

CPS lesson
Oscillations and Waves
ANSWER KEY

1.

An object can oscillate around:

- A. any equilibrium point
- * B. any stable equilibrium point
- C. certain stable equilibrium points
- D. any point

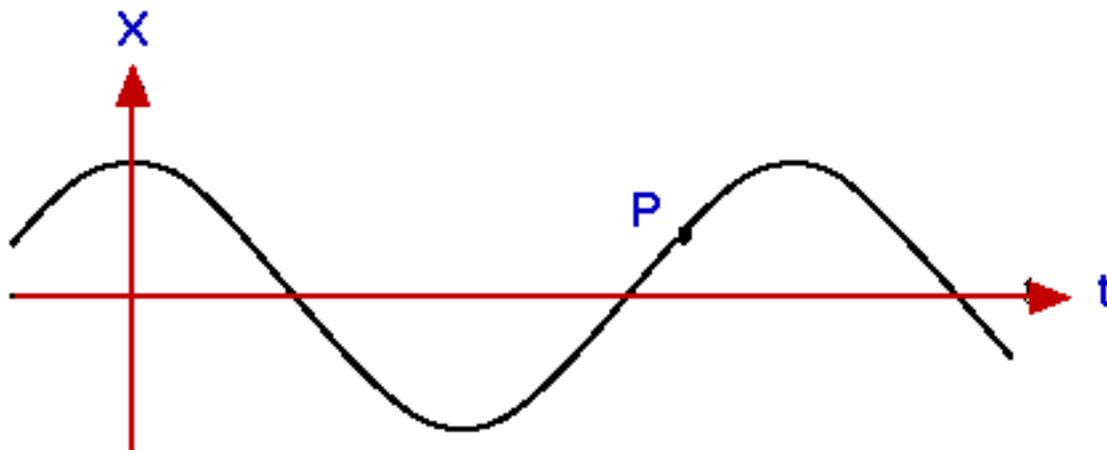
2.

Which of the following is necessary for an object to oscillate?

- A. stable equilibrium
- B. small or no friction
- C. a disturbance
- * D. all of the above

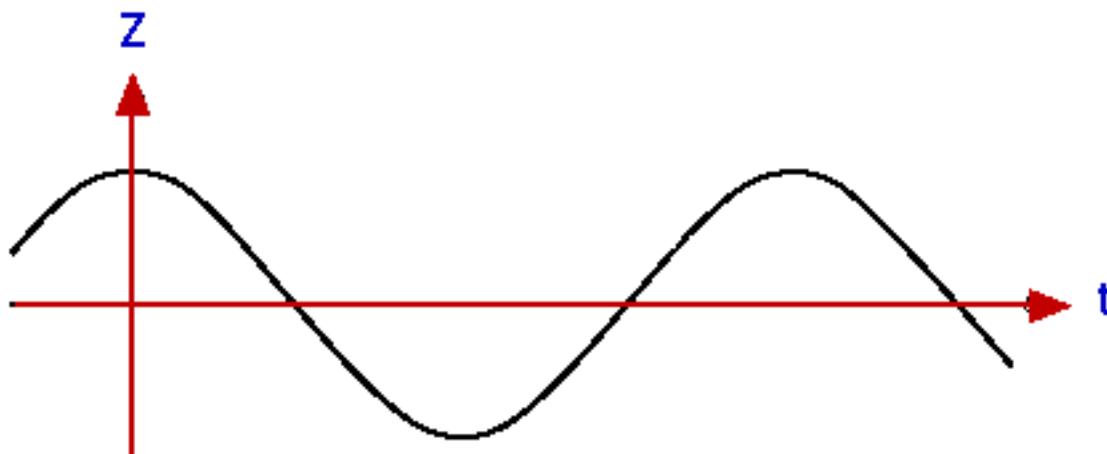
3.

At point P the object has:



- A. positive velocity and positive acceleration
- * B. positive velocity and negative acceleration
- C. negative velocity and positive acceleration
- D. negative velocity and negative acceleration
- E. positive velocity and zero acceleration

4. A mass is oscillating on a spring. Consider two possibilities:
 (i) at some point the velocity is zero but the acceleration is nonzero
 (ii) at some point both the velocity and acceleration are zero



- A. both occur

B. neither occurs

* C. only (i) occurs

D. only (ii) occurs

5.

