AP Physics 1 Waves and Simple Harmonic Motion Practice Test

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

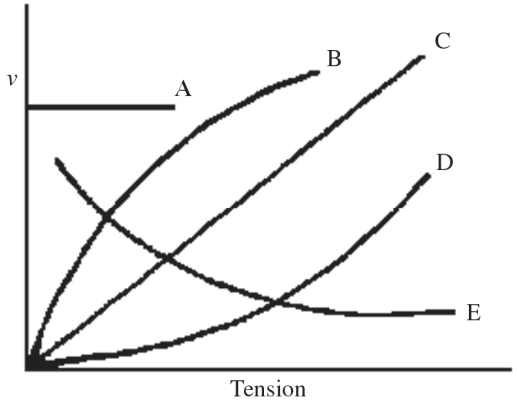
1) An object is attached to a vertical spring and bobs up and down between points A and B. Where is the object located when its kinetic energy is a minimum?
A) midway between A and B
B) one–fourth of the way between A and B
C) at either A or B
D) one–third of the way between A and B
E) at none of the above points

2) When a certain string is under tension T, the speed of a wave in the string is v. What will be the speed of a wave in the string if the tension is increased to $2T$ without changing the mass or length of the string?
A) $v/2$ B) $v/\sqrt{2}$ C) $2v$ D) $4v$ E) $v\sqrt{2}$

3) Two simple pendulums, A and B, are each 3.0 m long, and the period of pendulum A is T. Pendulum A is twice as heavy as pendulum B. What is the period of pendulum B?
A) $T/\sqrt{2}$ B) $T\sqrt{2}$ C) $2T$ D) $T/2$ E) T

4) A fisherman fishing from a pier observes that the float on his line bobs up and down, taking 2.4 s to move from its highest point to its lowest point. He also estimates that the distance between adjacent wave crests is 48 m. What is the speed of the waves going past the pier?
A) 1.0 m/s B) 20 m/s C) 5.0 m/s D) 120 m/s E) 10 m/s

5) Which one of the curves shown in the figure best represents the variation of wave speed v as a function of tension for transverse waves on a stretched string?



A) A B) B C) C D) D E) E

6) A pendulum of length L is suspended from the ceiling of an elevator. When the elevator is at rest the period of the pendulum is T. How does the period of the pendulum change when the elevator moves downward with constant acceleration?

A) The period decreases.
B) The period increases if the upward acceleration is more than $g/2$ but decreases if the upward acceleration is less than $g/2$.
C) The period increases.
D) The period does not change.
E) The period becomes zero.

7) You drop a stone down a well that is 9.5 m deep. How long is it before you hear the splash? The speed of sound in air is 343 m/s and air resistance is negligible.

A) 1.4 s B) 1.6 s C) 1.3 s D) 1.2 s E) 1.5 s

8) A simple pendulum and a mass oscillating on an ideal spring both have period T in an elevator at rest. If the elevator now moves downward at a uniform 2 m/s, what is true about the periods of these two systems?

A) The period of the pendulum would decrease but the period of the spring would stay the same.
B) Both periods would remain the same.
C) Both periods would increase.
D) Both periods would decrease.
E) The period of the pendulum would increase but the period of the spring would stay the same.

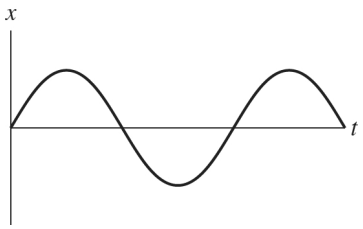
9) An object is oscillating on a spring with a period of 4.60 s. At time $t = 0.00$ s the object has zero speed and is at $x = 8.30$ cm. What is the acceleration of the object at $t = 2.50$ s?

A) 0.00 cm/s^2
B) 1.33 cm/s^2
C) 0.784 cm/s^2
D) 14.9 cm/s^2
E) 11.5 cm/s^2

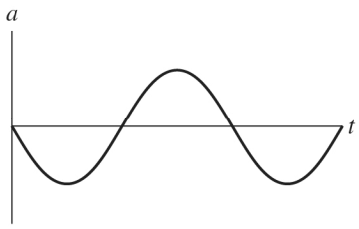
10) If the frequency of a system undergoing simple harmonic motion doubles, by what factor does the maximum value of acceleration change?

