Phys 410 – Homework #5

Numbered problems are from Taylor.

1) 7.14 (3 pts)
2) 7.15 (3 pts)
3) 7.21 (3 pts)
4) 7.29 (3 pts)
5) 7.31 (a and b). (6 pts)
   a) To get the kinetic energy, write down the (x,y) position vector of the pendulum in terms of x and ϕ, then take the derivative to get the velocity vector.
   b) When approximating for part (b), keep all terms linear in ϕ, but drop those that are quadratic in ϕ and ϕ-dot.

6) Extra Credit (3 pts) A small bar of soap slides without friction inside a spherical bowl in a uniform and vertical gravitational field. It is possible for the soap to execute purely circular motion around the center of the bowl, without sliding up or down the side of the bowl. What should be the angular frequency (around the bowl) for this type of motion? The answer will depend on the height (or theta value) of the circular motion, the radius of the spherical bowl, and (g). Suppose we gently tap the soap so that it is slightly disturbed from this purely circular motion. Will the motion oscillate about the circular case, or will the motion run away in an unstable manner? If it is stable, what is the frequency of small oscillations in the up and down direction?

Optional problems, for further study. If you attempt one of these, we will read your solution and give you written feedback. No extra credit. Solutions will be posted.

6) 7.34
7) 7.41. Note that there is gravitational potential energy (*mgz*) in this problem.
8) 7.43
9) 7.44 (a, and b). (computer problem). This is a continuation of problem 7.29.