An object hangs at rest from a spring. If the object is now pulled down, the sum of the elastic potential energy of the spring and the gravitational potential energy of the object

* A. increases

B. remains constant

C. decreases

6.

A person rides on a swing without pumping. When two people ride on it without pumping, the frequency of swinging:

A. increases

* B. remains the same

C. decreases

7.

A person sits on a swing without pumping. If instead the person stands on the swing without pumping, the frequency of swinging:

* A. increases

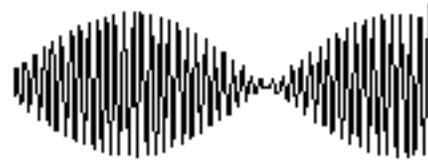
B. remains the same

C. decreases

8. The traces below show beats when two different pairs of waves are added. For which pair is the difference in frequency of the added waves larger?



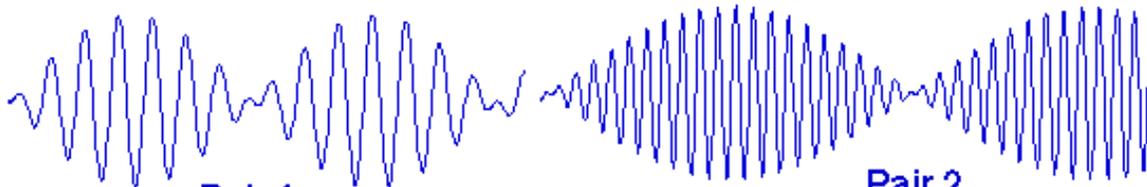
Pair 1



Pair 2

- * A. pair 1
- B. pair 2
- C. same for both
- D. need more info

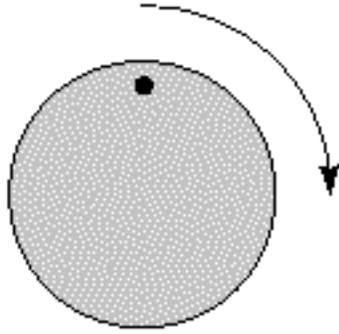
9. The traces below show beats when two different pairs of waves are added. Which of the two pairs originally contains a wave with the highest frequency?



- A. pair 1
- * B. pair 2
- C. both the same
- D. need more info

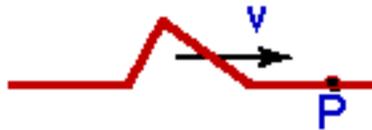
10.

The disk rotates at 29 rev/sec and is filmed with a camera taking 30 frames/sec. The dot on the film appears to:

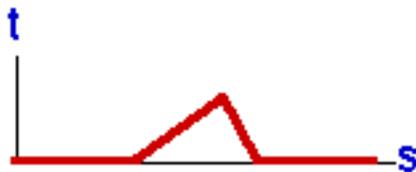


- A. slowly rotate clockwise
- * B. slowly rotate counter-clockwise
- C. rapidly rotate clockwise
- D. rapidly rotate counter-clockwise
- E. jump around randomly

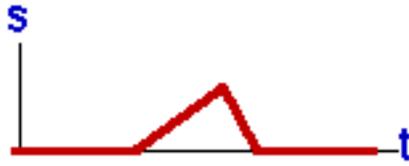
11. A pulse moves with uniform speed v on a rope. Which shows the displacement vs time of P?



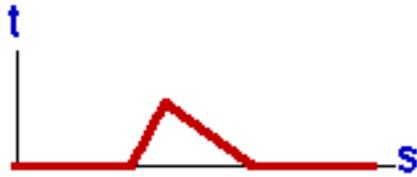
A.



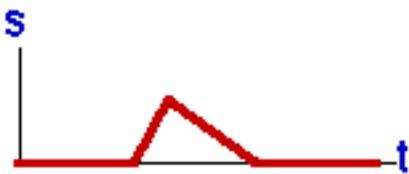
* B.



