Problems from the text:

Chapter 13;

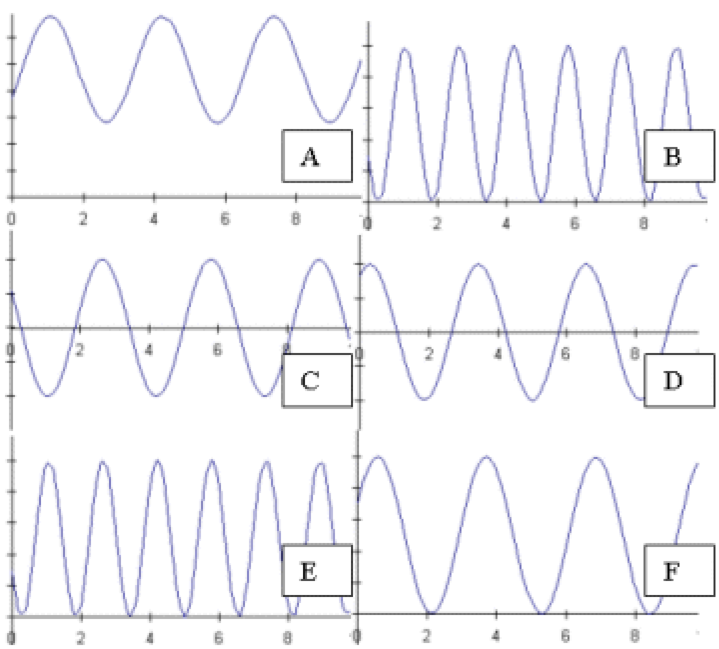
14, 18, 26, 32, 38, 40, 44

Oscillating graphs

A mass is hanging from a spring off the edge of a table. The position of the mass is measured by a sonic ranger sitting on the floor 25 cm below the mass' equilibrium position. At some time, the mass is started oscillating. At a later time, the sonic ranger begins to take data.

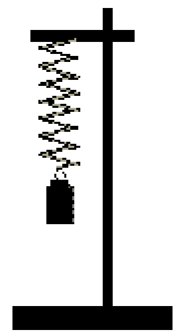
Below are shown a series of graphs associated with the motion of the mass and a series of physical quantities. The graph labeled (A) is a graph of the mass' position as measured by the ranger. For each physical quantity identify which graph could represent that quantity for this situation. If none are possible, answer N.

a. velocity of the mass
b. net force on the mass
c. force exerted by the spring on the mass
d. kinetic energy of the mass
e. potential energy of the spring
f. gravitational potential energy of the mass



Where's the force?

A 50 gram mass is hanging from a spring whose unstretched length is 10 cm and whose spring constant is 2.5 N/m. In the list below are described five situations. In some of the situations, the mass is at rest and remains at rest. In other situations, at the instant described, the mass is in the middle of an oscillation initiated by a person pulling the mass downward 5 cm from its equilibrium position and releasing it. Ignore both air resistance and internal damping in the spring.



At the time the situation occurs, indicate whether the force vector requested points up (U), down (D), or has magnitude zero (0).

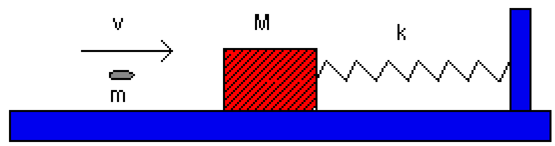
a. The force on the mass exerted by the spring when the mass is at its equilibrium position and is at rest.
b. The force on the mass exerted by the spring when the mass is at its equilibrium position and is moving downward.
c. The net force on the mass when the mass is at its equilibrium position and is moving upward.
d. The force on the mass exerted by the spring when it is at the top of its oscillation.
e. The net force on the mass when it is at the top of its oscillation.

Swingin' in the rain

Once, when on vacation in Italy, I visited a forest which had many waterfalls. At one of the waterfalls, a long rope hung down from the top of the cliff near the waterfall and had a seat on the bottom. Adventurous visitors could hop onto the seat and swing down into the waterfall as shown in the photo at the right. I estimated that their starting angle was about 20^o. I also timed their swing and discovered it took them 8 seconds to swing out and back. Estimate the length of the rope and the speed with which they passed through the waterfall. (The top of the rope is **not** shown in the photo.)

Catching a pellet and oscillating

The following problem is a standard problem found in the text (and in many others). A block of mass *M* at rest on a horizontal frictionless table. It is attached to a rigid support by a spring of constant k. A clay pellet having mass *m* and velocity *v* strikes the block as shown in the figure and sticks to it.



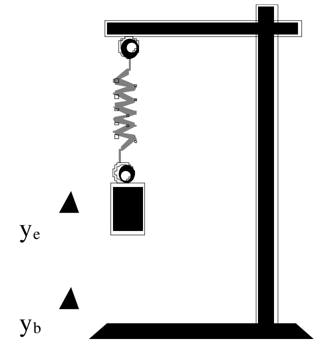
a. Determine the velocity of the block immediately after the collision.
b. Determine the amplitude of the resulting simple harmonic motion.

In order for you to solve this problem you must make a number of simplifying assumptions, some of which are stated in the problem and some of which are not. First, solve the problem as stated.

c. Discuss the approximations which you had to make in order to solve the problem. (Give at least 3.)

A cylinder is hung from a spring which is attached to a frame (see figure). The cylinder is pulled downward a distance y_{pull} and released. At the instant the cylinder passes its equilibrium position (as defined in the tutorial), a clock is started ($t = 0$).

Consider ***two*** coordinate systems to describe the motion of the cylinder. The first coordinate system is chosen with an origin ($y_b = 0$) at the base of the frame, and the upward direction is considered positive. The cylinder is shown at rest at its equilibrium position, y_0. The second coordinate system measures displacement from the cylinder's equilibrium position ($y_e = 0$).



On the axes below, sketch graphs of y_b vs. t and y_e vs. t.

Account for any differences between the two graphs.

Write the general equation that gives y_e as a function of time for the y_e vs. t graph you sketched above.

Write the equation that gives y_b as a function of time.
Explain how you arrived at your answer.

In the box at right, sketch a free-body diagram for the instant in time when the cylinder is located at $y_e = 0$. Label all forces like in tutorial. Are the forces the same in both coordinate systems?

Use your equations above to show that Newton's Second Law is the same in both coordinate systems. Show all work.