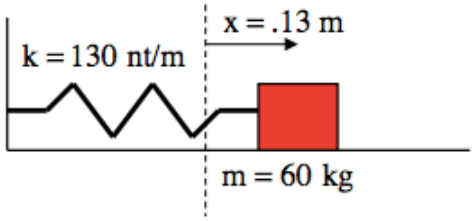
Chapter 13 XtraWrk – Vibrations and Waves

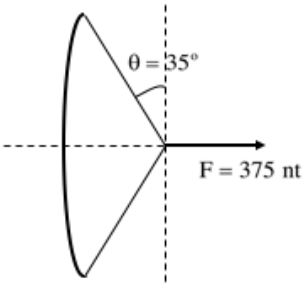
13.1) A 60-kg mass is attached to a spring with k = 130 N/m. The mass is extended 0.13 m from its equilibrium position along a frictionless surface.

a) What is the force on the mass in this position?
b) What is the acceleration of the mass at this point when it is released?
c) What is the amplitude of the periodic motion?
d) What is the frequency of the periodic motion?



13.6) A slingshot is pulled back with a force of 375 N as shown.

a) What is the tension in the string?
b) If a spring replaced the force and the string was pulled a distance of 0.3 m to duplicate the original situation, what would be the spring's spring constant?



13.11) A 0.1-kg mass is atop a spring that is compressed 0.02 m. When released, the mass rises 0.6 m. What's the spring constant?

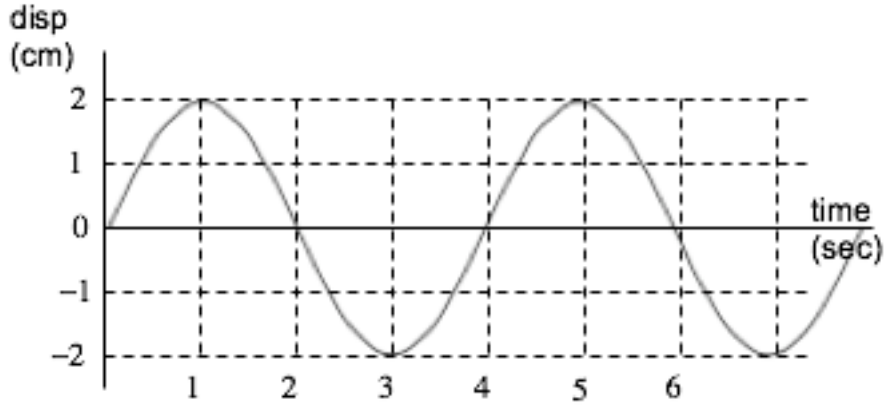
13.28) Consider a position function $x = (0.052\ \text{m})\sin(8\pi t - 2.82)$.

a) What is the period?
b) What is the frequency?
c) What is the amplitude?
d) When will it reach 0.026 m?
e) What is the phase shift?
f) Is the body moving away from or toward equilibrium at t = 0?

13.31) A 2-kg mass is attached to a spring with k = 5 N/m. It is elongated a distance of 3 m from its equilibrium position and released at t = 0, allowing it to oscillate on a frictionless surface.

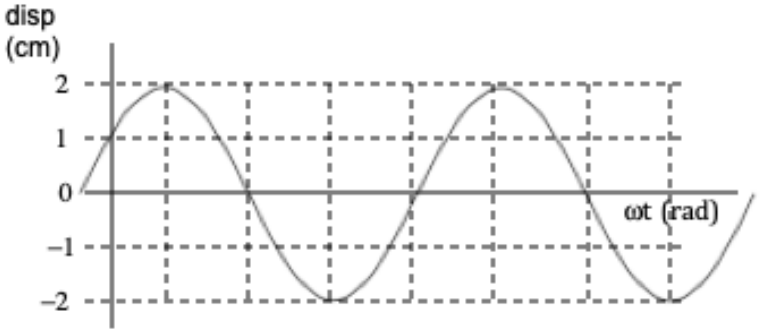
a) What is the force on the mass 3.5 seconds after it is released?
b) Through how many cycles does the body oscillate in 3.50 seconds?

13.42) For the sine wave shown here, determine:



a) Amplitude?
b) Period?
c) Angular frequency?
d) Maximum speed?
e) Maximum acceleration?
f) Position as a function of time relationship?

13.42 alternate) The sine wave shown here is the consequence of a body that is oscillating with a frequency of 20 Hz. Determine:



a.) Amplitude?
b.) Period?
c.) Angular frequency?
d.) Maximum speed?
e.) Maximum acceleration?
f.) Phase shift?
g.) Position as a function of time relationship?

14.39) A stretched string fixed at both ends has mass .040 kg and length 8.0 meters. The tension in the string is 49.0 newtons.

a.) Determine the position of the nodes and antinodes for the third harmonic (you will have to draw a sine wave to do this).
b.) What is the vibrational frequency for this harmonic?

14.48) A standing wave is set up around the periphery of a crystal goblet with four nodes and four antinodes equally spaced around the .20 meter circumference of its rim. If transverse waves move around the glass at 900 m/s, an opera singer would have to produce what frequency to shatter the glass?

14.50) A piccolo is .32 meters long and open at both ends.

a.) What is the lowest frequency the piccolo can play if the speed of sound in air is 340 m/s?
b.) I the highest note the piccolo can sound is 4000 Hz, what must be the distance between adjacent antinodes?

14.52) A tunnel is 20,000 meters long.

a.) At what frequency can the air in the tunnel resonate?
b.) Would it be a good idea to honk a horn in a tunnel like this?