component of both its velocity and its acceleration remain constant.

   C. the vertical component of its velocity remains constant and the vertical component of its acceleration is equal to -g.

   D. the horizontal component of its velocity remains constant and the vertical component of its acceleration is equal to -g.

   E. the horizontal component of its velocity remains constant and the vertical component of its acceleration is equal to zero.

7. ___A___ A monkey is sitting at the top of a tree 20 m above ground level. A person standing on the ground wants to feed the monkey. He uses a bow and arrow to launch the food to the monkey. If the person knows that the monkey is going to drop from the tree at the same instant that the person launches the food, how should the person aim the arrow containing the food? Air resistance is small enough to be ignored.

   A. He should aim it at the monkey.

   B. He should aim it below the monkey.

   C. He should aim it above the monkey.

8. ___C___ A pilot drops a package from a plane flying horizontally at a constant speed. Neglecting air resistance, when the package hits the ground the horizontal location of the plane will

   A. be behind the package.

   B. depend of the speed of the plane when the package was released.

   C. be over the package.

   D. be in front of the package.

9. ___A___ For an object in uniform circular motion, its velocity and acceleration vectors are always perpendicular to each other at every point in the path.

   A. True

   B. False

10. ___A___ If you set the cruise control of your car to a certain speed and take a turn, the speed of the car will remain the same. Is the car accelerating?

    A. Yes

    B. No

11. (40 points) A hockey puck slides off the edge of a table with an initial velocity of 20.0 m/s and experiences no air resistance. The height of the tabletop above the ground is 2.00 m. What is the speed (not the velocity) of the puck just before it touches the ground? **Make sure to show ALL work!**

The first thing you want to do is recognize that the x component of the velocity will remain constant so $v_{xi} = v_{xf} = 20$ m/s since $a_x = 0$ m/s^2. Then we need to solve for the y component of the final velocity v_{yf}. This can be done by using one of the kinematic equations. The problem doesn't give you anything about time (though you can still use 2 equations, 1 to solve for time and then plug time into the other equation) so you probably want the equation

$$v_{yf}^2 = v_{yi}^2 + 2a\Delta y$$

where $a = -g = -9.8$ m/s^2, $\Delta y = -2.00$ m as given in the problem and $v_{y_i} = 0$m/s. Plugging these in you get

$$\begin{aligned} v_{yf}^2 &= v_{yi}^2 + 2a\Delta y \\ v_{yf}^2 &= v_{yi}^2 - 2g\Delta y \\ v_{yf}^2 &= (0)^2 - 2 * (9.8) * (-2.00) \\ v_{yf}^2 &= 39.2 \\ \rightarrow v_{yf} &= \sqrt{(39.2)} = 6.26 \text{ m/s} \end{aligned}$$

So now we know the components of the velocity

$$\vec{v}_{yf} = 20 \text{ m/s}\hat{i} + 6.26 \text{ m/s}\hat{j},$$

but we want the speed, which is the magnitude of the velocity. So we get

$$v_{yf} = |\vec{v}_{yf}| = \sqrt{20^2 + 6.26^2} = 20.96 \text{ m/s}$$