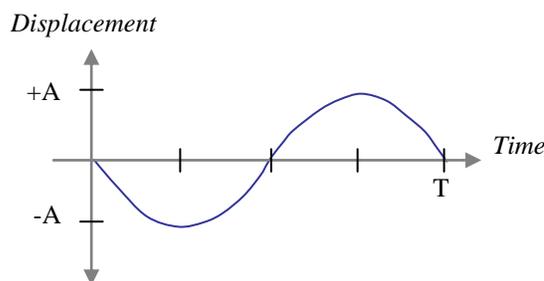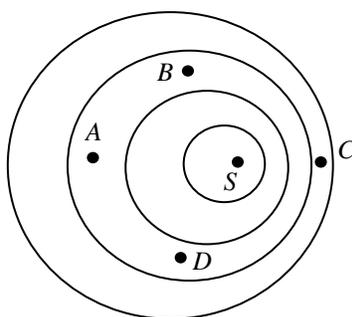# MULTIPLE CHOICE REVIEW: CHAPTERS 13 & 14

Displacement

1988 – 69. An object is attached to a spring and oscillates with amplitude A and time period T, as represented on the graph above. The nature of the velocity v and acceleration a of the object at time $T/4$ is best represented by which of the following?

  a. $v > 0$ and $a < 0$.
  b. $v > 0$ and $a = 0$.
  c. $v = 0$ and $a < 0$.
 d. $v = 0$ and $a > 0$.
  e. $v = 0$ and $a = 0$.

1998 – 49. A small vibrating object on the surface of a ripple tank is the source of waves of frequency 20 Hz and speed 60 cm/s. If the source S is moving to the right, as shown above, with speed 20 cm/s, at which of the labeled points will the frequency measured by a stationary observer be the greatest?

  a. A.
  b. B.
  c. C.
  d. D.
  e. It will be the same for all four points.

1993 – 47. A block of mass m slides on a horizontal frictionless table with an initial speed v_0. It then compresses a spring of force constant k and is brought to rest. How much is the spring compressed from its natural length?

  a. $\dfrac{v_0^2}{2 \cdot g}$
      b. $\dfrac{m \cdot g}{k}$
      c. $v_0 \cdot \dfrac{m}{k}$
      d. $v_0 \cdot \sqrt{\dfrac{m}{k}}$
   e. $v_0 \cdot \sqrt{\dfrac{k}{m}}$
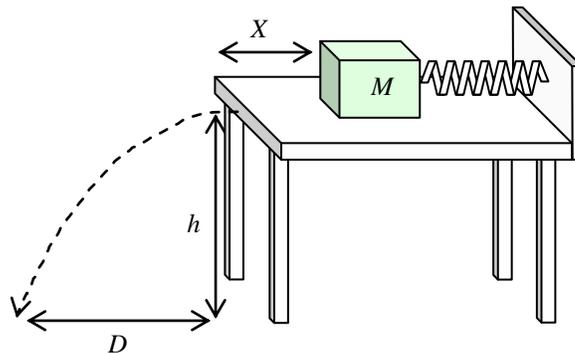
1986 – 2. One end of a spring is attached to a solid wall while the other end just reaches to the edge of a horizontal, frictionless tabletop, which is a distance h above the floor. A block of mass M is placed against the end of the spring and pushed towards the wall until the spring has been compressed a distance X, as shown above. The block is released, follows the trajectory shown, and strikes the floor a horizontal distance D from the edge of the table. Air resistance is negligible. Determine expressions for the following quantities in terms of $M, X, D, h,$ and g. Note that these symbols do not include the spring constant.

(a) The time elapsed from the instant the block leaves the table to the instant it strikes the floor.
(b) The horizontal component of the velocity of the block just before it hits the floor.
(c) The work done on the block by the spring.
(d) The spring constant.

2002 – 6. In the laboratory, you are given a cylindrical beaker containing a fluid and you are asked to determine the density ρ of the fluid. You are to use a spring of negligible mass and unknown spring constant k attached to a stand. An irregularly shaped object of known mass m and density D ($>> \rho$) hangs from the spring. You may also choose from among the following items to complete the task.
   - A metric ruler
          - A stopwatch
          - String

(a) Explain how you could experimentally determine the spring constant k.
(b) The spring-object system is now arranged so that the object (but none of the spring) is immersed in the unknown fluid, as shown at right. Describe any changes that are observed in the spring-object system and explain why they occur.
(c) Explain how you could experimentally determine the density ρ of the fluid. Identify any measurements required, equations used, and variables represented in those equations.
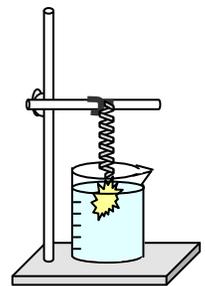
Frequency of Vibration $= f_0$

Amplitude of Displacement $= A_0$

Velocity of Waves on the String $= v_0$
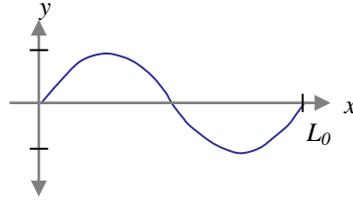
1980 – 4. In the graph above, a curve is drawn to represent the displacement y of a vibrating string as a function of the distance x from one end of the string. The string is fixed at both ends and has length L_0. It initially vibrates with frequency f_0 and amplitude A_0. The initial velocity of waves traveling on the string is v_0. In each of the graphs below, the frequency, amplitude, and velocity of waves on the string may be varied. Sketch a suitable curve to represent the vibration of the string for each situation. Your curve should be consistent with the proportions of the initial graph shown above.

(a)

Frequency of Vibration $= \dfrac{3}{2} \cdot f_0$

Amplitude of Displacement $= A_0$

Velocity of Waves on the String $= v_0$

(b)

Frequency of Vibration $= f_0$

Amplitude of Displacement $= \dfrac{1}{2} \cdot A_0$

Velocity of Waves on the String $= v_0$

(c)

Frequency of Vibration $= \dfrac{1}{2} \cdot f_0$

Amplitude of Displacement $= A_0$

Velocity of Waves on the String $= \dfrac{1}{4} \cdot v_0$

A 1.6 m organ pipe is open on one end and closed on the other. On a day when the temperature is 25 °C, the velocity of sound through the air in the pipe is 345.8 m/s.

(a) What is the lowest frequency that will resonate in the pipe in this situation?

(b) Will a tuning fork of 108 Hz resonate in the organ pipe on a day when the temperature is 25 °C? Justify your answer.

(c) Suppose the temperature of the air in the pipe drops to 20 °C. How will this affect the fundamental frequency of the pipe? Justify your answer.