PHYSICS

BOOKS - RESNICK AND HALLIDAY PHYSICS (HINGLISH)

WAVES-I

Sample Problem

1. A transverse wave traveling along an x axis has the form given by $y = y_m \sin(kx \pm \omega t + \phi)$.

Figure 16-10a gives the displacements of string elements as a function fo x, all at time t=0. Figure. 16-10b gives the displacements of the elements at x=0 as a function of t. Find the values of the quantities shown in Eq. 16-20. including the corret choice of sign.

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2. A wave traveling along a string is described by

y(x,t)=(0.00327 m) sin(72.1x - 2.721). (16-21) in which the numerical constants are in SI units (72.1 rad/m and 2.72 rad/s)

(a) What is the velocity of this wave?

(b) What is the displacement y at x= 22.5 cm and t=18.9s?

(c) What is the transverse velocity u of the string element at x =22.5 cm at time t= 18.9s? (This velocity, which is associated with the transverse oscillation of a string elenient, is parallel to the y axis. Do not confuse it with the constant velocity at which the wave form moves along the x axis.)

(d) What is the transverse acceleration of our string element at 18.9 3?

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3. In Fig. 16-13, two strings have been tied together with a knot and then stretched between two rigid supports. The strings have linear densities $\mu_1 = 1.4 \times 10^{-4}$ kg/m and $\mu_2 = 2.8. \times 10^{-4}$kg/m. Their lengths are $L_1 = 3.0m$ and $L_2 = 2.0m,$ and string 1 is under a tension of 400 N. Simultaneously, on each string a pulse is sent from the rigid support end, toward the knot. Which pulse reaches the knot first.

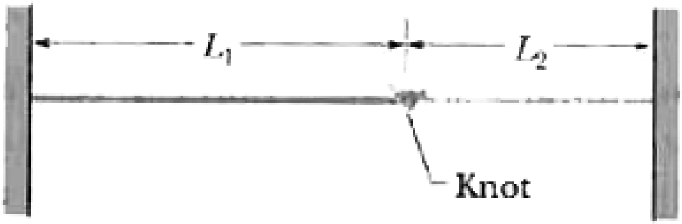

Figure 18-13 Two strings, of lengths L_1 and L_2, tied together with a knot and stretched between two rigid supports.

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4. A string has linear density $\mu = 525g/m$ and is under tension $\tau = 45N$. We send a sinusoidal wave with frequency f=120Hz and amplitude $y_m = 8.5$ mm along the string. At what average rate does the wave transport energy?

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5. Two identical sinusoidal waves, moving in the same direction along a stretched string, interfere with each other. The amplitude y of each wave is 9.8 mm, and the phase difference p between them is 100°.

(a) What is the amplitude y. of the resultant wave due to the interference, and what is the type of this interference?

(b) What phase difference, in radians and wavelengths, will give the resultant wave an amplitude of 4.9 mm?

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6. Two sinusoidal waves with the same amplitude of 4.0mm and the same wavelength traveled together along a string that is stretched along an x axis, the resultant wave due to their interference was recorded on video tape. The curves in Fig. 16-20 represent the resultant wave in two freeze frames, first as the solid curve and then, 1.0 ms later, as the dotted curve. The grid lines along the x axis are 1.0 cm apart, and the string clements oscillated vertically (perpendicular to the x axis) by 6.0 mm as the resultant wave passed through them. That wave moved a distance d =4.20 cm to the right in the 1.0 ms time interval. Write equations for the two interfering waves and for their resultant wave.

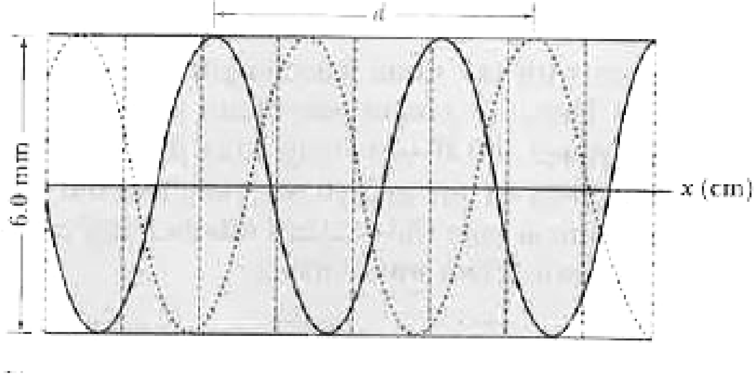

Figure 16-20 The resultant wave of two sinusoidal string wave traveling along an x axis is shown at two instants, between which the resultant wave travels distance d.

