Review Class

Chapter 16
Waves - I

16-1 What is Physics?
16-2 Types of Waves
16-3 Transverse and Longitudinal Waves
16-4 Wavelength and Frequency
16-5 The Speed of a Traveling Wave
16-6 Wave Speed on a Stretched String
16-7 Energy and Power of a Traveling String Wave
16-9 The Principle of Superposition for Waves
16-10 Interference of Waves
16-12 Standing Waves
16-13 Standing Waves and Resonance

16-4 Wavelength and Frequency
M1-061

A particle of a string moves up and down as a traveling sinusoidal wave passes through it. If the time for that particle to move from maximum displacement to zero displacement is 0.2 s, what is the frequency of the wave?

A) 5.50 Hz
B) 2.00 Hz
C) 3.25 Hz
D) 4.00 Hz
E) 1.25 Hz

Answer E

16-5 The Speed of a Traveling Wave
M1-042

A transverse sinusoidal wave of frequency 100 Hz is traveling along a stretched string with a speed of 20.0 m/s. What is the shortest distance between a crest and a point of zero transverse acceleration?

A) 0.05 m.
B) 0.20 m.
C) 0.10 m.
D) 1.20 m.
E) 0.15 m.

Answer A

16-5 The Speed of a Traveling Wave
M1-072

The equation of a transverse sinusoidal wave traveling along a stretched string is: y (x,t) = 0.035 sin (0.020x + 4.0t) ,where x and y are in meters and t is in seconds. What is the transverse speed of the particle at *x* = 0.035 m when t = 0.26 s?

A) 7.1 cm/s
B) 14 cm/s
C) 200 cm/s
D) -14 cm/s
E) 1.8 cm/s.

Answer A

16-5 The Speed of a Traveling Wave
M1-041

Figure 1 shows the snap shot of part of a transverse wave traveling along a string. Which statement about the motion of elements of the string is correct? For the element at

A) P, its speed is a maximum.
B) S, the magnitude of its acceleration is zero.
C) S, the magnitude of its acceleration is a maximum.
D) Q, its speed is zero.
E) Q, its displacement is a maximum.

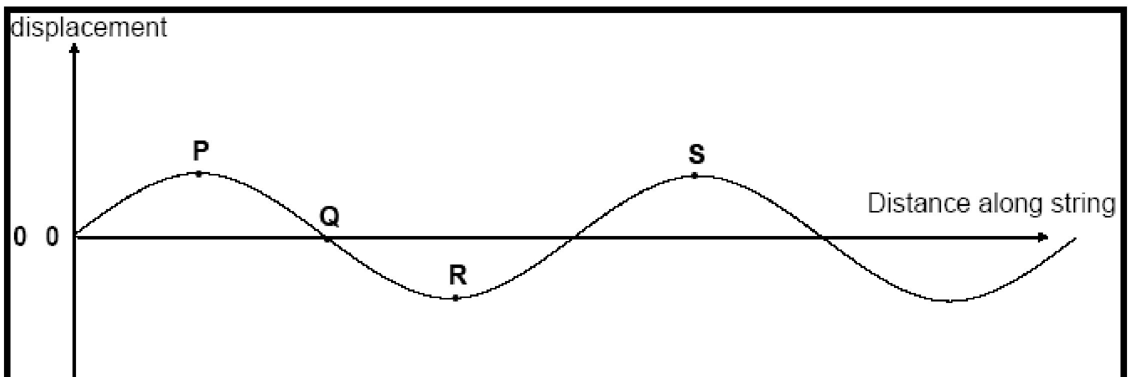


Figure 1

Answer C

16-5 The Speed of a Traveling Wave
M1-041

A wave in a string, is given by the equation:
$y(x,t) = 0.24*\sin(3.0*x-24*t)$,
where x and y are in meters and t is in seconds. Calculate the magnitude of the transverse speed at x = 2.0 m and t = 1.0 s.

A) 1.8 m/s.
B) 3.8 m/s.
C) 5.5 m/s.
D) 8.0 m/s.
E) 2.1 m/s.

Answer B

16-6 Wave Speed on a Stretched String
M1-062

A uniform wire, having a mass of 0.4 kg and length of 6.5 m, is connected to a pulse generator. The tension is maintained in the wire by suspending a 3.5 kg mass on the other end. Find the time it takes a pulse to travel from a pulse generator to the other end.

A) 0.28 s
B) 0.35 s
C) 0.40 s
D) 0.15 s
E) 2.00 s

Answer A

16-7 Energy and Power of a Traveling String Wave
M1-072

A stretched string is 2.70 m long, has a mass of 0.260 kg, and is under a tension of 36.0 N. A wave of amplitude 8.50 mm is traveling on this string. What must be the frequency of the wave for the average power to be 85.0 W?

A) 795 Hz
B) 1120 Hz
C) 179 Hz
D) 127 Hz
E) 193 Hz

Answer C

16-10 Interference of Waves
M1-062

Two identical traveling waves, with a phase difference ϕ, are moving in the same direction. If they are interfering and the combined wave has an amplitude 0.5 times that of the common amplitude of the two waves, calculate ϕ (in radians).

