13-1A) A particle will undergo simple harmonic motion if the restoring force acting on the particle is proportional to:
(a) The square root of the amplitude of motion of the particle.
(b) The frequency of oscillation of the particle.
(c) The particle's velocity.
(d) The particle's displacement from equilibrium.
(e) The square of the particle's displacement from equilibrium.

13-2A) Which one of the following is WRONG?
(a) A Hooke's law force will give simple harmonic motion.
(b) The frequency of oscillation is inversely proportional to the period of oscillation.
(c) For a given mass and Hooke's law spring, the larger the amplitude of oscillation, the larger the maximum speed.
(d) If you double the amplitude of oscillation of a mass on a Hooke's law spring, you double its maximum kinetic energy.
(e) The potential energy of a mass on a Hooke's law spring is proportional to the square of its displacement from equilibrium.

13-3A) A 5 kg mass is hung on the end of a Hooke's law spring with force constant k = 500 N/m. If the maximum speed of the mass is 5 m/s, what is its maximum displacement?
(a) 5 m (b) 50 m (c) 0.5 m (d) 0.05 m (e) You don't have enough information to tell.

13-4A) The maximum speed of a harmonic oscillator is 6.28 m/s and its period is T = 2 s. What is its maximum amplitude of motion?
(a) 12.6 m (b) 0.5 m (c) 2 m (d) 3.14 m (e) You don't have enough information to tell.

13-5A) If the mass m at the end of a spring is replaced by a mass 9m, the ratio f_n/f_o of the new to old frequency of oscillation of the vibrating spring should be about:
(a) 1/9 (b) 1/3 (c) 3 (d) 9 (e) None of these is close.

13-6A) An object undergoing simple harmonic motion takes 1 sec to travel from one end point of its motion to the opposite end point. What is the frequency of motion of this object?
(a) 2 Hz (b) π Hz (c) 2π Hz (d) $2/\pi$ Hz (e) 1/2 Hz

13-7A) When a mass m = 36 gm is hung on the end of an unstretched vertical, massless spring, the spring stretches by 0.4 m. If the spring is then compressed by 0.1 m from this latter position, about what should be the amplitude (A) and period (T) of oscillation?
(a) A = 0.9 m; T = 1.3 s (b) A = 0.9 m; T = 6 s (c) A = 0.1 m; T = 6 s
(d) A = 0.1 m; T = 1.3 s (e) None of these is correct.

13-8A) Which one of the following statements is WRONG?
(a) The acceleration of a particle undergoing simple harmonic oscillation also varies simple harmonically.
(b) The total energy of a particle undergoing simple harmonic motion is constant.
(c) As a particle undergoes simple harmonic motion, its energy oscillates between all potential energy at one limit and all kinetic energy at the other limit.
(d) If the tension in a string is constant, the speed of a wave on the string should not change when the wavelength doubles.
(e) If the tension in a string is constant, the frequency of oscillation should double when the wavelength doubles.

13-9A) A pendulum of length L undergoes simple harmonic motion at the earth's surface due to the gravitational force mg. Which one of the following is the correct expression for the angular frequency ω of the pendulum?
(a) $\sqrt{g/L}$ (b) L/g (c) $\sqrt{L/g}$ (d) g/L (e) $\sqrt{gL}$

13-10A) A pendulum of a certain length has a period of 2 s. If you reduce the pendulum's length to 1/4 of its initial value, what is the new period?
(a) 1 s (b) 2 s (c) 0.5 s (d) 8 s (e) 4 s

13-11A The distance between the crest and neighboring trough of a sinusoidal water wave is 3 m. If the frequency of this wave is 2 Hz, what is the speed of the wave?
(a) 1.5 m/s (b) 12 m/s (c) 6.0 m/s (d) 3 m/s (e) You don't have enough information to tell.

13-12A) If you double the tension in a string and simultaneously double its mass per unit length, the ratio of new to old wave speed is:
(a) 1/2 (b) 2 (c) 1 (d) ¼ (e) 4

The location x as a function of time t of a particle undergoing Simple Harmonic Oscillation is given by $x = A\cos(\omega t) = A\cos(2\pi f t)$.

13-13A) If f = 1 Hz, what is the particle's location at t = 0.25 sec?
(a) 0 (b) A (c) A/2 (d) -A (e) 0.87A

13-14A) If $\omega = 1$ rad/sec, what is the particle's location at $t = 2\pi$ sec?
(a) 0 (b) 0.87A (c) A/2 (d) -A (e) A

13-15A) Which one of the following statements is WRONG?
(a) If a pendulum clock is running slow, you could speed it up by shortening the length of its pendulum a bit
(b) If a pendulum clock is running slow, you could speed it up by shaving a bit of material off of the mass at its end.
(c) You could increase the wave speed in a rubberized string by pulling harder on the string to increase its tension.
(d) You could increase the wave speed in a rubberized string by decreasing the mass per unit length of the string.
(e) A pulse that reflects from a fixed end of a string moves back with displacement opposite to that it had coming in.

13-1B) A particle will undergo simple harmonic motion if the potential energy of the particle is proportional to:
(a) The square of the amplitude of motion of the particle.
(b) The frequency of oscillation of the particle.
(c) The particle's velocity.
(d) The particle's displacement from equilibrium.
(e) The square of the particle's displacement from equilibrium.

