HW 1

Due April 17, 2009 in recitation

Please answer all questions clearly and concisely. While you need not transcribe the question completely, it should be clear from your answer alone what you are talking about.

You are strongly encouraged to discuss the homework with your classmates, but you must complete the written homework by yourself, and of course, the material you submit must be your own.

Remember, show all of your work!

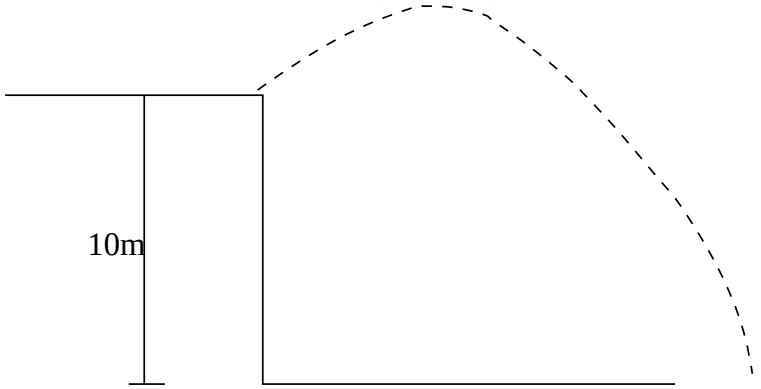
1. A particle moving in 1-dimension can be described by the equation:

$$x(t) = 5 - 2t + 10t^2 \tag{1}$$

where time is given in seconds, and position in meters.

   (a) Sketch the position as a function of time. Be sure to label your axes.
   (b) What is the velocity of the particle as a function of time?
   (c) What is the acceleration of the particle?
   (d) At what time does the particle turn around?
   (e) What is the position of the particle when the speed is 0?

2. You are standing at the top of a 10m cliff (as shown), throwing stones over the edge.



You throw a 0.2 kg stone at an angle of 30 degrees above the horizontal with a speed of $10m/s$.

   (a) What is the x-component of the stone's velocity immediately after it leaves your hand?
   (b) What is the y-component of the stone's velocity immediately after it leaves your hand?
   (c) How long after you throw it does it reach it's maximum height?
   (d) How long after you throw the stone does it take to hit the ground?
   (e) How far from the edge of the cliff does the rock hit?
   (f) What is the speed of the rock the instant before it hits the ground?
   (g) At what angle from the horizontal does the stone hit the ground?

(over)

3. Consider throwing a ball horizontally so fast that it circled the earth. Assume that the orbit has a circular radius of $6.4 \times 10^6 m$, and please use a gravitational constant $g = 9.8 m/s^2$.

   (a) How fast would the giant have to throw the ball so that it maintained a perfectly circular orbit?

   (b) How long (in hours) does it take for the ball to circle the earth?