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7. A sinusidal wave with amplitude $y_m = 0.5mm$ and wavelength $\lambda = 0.4m$. is travelling on a string with speed v=12 m/s. At t=0 particle at x=0.1 m is located at y=0.25 mm and going down.

(a) Find equation of wave.

(b) Plot the sinusoidal wave at t=0.

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8. Two sinusoidal waves $y_1, (x, t)$ and $y_2(x, t)$ have the same wavelength and travel together in the same direction along a string. Their amplitudes are $y_{m1} =$ 4.0 mm and $y_{m2} = 3.0mm,$ and their phase constants are 0 and $\pi/3$ rad, respectively. What are the amplitude $y_m{}'$, and phase constant of the resultant wave? Write the resultant wave in the form of Eq. 16-63.

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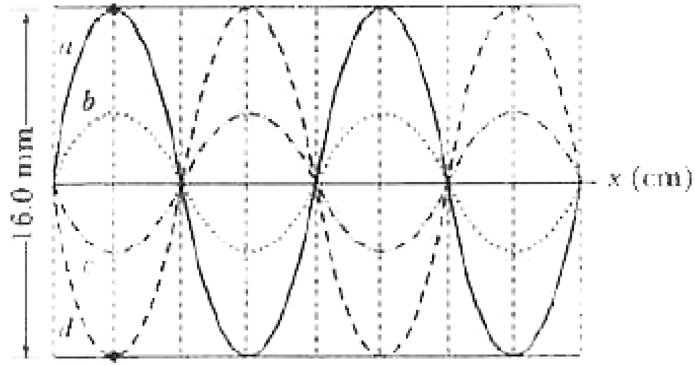
9. Two sinusoidal waves with the same amplitude and wavelength travel along a string that is stretched along an x axis, the resultant wave due to their superposition was recorded on video tape. The curves in Fig. 16-31 represent the resultant wave in four freeze frames in the sequence of a, b, c, and d, with 1.0 ms elapsing between curves a and d. The grid lines along the x axis are 1.0 cm apart, and the string elements oscillated perpendicular to the r axis by 16.0 mm (between the extreme displacements shown by curves a and d) as the resultant wave passed through them. Write equations for the two superposition waves and for their resultant wave.



The resultant wave of two sinusoidal string waves traveling along an x axis is shown at four instants (a, b, c, and d).

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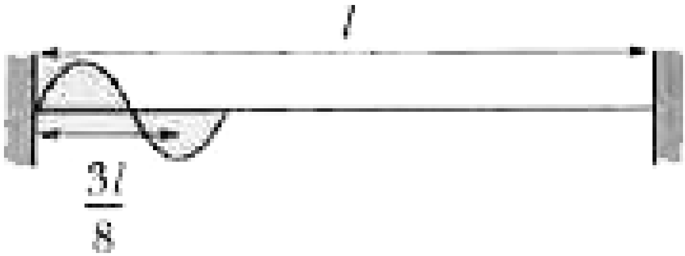
10. Consider a strong connected At both ends with rigid wall (Fig. 16-36).

Find the second longest resonance wave length for which 3/8 is an antinode.



A string connected at both ends with rigid wall.

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11. Figure 16-37 shows resonane oscillation of a string of mass m=2.500 g and lengt L= 0.800 m and that is under tension $\tau = 325.0 N$. What is the wavelength λ of the transverse waves producing the standing wave patient and what is the charmant number. What is the frequency of the transverst waves and of the osciallation of the moving string elements? What is the maximum magnitude of the transverse velocity u_m of the element oscillating a coordinate x =0.180 m? At what point during the element's oscillation is the transverse velocity maximum?

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Checkpoint

1. The figure is a composite of three snapshots, each of a wave traveling along a particular string. The phases for the waves are given by (a) 2x-4t, (b) 4x-8t, and (c) 8x-16t. Which phase corresponds to which wave in the

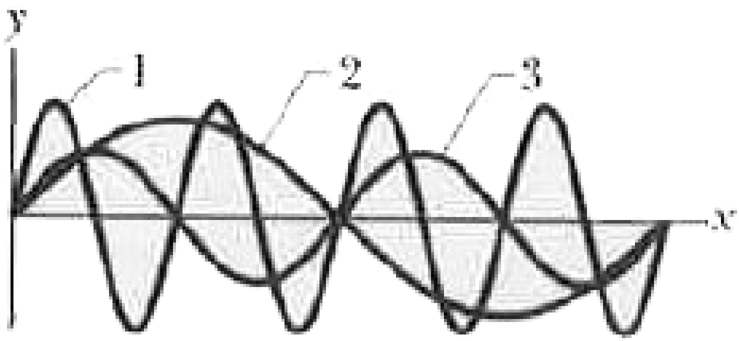

figure.

