Instructions. This is a take-home quiz. It is due to be handed in to me by Wednesday, February 11 at class time. You may work on this quiz alone or in a group of one or two other people. (If you work in a group, then you will hand in only one paper and all in the group will receive the same grade on the quiz.) You may use any books or other resources that you need to do the quiz with the exception of consulting other people. Your solutions must include sufficient detail so that I am able to understand your reasoning process in solving the problems. The paper that you hand in should be written neatly and use correct mathematical notation and writing. Writing, notation and neatness will taken into account in my grading of the quiz. All papers must be stapled together (not paper-clipped or folded). Points will be deducted for no staple. Note: You must do problems 1 and 2 on this quiz but you will only need to do one of problems 3 and 4. We will work either problem 3 or problem 4 in class on Friday, February 6 (whichever one the class votes on) and then you have to turn in the solution to the other one.

1. The position vector, at time $t$, of a particle in motion in the $xy$ plane is given by

$$r(t) = -5\cos(t)i - 5\sin(t)j.$$  

a. Find the path of motion of the particle. (Explain and draw a picture.)

b. Find the velocity vector, $v(t)$, at any time $t$.

c. Find the speed at any time $t$.

d. Find the acceleration vector, $a(t)$, at any time $t$.

e. In the picture that you drew in part a, draw the position vector and the velocity vector at time $t = 0$. Do the same at time $t = \pi/3$.

f. Is the particle travelling in a clockwise or counterclockwise direction?

2. The velocity vector, at time $t$, of a particle is given by

$$v(t) = ti - 2j$$  

and the particle is located at the point $(-2, 0)$ at time $t = 0$.

a. Find the position vector of the particle at any time $t$.

b. Sketch the path of motion of the particle over the time interval $0 \leq t \leq 5$. (You can use Mathematica to do this if you want to or do it by hand on graph paper.)

c. At what point is the particle located at time $t = 1$?

d. Will the particle ever arrive at the point $(6, -14)$? If so, at what time will this happen?

3. A man is standing 20 feet away from a box of width 5 feet and height 3 feet (See Diagram) and is tossing bean bags – trying to get them to land in the box. He is tossing the bean bags from an initial height of 3 feet and with an initial angle of $a = 45^\circ$. What range of initial speeds ($v_0$) must the man use to ensure that the bean bags land in the box? (Assume that the only vertical force that acts on the bean bags during their flight is the acceleration due to gravity. Thus assume that $a(t) = -32j$.) Be detailed in your solution. Write in sentences.
4. A man is standing 20 feet away from a box of width 5 feet and height 3 feet (See Diagram) and is tossing bean bags – trying to get them to land in the box. He is tossing the bean bags from an initial height of 3 feet and with an initial speed of $v_0 = 40$ feet per second. What ranges of angles ($\theta$) must the man use to ensure that the bean bags land in the box? (Assume that the only vertical force that acts on the bean bags during their flight is the acceleration due to gravity. Thus assume that $a(t) = -32J$.) Be detailed in your solution. Write in sentences.