Due Jan. 20, Tuesday

All problems must be solved symbolically first. Then, any numerical answer, when required, can be computed by substituting numbers into the symbolic expression at/near the very end. Solving problems symbolically means deriving the answer in terms of symbols, instead of numerical values. Recommended symbols are given below for some problems. All problem numbers refer to those in the textbook. (Not all problems may be graded in detail, due to limited man power; however, you must do all problems.)

Problem 1 (10 points) Problem 14.4 (the basics of the SHM). (a) Suggested symbols: 8.8 cm $\rightarrow x_0$, 0.66 s $\rightarrow T$. (b) Suggested symbols: 1.8 s $\rightarrow t$ (assuming time = 0 initially).

Problem 2 (10 points) Problem 14.5 (a spring force driven free fall). Suggested symbols: m for child's mass (35 kg), t_p for the bounce period (2.0 sec). You will need more symbols for unstated quantities that you must include!

Problem 3 (10 points) Problem 14.13 (reading SHM graphs).

Problem 4 (10 points) Problem 14.28 (the basics of the SHM energy).

Problem 5 (10 points) Problem 14.37 (a bullet hitting a mass on spring). Suggested symbols can be found in the diagram.

Problem 6 (10 points) Problem 14.76 (an atomic SHO in a DNA). Suggested symbol: m for the mass of the atom.

Problem 7 (10 points) Problem 14.78 (a man on a raft). Suggested symbols: 320 kg $\rightarrow M$, 75 kg $\rightarrow m$, 3.5 cm $\rightarrow x_s$.

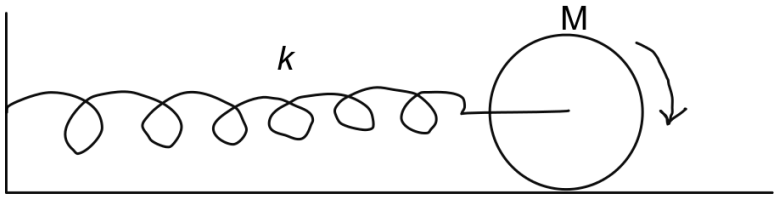
Problem 8 (10 points) Problem 14.87 (a journey through the Earth). You should express your answer in terms of the earth mass (M), the earth radius (R), and the gravitational constant (G), before evaluating the numerical answer. If necessary, you can use symbols m for the mass of the apple and d for the diameter of the circular hole.

Problem 9 (10 point) A solid cylinder with uniform density, attached to a horizontal spring (k = 2.00 N/m), rolls without slipping along a horizontal surface. The system is released from rest when the spring is stretched by A = 0.150 m. Find (a) the translational kinetic energy and (b) the rotational kinetic energy of the

cylinder as it passes through the equilibrium position of the spring. (c) Show that the cylinder's center of mass executes simple harmonic motion with period

$$T = 2\pi\sqrt{\frac{3M}{2k}}$$

where M is the cylinder mass. (Hint: There are more than one way to do this problem. Taking the time derivative of the total mechanical energy is one way.)



Problem 10 (10 points; extra credit) Problem 14.59 (damped SHO).