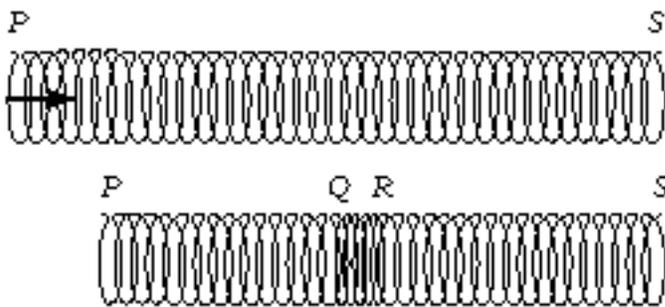
C.



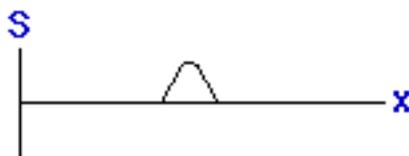
D.



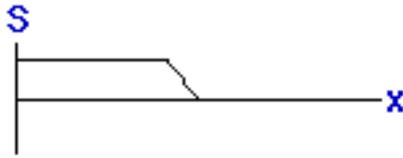
12. One end of a slinky is moved right (positive x) and kept there. The pulse has made it to QR. Which graph plots displacement of the links?



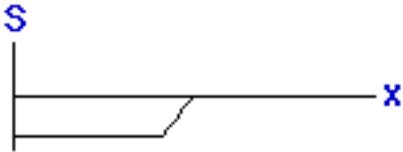
A.



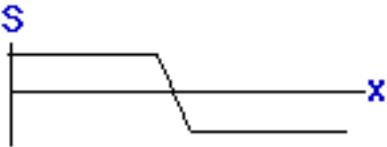
* B.



C.



D.



13. A thick and thin string are connected end-to-end. A wave travels along it. What changes when the wave crosses the connection point?

- A. frequency
- B. period
- C. wave speed
- * D. exactly two of the above
- E. all three of the above

14. A traveling pulse on a string carries:

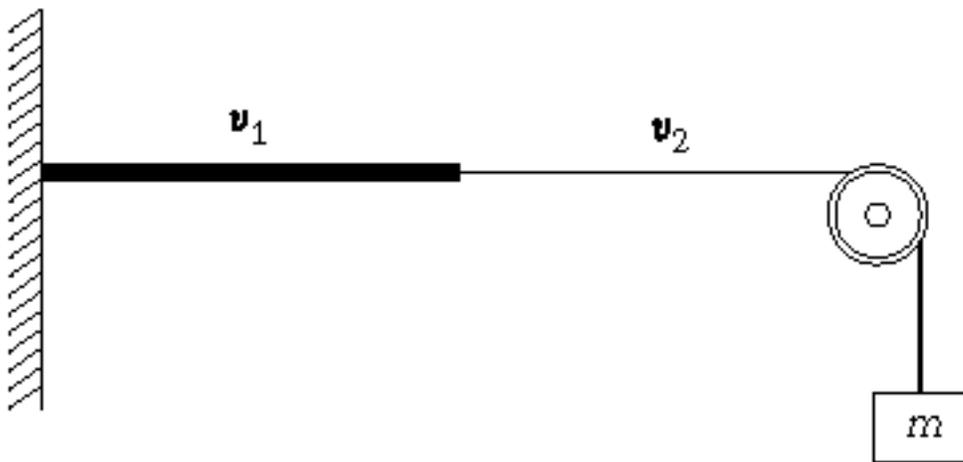
- A. energy

B. momentum

* C. both energy and momentum

D. neither energy nor momentum

15. Two joined strings are made of the same material but the first has 4 times the diameter of the second. What is the ratio of the speeds v_1/v_2 of a pulse traveling from one to the other?



A. 1

B. $1/2$

* C. $1/4$

D. $1/16$

16. Two pulses of equal and opposite maximal displacement cross each other. Which of the following statements is true in the region of the overlapping pulses?

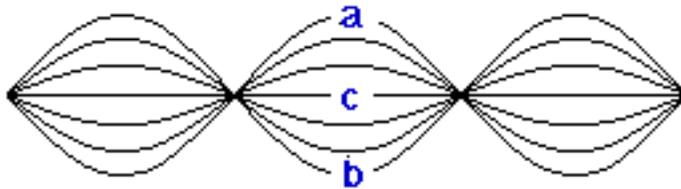
A. There is an instant at which the string is straight.