A) $2/\pi$ B) 2 C) $\sqrt{2}$ D) 4

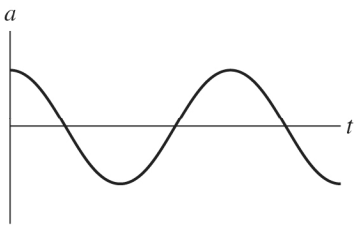
11) The figure shows a graph of the position x as a function of time t for a system undergoing simple harmonic motion. Which one of the following graphs represents the acceleration of this system as a function of time?



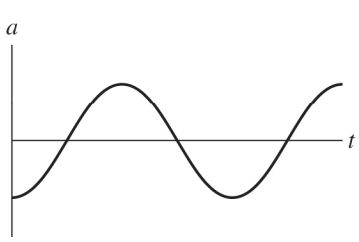
a)



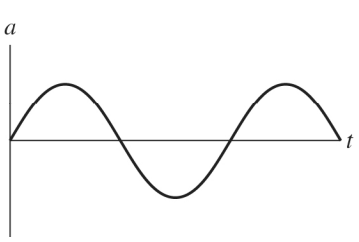
b)



c)



d)



A) graph a B) graph b C) graph c D) graph d

12) A wire that is 1.0 m long with a mass of 90 g is under a tension of 710 N. When a transverse wave travels on the wire, its wavelength is 0.10 m and its amplitude is 6.5 mm. What is the frequency of this wave?
A) 1500 Hz B) 1000 Hz C) 890 Hz D) 1200 Hz E) 920 Hz

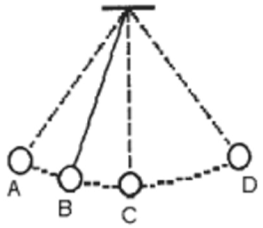
13) When a 0.350–kg package is attached to a vertical spring and lowered slowly, the spring stretches 12.0 cm. The package is now displaced from its equilibrium position and undergoes simple harmonic oscillations when released. What is the period of the oscillations?
A) 0.286 s B) 0.695 s C) 0.0769 s D) 1.44 s E) 0.483 s

14) A 15–m rope is pulled taut with a tension of 140 N. It takes 0.545 s for a wave to propagate along the rope. What is the mass of the rope?
A) 5.1 kg B) 3.2 kg C) 2.1 kg D) 2.8 kg E) 1.7 kg

15) In 1851 Jean Bernard Leon Foucault demonstrated the rotation of the earth using a pendulum 11.0 m long, which was set up in the Paris Observatory. How long would it have taken for Foucault's pendulum to make one complete swing back to its starting point if $g = 9.81\ \text{m/s}^2$ at the observatory?
A) 1.79 s B) 2.58 s C) 6.65 s D) 5.63 s E) 2.12 s

16) If both the mass of a simple pendulum and its length are doubled, the period will
A) increase by a factor of 4.
B) increase by a factor of $1/\sqrt{2}$.
C) increase by a factor of 2.
D) be unchanged.
E) increase by a factor of $\sqrt{2}$.

17) A ball swinging at the end of a massless string, as shown in the figure, undergoes simple harmonic motion. At what point (or points) is the magnitude of the instantaneous acceleration of the ball the greatest?



A) A and D B) C C) A and C D) A and B E) B

18) The speed of sound in steel is 5000 m/s. What is the wavelength of a sound wave of frequency 660 Hz in steel?
A) 1.21 m B) 0.132 m C) 2.41 m D) 0.829 m E) 7.58 m

19) A tsunami, an ocean wave generated by an earthquake, propagates along the open ocean at 700 km/hr and has a wavelength of 750 km. What is the frequency of the waves in such a tsunami?
A) 0.15 Hz B) 0.93 Hz C) 6.8 Hz D) 0.00026 Hz E) 1.1 Hz

20) A piano wire of linear mass density 0.0050 kg/m is under a tension of 1350 N. What is the wave speed in this wire?
A) 260 m/s B) 1040 m/s C) 520 m/s D) 130 m/s

