1003 Problem Set 2 (*Work together*)

- **if your name is next to a problem, you are presenting the problem in class**
- **if the name next to the problem is (Random) I will call on someone randomly**

(Robert) 19. Refer to Conceptual Example 2 as an aid in solving this problem. A 100-coil spring has a spring constant of 420 N/m. It is cut into four shorter springs, each of which has 25 coils. One end of a 25-coil spring is attached to a wall. An object of mass 46 kg is attached to the other end of the spring, and the system is set into horizontal oscillation. What is the angular frequency of the motion?

(Dwyane) *20. Objects of equal mass are oscillating up and down in simple harmonic motion on two different vertical springs. The spring constant of spring 1 is 174 N/m. The motion of the object on spring 1 has twice the amplitude as the motion of the object on spring 2. The magnitude of the maximum velocity is the same in each case. Find the spring constant of spring 2.

(Random)*21. ssm mmh A spring stretches by 0.018 m when a 2.8-kg object is suspended from its end. How much mass should be attached to this spring so that its frequency of vibration is $f = 3.0$ Hz?

(Rachel) 22. An object attached to a horizontal spring is oscillating back and forth along a frictionless surface. The maximum speed of the object is 1.25 m/s, and its maximum acceleration is 6.89 m/s^2. How much time elapses between an instant when the object's speed is at a maximum and the next instant when its acceleration is at a maximum?

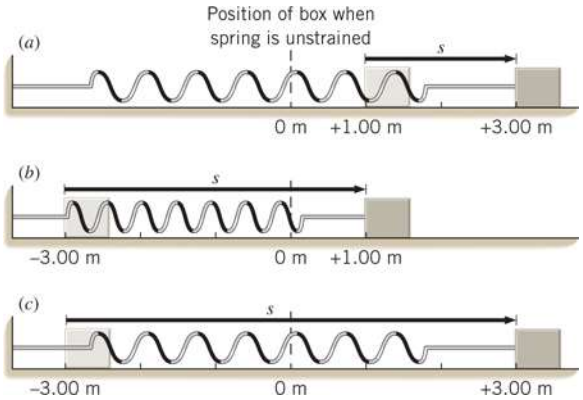
(Random) 23. mmh A vertical spring (spring constant = 112 N/m) is mounted on the floor. A 0.400-kg block is placed on top of the spring and pushed down to start it oscillating in simple harmonic motion. The block is not attached to the spring. **(a)** Obtain the frequency (in Hz) of the motion.**(b)** Determine the amplitude at which the block will lose contact with the spring.

(Abner) 24. A tray is moved horizontally back and forth in simple harmonic motion at a frequency of $f = 2.00$ Hz. On this tray is an empty cup. Obtain the coefficient of static friction between the tray and the cup, given that the cup begins slipping when the amplitude of the motion is 5.00×10^{-2} m.

(Ankith) 25. A pen contains a spring with a spring constant of 250 N/m. When the tip of the pen is in its retracted position, the spring is compressed 5.0 mm from its unstrained length. In order to push the tip out and lock it into its writing position, the spring must be compressed an additional 6.0 mm. How much work is done by the spring force to ready the pen for writing? Be sure to include the proper algebraic sign with your answer.

(Nate) 26. The drawing shows three situations in which a block is attached to a spring. The position labeled "0 m" represents the unstrained position of the spring. The block is moved from

an initial position x_0 to a final position x_f, the magnitude of the displacement being denoted by the symbol s. Suppose the spring has a spring constant of $k = 46.0$ N/m. Using the data provided in the drawing, determine the total work done by the restoring force of the spring for each situation.



(Random) 27. A spring is hung from the ceiling. A 0.450-kg block is then attached to the free end of the spring. When released from rest, the block drops 0.150 m before momentarily coming to rest, after which it moves back upward. **(a)** What is the spring constant of the spring? **(b)** Find the angular frequency of the block's vibrations.

(Random) 28. A 3.2-kg block is hanging stationary from the end of a vertical spring that is attached to the ceiling. The elastic potential energy of this spring-block system is 1.8 J. What is the elastic potential energy of the system when the 3.2-kg block is replaced by a 5.0-kg block?

(Nate) 43. A simple pendulum is made from a 0.65-m-long string and a small ball attached to its free end. The ball is pulled to one side through a small angle and then released from rest. After the ball is released, how much time elapses before it attains its greatest speed?

(Abner) 44. **mmh** Astronauts on a distant planet set up a simple pendulum of length 1.2 m. The pendulum executes simple harmonic motion and makes 100 complete vibrations in 280 s. What is the magnitude of the acceleration due to gravity on this planet?

(Robert) 45. The length of a simple pendulum is 0.79 m and the mass of the particle (the "bob") at the end of the cable is 0.24 kg. The pendulum is pulled away from its equilibrium position by an angle of 8.508 and released from rest. Assume that friction can be neglected and that the resulting oscillatory motion is simple harmonic motion. **(a)** What is the angular frequency of the motion? **(b)** Using the position of the bob at its lowest point as the reference level, determine the total mechanical energy of the pendulum as it swings back and forth. **(c)** What is the bob's speed as it passes through the lowest point of the swing?

(Rachel) 46. A spiral staircase winds up to the top of a tower in an old castle. To measure the height of the tower, a rope is attached to the top of the tower and hung down the center of the staircase. However, nothing is available with which to measure the length of the rope. Therefore, at the bottom of the rope a small object is attached so as to form a simple pendulum that just clears the floor. The period of the pendulum is measured to be 9.2 s. What is the height of the tower?

(Dwyane) 47. Two physical pendulums (not simple pendulums) are made from meter sticks that are suspended from the ceiling at one end. The sticks are uniform and are identical in all respects, except that one is made of wood (mass = 0.17 kg) and the other of metal (mass = 0.85 kg). They are set into oscillation and execute simple harmonic motion. Determine the period of **(a)** the wood pendulum and **(b)** the metal pendulum.