Phys 200 – Equations of Motion Worksheet 9-21-2015

General Procedure:
1) Define orthogonal axes (i.e. $x$ - and $y$ -)
2) Write down the position equation for each of your dimensions (i.e. $x$ - and $y$ -)
3) Find the $x$ - and $y$ - components for your initial conditions (i.e. initial position, initial velocity, acceleration)
4) Given initial conditions, and your knowledge of calculus, solve for the desired value(s).

Note: Solving for the desired values may be a multi-step process! For example, you may need to solve an equation for the velocity in the $y$- direction in order to find a time that you will use in an equation of motion for the $x$- direction.

Question 1:
A baseball player throws a baseball perfectly horizontally off a cliff, with a velocity of 40 m/s. She notices that the ball hits the ground 3.5 seconds later.

a) How far down did the ball fall?
b) How far does the ball travel in the horizontal direction?
c) What is the magnitude of the velocity of the ball when it hits the ground?
d) What angle (with positive angles as counter-clockwise from the $x$- axis) is the ball travelling with when it hits the ground?
Question 2:

A soccer ball is kicked with a velocity of 20 m/s at an angle of 40 degrees from horizontal.

   a) What is the maximum height the soccer ball reaches?
   b) What is the total time the soccer ball is in the air?
   c) How far away does the soccer ball land?
   d) Where is the soccer ball 3 seconds after it is kicked?

Question 3:

A rock is thrown into the air at with a magnitude of velocity of 65 m/s. If the rock is observed to rise to a maximum height of 8 meters, at what angle was the ball thrown relative to the ground?
Question 4:

A golfer practicing on a range hits a golf ball from a height of 5 meters above the range. The ball leaves the club with a horizontal velocity of 20 m / s.

   a) How long after the ball is hit does it hit the ground?
   b) What is the horizontal distance the ball travels?
   c) What is the acceleration of the ball 0.5 seconds after it is hit?
   d) What is the magnitude of the velocity of the ball 0.8 seconds after it leaves the club?

Question 5:

You are trying to throw a book to a friend who is in a window 10 vertically up, and 2 meters away in the horizontal direction. With what initial velocity and angle must you throw the book in order to have it travelling with zero velocity in the y-direction when it reaches your friend?
Question 6:

You are part of the revolution! And in charge of a catapult team that needs to knock down the keep (the main tower) of a castle. The keep is located 10 meters behind a 7 meter tall wall, and you want to hit the very bottom of the keep with your projectile. In order to avoid arrows being shot from the keep, your catapult is located 400 m away from the castle wall. What angle and magnitude of the initial velocity would you need in order to just clear the wall, and land at the bottom of the keep?