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2. Here are the equations of three waves:

(1) (y) (x,t) =2 sin (4x-2t), (2). (y)(x,t) =sin (3x-4t), (3) (y) (x,t)=2 sin (3x-3t).

Rank the waves according to their (a) wave speed and (b) maximum speed perpendicular to the wave's direction of travel (the transverse speed), greatest first.

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3. You send a travelling wave along a particular string by oscillation one end. If you increase the freuency of the oscillation, do (a) the speed of the wave and (b) the wavelength of the wire increase, decrease, or remain the same? If, instead, you increase the tension in the string, do (c) the speed of the wave and (d) the wavelength of the wave increase, decrease, or remain the same?

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4. Here are four possible phase difference between two identical waves, expressed in wavelengths 0.20, 0.45, 0.60, and 0.80. Rank them according to the amplitude of the resultant wave, greatest first.

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5. Find the particles closet to x=0.1 having same velocity as a particle at x=0.1 at t=0.

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6. At what time after t=0, x=0.2m will be at y =0.25nm and going up for the first time.

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7. Two waves with the same amplitude and wavelength interface in three different situation to produce resultant waves with the following equations:

(1) y' (x,t) =4 sin (5x-4t)

(2) y' (x,t) =4 sin (5x) cos (4t)

(3) y' (x,t) =4 sin (5x+4t)

In which stituation are the two combing waves traveling (a) toward positive x, (b) toward negative x, and (c) in opposite directions?

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8. In the following series of resonant frequenies, one frequency (lower than 400 Hz) is missing. 150, 225, 300, 375Hz, (a) What is the missing frequency? (b) What is the frequency of the seventh harmonic?

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Problems

1. A stretched string has a mass per unit length of 5.00 g/cm and a tension of 10.0 N A sinusoidal wave on this string has an amplitude of 0.16 mm and a frequency of 100 Hz and is traveling in the negative direction of an x axis. If the wave equation is of the form y(x,t)= $y_m \sin(kx \pm \omega t)$, what are (a) y_m (b) k. (c) ω, and (d) the correct choice of sign in front of ω?

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2. The heaviest and lightest strings on a certain violin have linear densities of 3.2 and 0.26 g/m. What is the ratio of the diameter of the heaviest string to that of the lightest string, assuming that the strings are of the same material?

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3. A string fixed at both ends is 7.50 m long and has a mass of 0.120 kg. It is subjected to a tension of 96.0 N and set oscillating (a) What is the speed of the waves on the string? (b) What is thc longest possible wavelength for a standing wave? (c) Give the frequency of that wave.

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4. The equation of a transverse wave on a string is $y = (2.0mm)\sin\left[\left(15m^{-1}\right]x - \left(900s^{-1}\right)t\right]$. The linear density is 4.17 g/m. (a) What is the wave speed? (b) What is the tension in the string?

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5. Two waves are generated on a string of length 4.0 m to produce a three-loop standing wave with an amplitude of 1.0 cm.The wave speed is 100 m/s. Let the equation for one of the waves be of the form $y(x, t) = y_m \sin(kx + \omega t)$. In the equation for the other wave, what are (a) y_m (b) k, (c) ω and (d) the sign in front of w!

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6. What phase difference between two identical traveling waves, moving in the same direction ulung a stretched string, results in the combined wave having an amplitude 0.852 times that of the common amplitude of the two combining waves! Express your answer in (a) degrees (b) radiants, and (c) wavelengths

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7. A 100 g wire is held under a tension of 220 N with one end at x=0 and the other x=10.0m. At time t=0 pulse 2 is sent along the wire from the end at x=0. What position x do the pulses begin to meet?

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8. String A is streched between two clamps separated by distance L. String B, with the same linear density and under the same tension as string A, is stretched between two clamps separated by distance 3L eight harmonies of string B. For which of these eight har. monics of B (if any) does the frequency match the frequency of (a) A's first harmonic, (b) A's second harmonic, and (C) A sthird hannonic?

