MIDTERM 1

Physics 9A-02 **NAME:**

April 18, 2003 **ID #:**

General Instructions: This examination is closed book. Only a calculator is allowed. Please show all your work and box your answers. Credit will only be given for *complete* solutions. Answers must have correct units. There are six problems on three pages. Note that not all the problems are worth the same number of points. The acceleration due to gravity is g=9.8 m/s^2.

[20 points] 1. A ball rolls off a barn roof that slopes with an angle of 60 degrees from the horizontal (see figure). Its velocity is 4 m/s just as it leaves the roof, and the edge of the roof is 20 m above the ground.

a. How far from the barn will the ball hit the ground?

b. What are the horizontal and vertical components of velocity when it hits the ground?

[20 points] 2. One day in discussion section, Norman is demonstrating uniform circular motion by whirling a ball tied to a string of length 0.3 m. Assume Norman gets the ball going around the circle 4 times each second. What is the ball's speed (magnitude of velocity)? What is the magnitude of the ball's acceleration? What is its direction?

[20 points] 3. The position vector as a function of time of an object is given by (in meters),

$$\vec{r} = 3t^2\ \hat{i} + (2 + 5t)\ \hat{j}.$$

a. Where is the object at times $t = 0.0, 1.0$, and 2.0 seconds?

b. What is the value of $\vec{v}$ at times $t = 0.0$ and $t = 1.0$ seconds?

c. Sketch the trajectory. Sketch the velocities on your trajectory.

d. The object has mass $m = 7$ kg. What is the force acting on it at time $t = 1$ second?

[15 points] 4. Using the graph of velocity as a function of time shown below, plot the position as a function of time and the acceleration as a function of time. Assume the object starts at $x = 4$ at time $t = 0$. Label the vertical axes with numerical values (and units) in both cases.

[20 points] 5. A rescue plane is flying at a constant elevation of 800 m with a velocity of 100 m/s, directly towards a person struggling in the water. At what angle of sight should the pilot release a rescue capsule if it is to strike the person? (See figure.)

[15 points] 6. A cart starts off at rest on a frictionless surface. Two people start pushing on it with the forces shown in the figure. What can you say about the force that a third person must exert in order to get the cart to move precisely in the x direction?