

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  $50m$  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  $1m/s$ ? 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?