B. There is an instant at which the energy is zero.

- C. There are one or more points instantaneously at rest.
- * D. Exactly two of the above statements are true.
- E. All three of the above statements are true.

17.

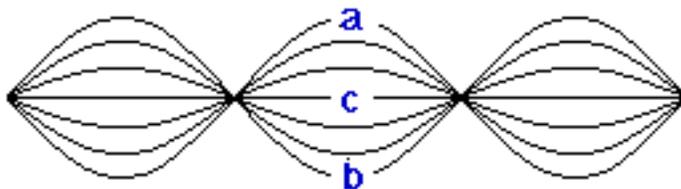
A string clamped at its ends vibrates in a standing mode. In position c, the instantaneous velocity of points along the string is:



- A. zero everywhere
- B. upward everywhere
- C. downward everywhere
- * D. some points are zero, some upward, some downward

18.

A string clamped at its ends vibrates in a standing mode. In position b, the instantaneous velocity of points along the string is:



- * A. zero everywhere
- B. upward everywhere
- C. downward everywhere

D. some points are zero, some upward, some downward

19.

A simple harmonic oscillator has a position given by $15\cos(6t+9)$ in appropriate units. The angular frequency is:

A. 15

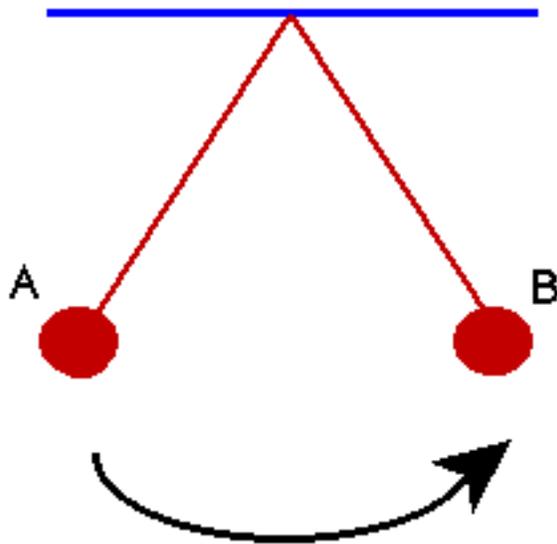
* B. 6

C. 9

D. 12p

20.

If it takes 6 seconds for the bob to get from A to B, the period of the pendulum is:



A. 3 s

B. 6 s

* C. 12 s

D. 12p s

21.

Hooke's law states that the restoring force is always opposite in direction to the object's displacement.

* A.

True

B.

False

22.

A pendulum only exhibits simple harmonic motion for small angular displacements.

* A.

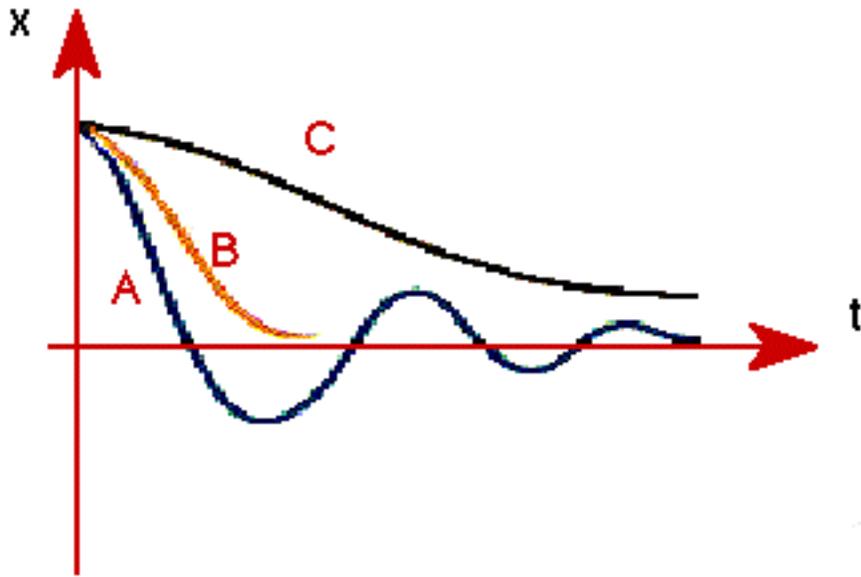
True

B.