13-2B) Which one of the following is WRONG?
(a) A Hooke's law force will give simple harmonic motion.
(b) The frequency of oscillation is proportional to the period of oscillation.
(c) For a given mass and Hooke's law spring, the larger the amplitude of oscillation, the larger the maximum speed.
(d) If you double the amplitude of oscillation of a mass on a Hooke's law spring, you quadruple its maximum kinetic energy.
(e) The potential energy of a mass on a Hooke's law spring is proportional to the square of its displacement from equilibrium.

13-3B) A mass m = 4.0 kg, hanging from a spring with force constant k = 80 N/m is set into vertical motion, starting from rest with initial displacement of 0.1 m. About what should be the speed of the mass as it passes through the equilibrium point?
(a) zero (b) 0.45 m/s (c) 2.0 m/s (d) 3.4 m/s (e) 4.0 m/s

13-4B) A harmonic oscillator has maximum speed of 6.28 m/s and frequency f = 0.5 Hz. What is its maximum amplitude of motion?
(a) 12.6 m (b) 0.5 m (c) 2 m (d) 3.14 m (e) You don't have enough information to tell.

13-5B) If the force constant of a spring is reduced by a factor of four, the ratio T_n/T_o of the new to old period of oscillation of the vibrating spring should be about:
(a) 1/4 (b) 1/2 (c) 2 (d) 4 (e) None of these is close.

13-6B) An object undergoing simple harmonic motion takes 1 sec to travel from one end point of its motion to the opposite end point. What is the angular frequency of motion of this object?
(a) π rad/s (b) 2 rad/s (c) 2π rad/s (d) $2/\pi$ rad/s (e) $1/\pi$ rad/s

13-7B) When a mass m = 72 gm is hung on the end of an unstretched vertical, massless spring, the spring stretches by 0.2 m. If the spring is then compressed by 0.2 m from this latter position, about what should be the amplitude (A) and period (T) of oscillation?
(a) A = 0.2 m; T = 0.9 s (b) A = 1.0 m; T = 0.9 s (c) A = 1.0 m; T = 12 s
(d) A = 0.2 m; T = 12 s (e) None of these is correct.

13-8B) Which one of the following statements is WRONG?
(a) The acceleration of a particle undergoing simple harmonic oscillation also varies simple harmonically.
(b) The total energy of a particle undergoing simple harmonic motion is not constant.
(c) As a particle undergoes simple harmonic motion, its energy oscillates between all potential energy at one limit and all kinetic energy at the other limit.
(d) If the tension in a string is constant, the period of oscillation should double when the wavelength doubles.
(e) If the tension in a string is constant, the speed of a wave on the string should not change when the wavelength doubles.

13-9B) A pendulum of length L undergoes simple harmonic motion at the earth's surface due to the gravitational force mg. Which one of the following is the correct expression for the frequency f of the pendulum?
(a) $2\pi\sqrt{g/L}$ (b) L/g (c) $\sqrt{L/g}$ (d) g/L (e) $(1/2\pi)\sqrt{g/L}$

13-10B) A pendulum of a certain length has a period of 2 s. If you quadruple the pendulum's length, about what is the new period?
(a) 1 s (b) 2 s (c) 0.5 s (d) 4 s (e) 8 s

13-11B The distance between the crest and neighboring trough of a sinusoidal water wave is 1.5 m. If the speed of the wave is 3 m/s, about what is the frequency of the wave?
(a) 1.0 Hz (b) 2.0 Hz (c) 4.5 Hz (d) 3.0 Hz (e) You don't have enough information to tell.

13-12B) If you double the tension in a string and simultaneously halve its mass per unit length, the ratio of new to old wave speed is:
(a) 1 (b) 2 (c) ½ (d) ¼ (e) 4

The location x as a function of time t of a particle undergoing Simple Harmonic Oscillation is given by $x = A\cos(\omega t) = A\cos(2\pi f t)$.

13-13B) If f = 1 Hz, what is the particle's location at t = 1/6 sec?
(a) 0 (b) A (c) A/2 (d) -A (e) 0.87A

13-14B) If $\omega = 1$ rad/sec, what is the particle's location at $t = \pi$ sec?
(a) 0 (b) A (c) A/2 (d) -A (e) 0.87A

13-15B) Which one of the following statements is WRONG?
(a) If a pendulum clock is running slow, you could speed it up by lengthening its pendulum a bit
(b) If a pendulum clock is running slow, shaving a bit of material off of the mass at its end doesn't change its period.
(c) You could increase the wave speed in a rubberized string by pulling harder on the string to increase its tension.
(d) You could increase the wave speed in a rubberized string by decreasing the mass per unit length of the string.
(e) A pulse that reflects from a fixed end of a string moves back with displacement opposite to that it had coming in.

13-1A) d 2A) d 3A) c 4A) c 5A) b 6A) e 7A) d 8A) e 9A) a 10A) a 11A) b 12A) c 13A) a 14A) e 15A) b

13-1B) e 2B) b 3B) b 4B) c 5B) c 6B) a 7B) a 8B) b 9B) e 10B) d 11B) a 12B) b 13B) c 14B) d 15B) a