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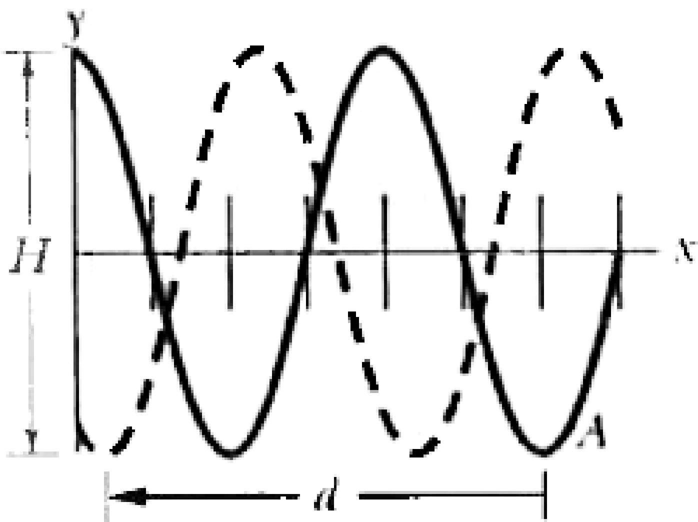
9. Two sinusoidal waves with the same amplitude of 6.00 mm and the same wavelength travel together along a string that is stretched along an x axis. Their resultant wave is shown twice in Fig. 16 39. as velley travels in the negative direction of the x axis by distance d= 56.0 cm in 8.0 ms. The lick matks along the axis are separated by 10cm, and height H is 8.0mm. Let the equation for one wive be of the form y(x,t) $= y_m \sin(kx \pm \omega t + \phi_1)$, where $\phi_1 = 0$ and you must choose the correct sign in front of ω. For the equation for the other wave, what are (a) y_m, $(b) k$, $(c) \omega$, $(d) \phi_2$, and (e) the sign in front of ω?



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10. The tension in a wire clamped at both ends is halved with out appreciably changing the wire length between the clamps. What is the ratio of the new to the old wave speed for transverse waves traveling along this wire?

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11. Two identical traveling waves, moving in the same direction are out of phase by 0.70π rad. What is the amplitude of the resultant wave in terms of the common amplitude of the two combinag waves

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12. A rope, with mass 1.39 kg and fixed at both ends oscillates in a second-harmonic standing wave pattern. The displacement of the rope is given by

$y-(0.10m)(\sin \pi x/2)\sin 12\pi t.$

where x=0 at one end of the rope, x is in meters and t is in seconds. What are (a) the length of the rope, (b) the speed of the waves on the rope, and (c) the tension of the rope? (d) If the rope oscillates in a third-harmonic standing wave pattern, what will be the period of oscillation?

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13. A sinusoidal wave travels along a string. The time for a particular point to move from maximum placement to zero is 0.135s. What are the (a) period and (b) frequency? (c) The wavelength is 1. 40m, what is the wave speed?

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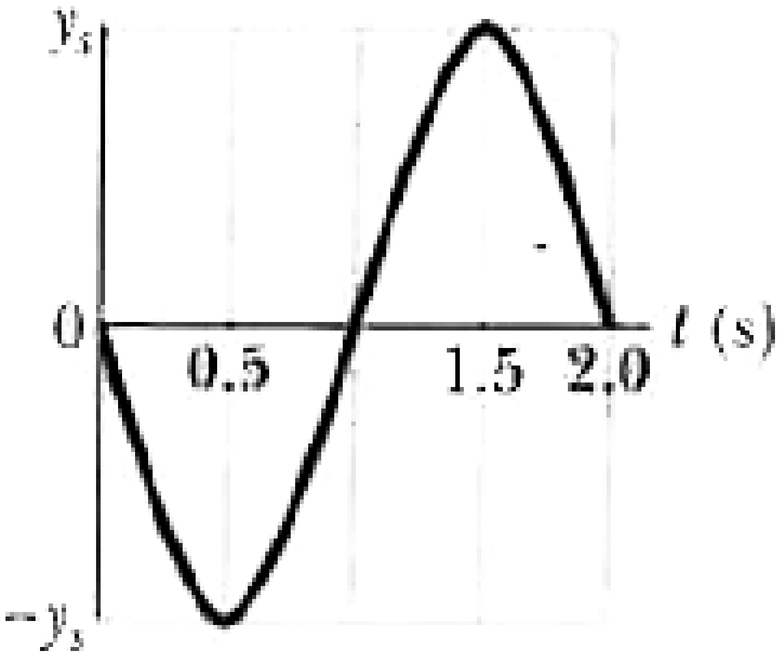
14. For a particular transverse standing wave on a long string, one of the antinodes is at r=0 and an adjacent node is at x=0.10 m. The displacement y(t) of the string particle at x =0 is shown in Fig. 16-40, where the scale of the y axis is set by $y_s = 4.0cm$. When t = 0.50 s, what is the displacement of the string particle at (a) x= 0.20 m and (b) x= 0.30 m? What is the transverse velocity of the string particle at x =0.20 m at (c) t=0.50s and (d) t=1.0s? (e) Sketch the standing wave at t=0.50s for the range x=0 to