False

23.

Which is the best plot of overdamping?



- A.
- A
- B.
- B
- * C.
- C

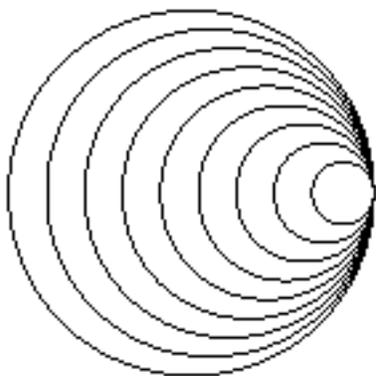
24. An oscillator has a natural frequency of 15 Hz. If this oscillator were driven, how would the amplitude at a driving frequency of 17 Hz compare to the amplitude at 16 Hz?

- A. it would be bigger
- B. the same
- * C. smaller

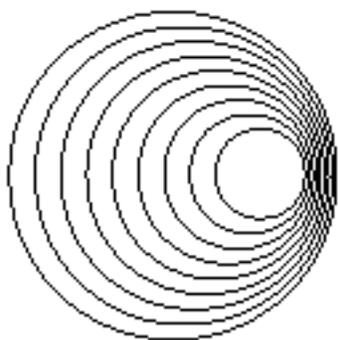
25.

Which figure represents a source moving at less than mach 1?

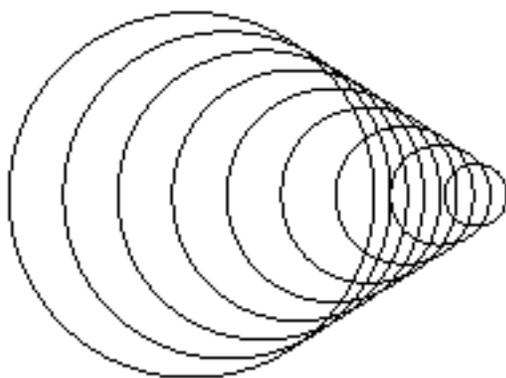
A.



* B.

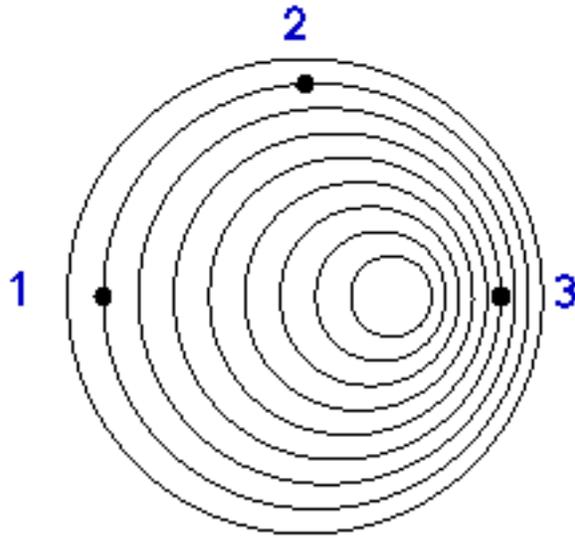


C.



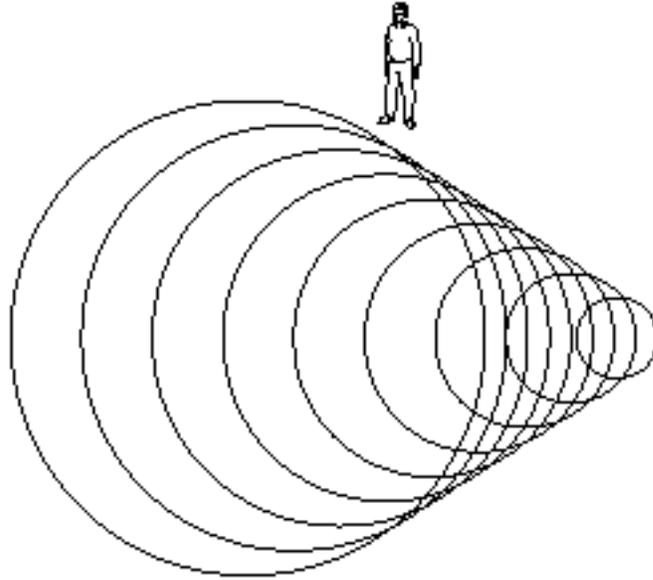
26.
Three people at 1, 2, and 3 are listening to a sound wave emitted by a moving source.