A) 1.30
B) 3.50
C) 0.75
D) 2.64
E) 0.13

Answer D

16-10 Interference of Waves
M1-062

When a wave travels through a medium, individual particles execute a periodic motion given by the equation:

$$y = 4.0 \sin[\frac{\pi}{4}(2t + \frac{x}{8})]$$

where y and x are in meters and t is in seconds. The phase difference at any given instant between two particles that are 20.0 m apart is:

A) 65.6°
B) 112.5°
C) 130°
D) 134.2°
E) 224°

Answer B

16-10 Interference of Waves
M1-042

A transverse sinusoidal wave is traveling on a string with a speed of 300 m/s. If the wave has a frequency of 100 Hz, what is the phase difference between two particles on the string that are 85 cm apart?

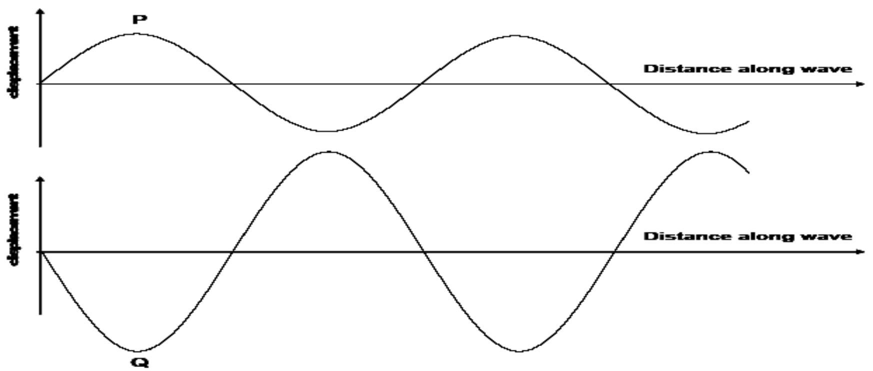
A) 1.8 radians.
B) 3.4 radians.
C) 0.6 radians.
D) 5.6 radians.
E) 4.1 radians.

Answer A

16-10 Interference of Waves
M1-042

Figure 2 shows the displacements at the same instant for two waves, P and Q, of equal frequency and having amplitude Y and 2*Y, respectively. If the two waves move along the positive x-direction, what is the amplitude of the resultant wave, and the phase difference between the resultant wave and the wave P?

A) Resultant amplitude is 2*Y, and the phase difference is zero.
B) Resultant amplitude is 2*Y, and the phase difference is Pi.
C) Resultant amplitude is 3*Y, and the phase difference is Pi.
D) Resultant amplitude is Y, and the phase difference is zero.
E) Resultant amplitude is Y, and the phase difference is Pi.



The waves are superimposed to give a resultant wave.

Figure 2

Answer E

16-12 Standing Waves
M1-062

A string, fixed at its ends, vibrates according to the equation

$$y = 0.5 \sin(1.5 \pi x) \cos(40 \pi t)$$

where x and y are in meters and t is in seconds. What are the amplitude and velocity of the component waves whose superposition can give rise to this wave?

A) 0.25 m, 52.3 m/s
B) 0.50 m, 26.7 m/s
C) 0.25 m, 26.7 m/s
D) 0.50 m, 52.3 m/s
E) 0.15 m, 100 m/s

Answer C

16-13 Standing Waves and Resonance
M1-062

A string is fixed at both ends. On increasing the tension in the string by 2.5 N, the fundamental frequency is altered in the ratio of 3 : 2. The original stretching force is:

A) 3 N
B) 4 N
C) 2 N
D) 5 N
E) 6 N

Answer C

16-13 Standing Waves and Resonance
M1-061

A vibrator having a frequency of 200 Hz generates a standing wave of six loops with amplitude 2.0 x 10^{-3} m of in a string clamped at both side. If the speed of the wave on the string is 100 m/s, what is the length of the string?

A) 1.25 m
B) 3.5 m
C) 0.75 m
D) 1.5 m
E) 2.0 m

Answer D

16-13 Standing Waves and Resonance
M1-061

For the superposition of the following two harmonic waves:

$$y_1 = (4.0 \text{ m}) \sin(2\pi x - 4\pi t)$$
$$y_2 = (4.0 \text{ m}) \sin(2\pi x + 4\pi t)$$

where x is in meter and t is in second, the distance between any two successive nodes will be:

A) 0.50 m
B) 0.25 m
C) 0.75 m
D) 1.30 m
E) 0.13 m

Answer A

16-13 Standing Waves and Resonance
M1-061

A string of length 50.0 m and mass of 25.0 grams is under tension of 75.0 N. An electric vibrator operating at 40.0 Hz is generating a harmonic wave in the string. The average power the vibrator can supply to the string is 500 W. What is the amplitude of the wave?

A) 0.20 m
B) 0.31 m
C) 2.70 m
D) 1.85 m
E) 0.29 m

Answer E

16-13 Standing Waves and Resonance
M1-042

A 50 cm long string with a mass of 0.01 kg is stretched with a tension of 18 N between two fixed supports. What is the resonant frequency of the longest wavelength on this string?

A) 30 Hz.
B) 150 Hz.
C) 50 Hz.
D) 312 Hz.
E) 9.8 Hz.

Answer A