21) A stretched string is observed to have four equal segments in a standing wave driven at a frequency of 480 Hz. What driving frequency will set up a standing wave with five equal segments?
A) 600 Hz B) 240 Hz C) 360 Hz D) 120 Hz

22) Seven seconds after a brilliant flash of lightning, thunder shakes the house. Approximately how far was the lightning strike from the house?
A) much closer than one kilometer
B) much farther away than two kilometers
C) about one kilometer away
D) about two kilometers away

23) Suppose that a sound source is emitting waves uniformly in all directions. If you move to a point twice as far away from the source, the frequency of the sound will be
A) twice as great.
B) half as great.
C) one–fourth as great.
D) unchanged.

24) A pipe of length L closed at one end is resonating at its fundamental frequency. Which statement is correct?
A) The wavelength is 2L and there is a displacement node at the pipe's open end.
B) The wavelength is L and there is a displacement antinode at the pipe's open end.
C) The wavelength is 4L and there is a displacement antinode at the pipe's open end.
D) The wavelength is 4L and there is a displacement node at the pipe's open end.
E) The wavelength is 2L and there is a displacement antinode at the pipe's open end.

25) What characteristics of a sound wave are related to the "pitch" of a musical note?
A) frequency B) wavelength C) amplitude D) period

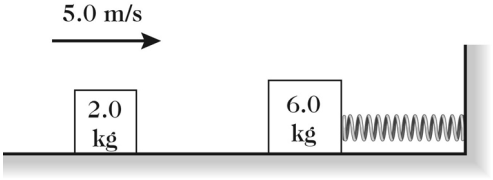
26) If a string fixed at both ends resonates in its fundamental mode with a frequency of 150 Hz, at which of the following frequencies will it *not* resonate? (There could be more than one correct choice.)
A) 500 Hz B) 300 Hz C) 450 Hz D) 75 Hz E) 600 Hz

27) If we double the frequency of a system undergoing simple harmonic motion, which of the following statements about that system are true? (There could be more than one correct choice.)
A) The period is doubled.
B) The period is reduced to one–half of what it was.
C) The amplitude is doubled.
D) The angular frequency is reduced to one–half of what it was.
E) The angular frequency is doubled.

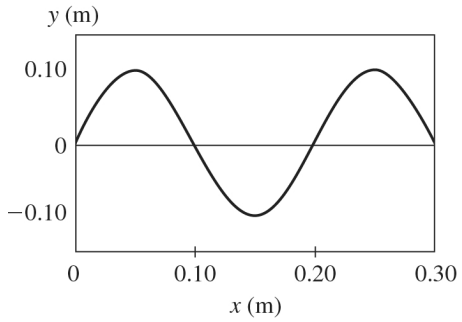
28) A mass on a spring undergoes SHM. When the mass passes through the equilibrium position, which of the following statements about it are true? (There could be more than one correct choice.)
A) Its acceleration is zero.
B) Its speed is zero.
C) Its total mechanical energy is zero.
D) Its elastic potential energy is zero.
E) Its kinetic energy is a maximum.

Free Response Questions

29) A 2.0 kg box is traveling at 5.0 m/s on a smooth horizontal surface when it collides with and sticks to a stationary 6.0 kg box. The larger box is attached to an ideal spring of force constant (spring constant) 150 N/m, as shown in the figure. Find (a) the amplitude of the resulting oscillations of this system, (b) the frequency of the oscillations and (c) the period of the oscillations.



30) The figure shows a "snapshot" of a wave at a given instant of time. The frequency of this wave is 120 Hz. What are the (a) amplitude, (b) wavelength, and (c) speed of this wave?



Answer Key
Testname: WAVES AND SHM PRACTICE TEST

1) C
2) E
3) E
4) E
5) B
6) C
7) A
8) B
9) D
10) D
11) A
12) C
13) B
14) D
15) C
16) E
17) A
18) E
19) D
20) C
21) A
22) D
23) D
24) C
25) A
26) A, D
27) B, E
28) A, D, E
29) (a) 0.29 m, (b) 0.69 Hz, (c) 1.5 s
30) (a) 0.10 m (b) 0.20 m (c) 24 m/s