Which of the following statements is true?



- A. the wavefronts move fastest at 1
- B. the wavefronts move fastest at 3
- C. the frequency is highest at 1
- D. the frequency is highest at 2
- * E. the frequency is highest at 3

27.
An airplane is flying past a person at greater than mach 1. The person hears:



- A. a sonic boom at the instant the plane exceeded mach 1
- B. a succession of sonic booms
- C. an immediate sonic boom followed by silence
- * D. first silence, then a sonic boom, then the engine sounds
- E. nothing, since the airplane was always faster than sound

28.
You blow over the end of a bottle. The ratio of the first overtone frequency to the fundamental is:

- A. 1
- B. 2
- * C. 3
- D. 4
- E. 5

29. You shake the end of a slinky back and forth. It reflects perfectly off the far end which is clamped. The interference between the original and the reflected wave gives:

- A. complete cancellation
- B. a standing wave with the original amplitude
- * C. a standing wave with twice the amplitude
- D. a traveling wave with twice the amplitude

30. A tuning fork is struck and swung in a circle at the end of a string. As the tuning fork approaches you, the frequency heard is higher because:

- A. it is vibrating in a higher energy mode
- * B. the wavefronts are closer together
- C. the speed of sound is increased
- D. the tuning fork is getting louder as it approaches

31.

A 1-m pendulum bob on a string has a period of about 2 s. At what frequencies can the bob be tapped to excite resonances?

- A. 1 Hz
- B. 0.5 Hz
- C. 0.25 Hz
- D. 0.5 and 1 Hz
- * E. 0.25 and 0.5 Hz

32.

Which of the following statements is false?

- A. Electromagnetic radiation is a wave.
- * B. All waves are sinusoidal.
- C. In a transverse wave, the particles move perpendicular to the direction of the wave.
- D. In a longitudinal wave, the particles move parallel to the direction of the wave.

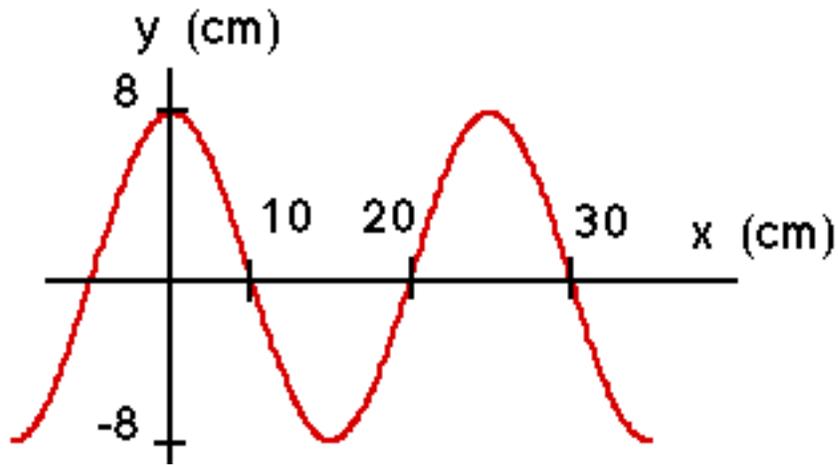
33.

A wavefunction is given by $49\sin(81x-36t+5)$ in appropriate units. The amplitude of this wave is:

- * A. 49
- B. 81
- C. 36
- D. -36
- E. 5

34.

The period of the graphed wave in SI units is:



- A. 0.08
- B. 0.16
- C. 0.1
- D. 0.2
- * E. need more info

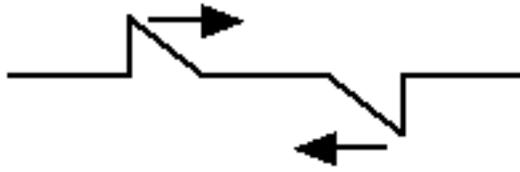
35.

Which of the following statements is false?

