Problem Set I.
Fall 2006 Physics 200a
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1. From the top of a building of height $h = 100m$ I throw a stone up with velocity $10m/s$. What is the maximum height it reaches and when is that? How many seconds does it spend on its way down between $h = 50m$ and $h = 0m$? What is its velocity when $h = 50m$? If when it is airborne I quickly dig a hole 50 m deep, when and with what speed will it hit the bottom?

2. Romeo is at $x = 0$ at $t = 0$ when he sees Juliet at $x = 6m$.
   (a) He begins to run towards her at $v = 5m/s$. She in turn begins to accelerate towards him at $a = -2m/s^2$. When and where will they cross? Sketch their motions measuring time horizontally and position vertically.
   (b) Suppose instead she moved away from him with *positive* acceleration a. Find a_{max}, the maximum a for which he will ever catch up with her. For this case find the time t of their contact. Show that for smaller values of a these star crossed lovers will cross twice. Draw a sketch for this case. Explain in words why they cross twice.

3. A particle moves as per the equation $x = 30 + 40t + 60t^2 + 40t^3$. Find its velocity and acceleration for all times. When does its velocity equal 1 m/s? At that instant what is its acceleration?

4. *[Difficult]* Ball A is dropped from rest from a building of height H exactly when ball B is thrown up vertically. When they collide A has double the *speed* of B. If the collision occurs at height h what is h/H? Hint: Write equations for heights y_A , y_B and velocities v_A and v_B . What can you say about these at the time of the collision?