x=0.40m.

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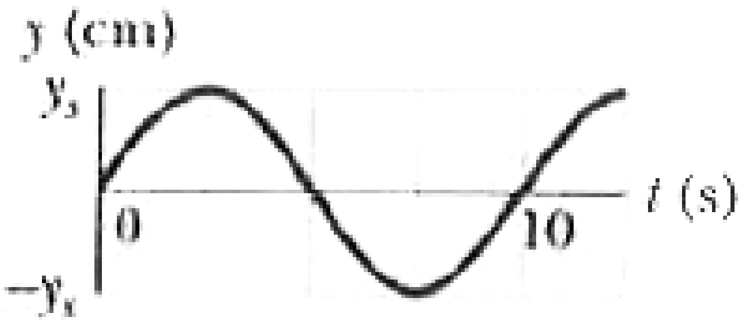
15. A sinusoidal transverse wave of wavelength 18 cm travels along a string in the positive direction of an x axis. The displacement y of the string particle at x= 0) is given in Fig. 16-41 as a function of time t. The scale of the vertical axis is set by $y_1 = 4.0cm,$ The wave equation is to be in the form $y(x,t) = y_{nI}\sin(kx \pm \omega t + \phi)$. (a) At t= 0), is a plot of y versus x in the shape of a positive sine function on a legative sinc function? What are $(b) y_{nI} (c) k$, $(d) \omega (e) \phi$, (f) the sign in front of ω, and (g) the speed of the wave? (h) What is the transverse velocity of the particle at x=0 when t=5.0 s?



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16. Two sinusoidal waves of the same frequency are to be sent in the same direction along a taut string. One wave has an amplitude of 5.50 mm, the other 12.0 mm. (a) What phase difference ϕ_1 between the two waves results in the smallest amplitude of the resultant wave? (b) What is that smallest ! amplitude? (c) What phase difference ϕ_2 results in the largest

amplitude of the resultant wave? (d) What is that largest amplitude? (e) What is the resultant amplitude if the phase angle is $(\phi_1 - \phi_2)/2$?

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17. A nylon guitar string has a linear density of 7.20 g/m and is under a tension of 180 N. The fixed supports are distance D =90.0 cm apart. The string is oscillating in the standing wave pattern shown in Fig. 16-42. Calculate the (a) speed, (b) wavelength, and (c) frequency of the traveling waves whose superposition gives this standing wave.

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18. A sinusoidal wave of angular frequency 1200 rad/s and amplitude 3.00 mm is sent along a cord with linear density 4.00 g/m and tension 1200 N.

(a) What is the average rate at which energy is transported by the wave to the opposite end of the cord? (b) If simultaneously, an identical wave travels along an adjacent identical cord, what is the total average rate at which energy is transported to the opposite ends of the two cords by the waves? IT, instead, those two Waves are sent along the same cuid simultaneously, what is the tolal average rate at which they transport energy when their phase difference is (c) 0, (d) $0.4\pi rad$, and (e) π rad?

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19. A generator at one end of a very long string creates a wave given by $y = (6.0cm)\cos\frac{\pi}{2}\left[\left(2.00m^{-1}\right)x + \left(6.00s^{-1}\right)t\right]$, and a generator at the other end creates the wave

$y = (6.0cm)\cos\frac{\pi}{2}\left[\left(2.00m^{-1}\right)x - \left(6.00s^{-1}\right)t\right]$.

Calculate the (a) frequency, (b) wavelength, and (c) speed of each wave. For $x \geq 0$, what is the location of the node having the (d) smallest, (e) second smallest, and (f) third smallest value of x? For $x \geq$, what is the location of the antinode having the (g) smallest, (h) second smallest, and (i) third smallest value of x?