- A. The resultant of two waves is found by adding them point by point.
- * B. Two waves interfere in a small region of space. The waves leaving the region are weaker than the waves going in.
- C. The frequency of a wave traveling through different media does not change.
- D. When a pulse reflects off the free end of a string, it does not get inverted.

36.

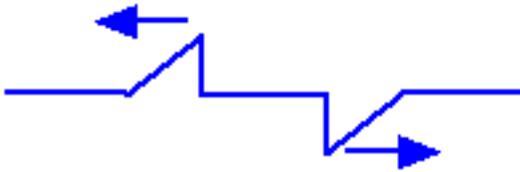
Two pulses travel toward each other. What does the string look like after they have encountered each other?



A.



B.



* C.



37.
If you want to increase the speed of a pulse on a rope, you should tighten up the rope.

* A.
True

B.
False

38.
Sound waves in a fluid are not:

A. longitudinal

- * B. transverse
- C. pressure oscillations
- D. displacement oscillations

39.
There is no Doppler effect for waves other than sound.

True A.

False * B.

40.
Which of the following statements is true?

A. You only get a Doppler effect if the source and observer are moving relative to each other.

B. If the source and observer are getting closer to one another, the observed frequency increases.

C. The wave speed does not affect the Doppler shift.

* D. More than one statement is true.

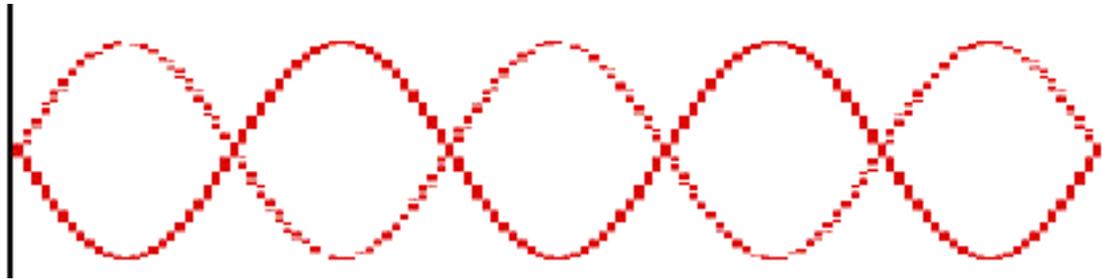
41.
Is there a wave speed associated with a standing wave?

No A.

Yes * B.

42.

How many nodes does this standing wave have?



A. three

B. four

C. five

* D. six

43.

The fundamental mode has the largest wavelength.

* A.

True

B.

False

44.

The first overtone of an organ pipe open at one end is sounded. How many nodes does it have?

A. zero

B. one

* C. two

45.

You can hear a beat from:

A. an A and a C tuning fork

* B. two organ pipes of slightly different lengths

C. two waves on the same guitar string

D. a flute and organ pipe

46.

A pipe open at one end has odd harmonics only.

* A.

True

B.

False

47. An oscillator excites a standing wave on a string. A 6-kg hanging mass sets the tension. The frequency of the oscillator is doubled. To achieve the same wavelength as before, the hanging mass must be:

* A. quadrupled

B. doubled

C. left unaltered

D. halved

E. quartered

48.

A tuning fork sounds middle C in air. If I filled this room with helium gas and struck the fork, it would sound:

A. higher in frequency

* B. the same tone

C. lower in frequency

49. Two waves of the same amplitude A interfere. The resultant also has amplitude A . This occurs if the phase difference between the waves is:

A. between 0 and $\pi/2$

B. exactly $\pi/2$

* C. between $\pi/2$ and π

D. It is impossible to add two waves and get a resultant whose shape is identical to one of the waves alone.

50. A car driving toward a cliff at one-tenth the speed of sound blows its horn. Approximately what frequency does the driver hear the echo make?

* A. 20% higher than the normal horn sound

B. 10% higher than normal

C. just the usual horn sound

D. 10% lower in frequency

E. 20% lower

51.

Two friends standing still on a sidewalk are talking to each other on a windy day. Will they hear a Doppler shift of each other's voices due to the motion of the medium?

A. Yes

* B. No

C. It depends on which way the wind is blowing.

END ANSWER KEY