Phys 103 – Spring 2013

Homework 2

Due on Friday 04/19 by 6 PM in box outside Daly 312

All textbook problems are from chapter 2. In problems which involve writing or revising a program you are required to provide the code by printing the m file, and any applicable output of Matlab.

1. Problem 1

2. Problem 3. Provide the improvement in the computed range and time of flight for the case of no air resistance, initial height 0 m, initial speed 50 m/s, angle $\theta = 45^{\circ}$, and $\tau = 0.5, 0.1, 0.01$ sec.

3. Problem 10. Do not carry out the horizontal range versus angle calculation. Instead plot the projectile motion for initial height 1 m, initial velocity 50 m/s, and angle 45º. Present the results of the original balle.m program and your modified program on the same plot, and comment on their differences. Also provide the horizontal range and time of flight for both fixed and velocity dependent drag coefficient in this case. Don't forget to implement the interpolation scheme of problem 2.3, and use correct units.

4. Problem 17. Use $\theta_m = [5:5:175]$, $\tau = 0.05$, and 5000 steps.

5. Problem 22

6. **Bonus question:** In the 1968 Olympic games in Mexico City, Bob Beamon established a world record with a long jump of 8.90 m, 0.80m longer than the previous world record. Since 1968, Beamon's jump has been exceeded only once in competition, by Mike Powell's jump of 8.95m in Tokyo in 1991. After Beamon's remarkable jump, some people suggested that the lower air resistance at Mexico City's 2250m altitude was a contributing factor.

To check this claim compute four different jumps with two different values for initial velocity V_0, and air density ρ:

(a) "Nominal" jump at sea level. V_0 = 10 m/s and ρ = 1.29 kg/m^3

(b) "Nominal" jump at high altitude. V_0 = 10 m/s and ρ = 0.94 kg/m^3

(c) Beamon's jump (at high altitude ρ = 0.94 kg/m^3). Determine V_0 to get Beamon's record, 8.90 m

(d) Beamon's jump at sea level. ρ = 1.29 kg/m^3 and V_0 is the value determined in (c)

Present your results by completing the following table:

Initial speed (m/s)	ρ (kg/m^3)	Distance (m)
10	1.29	
10	0.94	
	0.94	8.9
	1.29	

and plotting all four trajectories on a single plot with appropriate legend (provide a second plot, which zooms in the final portion of the jump). Which is more important, the air density or the jumper's initial velocity?

Constants for this problem are: Athlete's mass, m = 80 kg, Athlete's cross-sectional area, s = 0.50 m^2, drag coefficient, c = 0.5, and the initial angle, θ_0 = 22.5°.

Instructions: Use τ=10^{-3} sec, and interpolate the final portion of the jump for a better range estimate. To find the initial speed in (c), write a function that calculates the range difference between a nominal jump [say (b)] and a jump with an initial velocity V_0, and use fzero with V_0 as a parameter to find V_0^* that results in a range of 8.90 m.