Problem Set I. Fall 2006 Physics 200a R. Shankar

- 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?

## Open Yale courses

© Yale University 2012. Most of the lectures and course material within Open Yale Courses are licensed under a Creative Commons Attribution-Noncommercial-Share Alike 3.0 license. Unless explicitly set forth in the applicable Credits section of a lecture, third-party content is not covered under the Creative Commons license. Please consult the Open Yale Courses Terms of Use for limitations and further explanations on the application of the Creative Commons license.