Recitation Problems

Wednesday, February 1 – Kinematics in Two Dimensions

Problem 1:

A ball rolls off a shelf of height h at speed v.

- (a) How far from the base of the shelf will it land?
- (b) How fast will it be traveling when it lands?
- (c) In what direction will it be moving when it lands?

Problem 2:

In class yesterday, you saw us do a demonstration, as follows:

The barrel of a gun that shot ball bearings was pointed directly at a small target. Once the ball bearing left the barrel of the gun, its path of flight curved downward, due to the influence of gravity.

At the instant that the ball bearing left the barrel, the target was dropped from its support, and was struck as it fell by the ball bearing.

This happens regardless of the angle of the gun and the initial velocity of the ball bearing.

Argue in (a) words, (b) algebra, and (c) diagrams why this must be the case.

You will receive 5 points extra credit on your group practice exam on Friday for each separate argument that your group is able to explain to your TA.

Problem 3:

In a certain baseball stadium, the outer wall is a distance $D = 120$ m from home plate, and has a height $h = 10$ m.

Assume that the batter hits the ball at an angle $\theta = 30^\circ$ above the horizontal. How fast must the batter hit the ball for it to (a) land at the base of the outer wall, and (b) travel over the wall?

Roadmap for doing this problem:

1. Write down expressions for $x(t)$, $y(t)$, and (if you need them) $v_x(t)$ and $v_y(t)$.
    - Convert the initial velocity vector $\vec{v}_0$ into the component representation ($v_{x,0}$ and $v_{y,0}$)
2. Write down a sentence in terms of your algebraic variables that can be used to answer the question. (This is the hardest aspect of these problems; don't neglect it!)
3. Perform the algebra that your sentence indicates that you do
    - If you have to use the quadratic formula, determine the physical meaning of each answer
4. Substitute numerical values and interpret your answer