Homework Assignment 2
(Due in class Tues. Sept. 8)

(10) 1. A superball of mass $M$ and a marble of mass $m$ are dropped from a height $h$ with the marble just on top of the superball. The superball collides with the floor, rebounds, and hits the marble. How high does the marble go? How high does the superball go? Ignore the sizes of the superball and marble and assume perfectly elastic collisions, and all motion is vertical. Assuming $m \ll M$, how much higher than the superball does the marble go?

(10) 2. Taylor 4.7

(10) 3. Taylor 4.2

(10) 4. A particle of mass $m$ moving in one dimension has potential energy $U(x) = U_0 \left[ 2\left(\frac{x}{a}\right)^2 - \frac{x}{a^4}\right]$ where $U_0$ and $a$ are positive constants. (a) Find the force $F(x)$ which acts on the particle. (b) Sketch $U(x)$. Find the positions of stable and unstable equilibrium. (c) What is the angular frequency of small oscillations about the points of stable equilibrium? (d) What is the minimum speed the particle must have at the origin to escape to infinity? (e) At $t = 0$ the particle is at the origin and its velocity is in the positive $x$-direction and equal in magnitude to the escape speed of part (d). Find $x(t)$ and sketch the result.

(10) 5. Taylor 4.36