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20. A string under tension τ_1 oscillates in the third harmonic at frequency f_3, and the waves on the string have wavelength λ_3, If the tension is increased to $\tau_f = 8\tau_i$, and the string is again made to oscillate in the third harmonic, what then are (a) the frequency of oscillation in terms of f_3 and (b) the wavelength of the waves in terms of λ_3 ?

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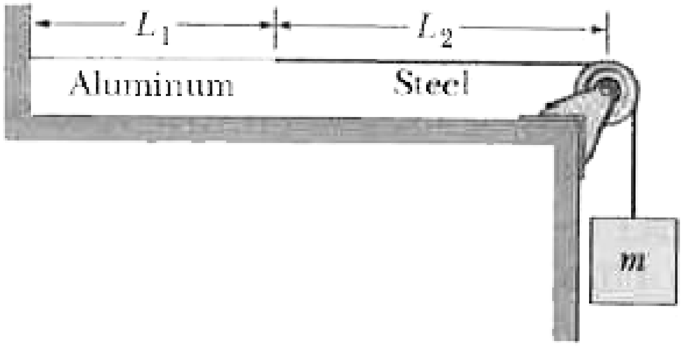
21. In Fig. 16-43, an aluminum wire, of length $L_1 = 60.0cm$, cross-sectional area $1.25 \times 10^{-2} cm^2$ and density 2.60g/cm^3, is joined to a steel wire, of density 7.80 g/cm^3 and the same cross-sectional area. The compound wire, loaded with a block of mass m =10.0 kg, is arranged so that the distance L_2 from the joint to the supporting pulley is 86.6 cm. Transverse waves are set up on the wire by an external source of variable frequency: a node is located at the pulley, (a) Find the lowest frequency that generates a standing wave having the joint as one of the nodes. (b)

How many nodes are observed at this frequency?



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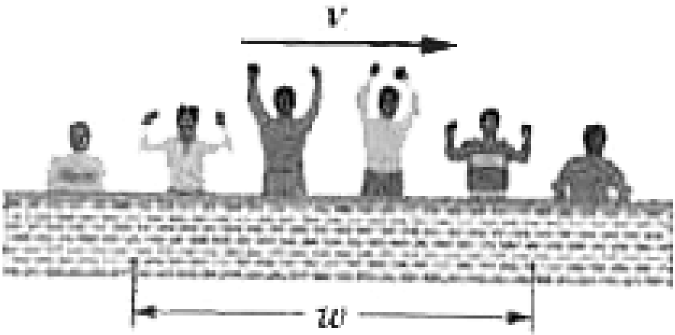
22. A human wave. During sporting events within large, density packed stadiums, spectators will send a wave (or pulse) around the stadium (Fig. 16-44). As the wave reaches a group of spectators, they stand with a cheer and then sit. At any instant, the width w of the wave is the distance froin the leading edge (people are just about to stand) to the trailing edge (people have just sat down). Suppose a human wave fravels a distance of 853 seats around a stadium in 51 s, with spectators requiring about 1.8 s to respond to the wave's passage by stand- ing and then sitting. What are

(a) the wave speed v in seats per second) and (b) width w (in number of



sears)?

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23. The linear density of a string is $1.9 \times 10^{-4}\text{kg/m}$. A transverse wave on the string is described by the equation

$y = (0.021m)\sin\left[\left(2.0m^{-1}\right)x + \left(30s^{-1}\right)t\right]$. What are (a) the wave speed and (b) the tension in the string?

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24. Two sinusoidal waves with identical wavelengths and amplitudes travel in opposite directions along a string with a speed of 15 cm/s. If the time interval between instants when the string is fiat is 0.20 s, what is the wavelength of the waves?

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25. A string that is stretched between fixed supports separated by 75.0 cm has resonant frequencies of 450 and 308 Hz, with no intermediate resonant frequencies. What are (a) the lowest resonant frequency and (b) the wave speed?

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26. If a transmission line in a cold climate collects ice, the increased diameter tends to cause vortex formation in a passing wind. The air pressure variations in the vortexes lend to cause the line to oscillate (gallop), especially if the frequency of the variations matches a resonant frequency of the line. In long lines, the resonant frequencies are so close that almost any wind speed can set up a resonant mode vigorous enough to pull down support towers or cause the line to short on with an adjacent line. If transmission line has a length of 310 m, id linear density of 3.35 kg/mı, and a tension of 90.1 MN, what are the frequency of the fundamentail made and (b) the frequency difference between sucessive modes?

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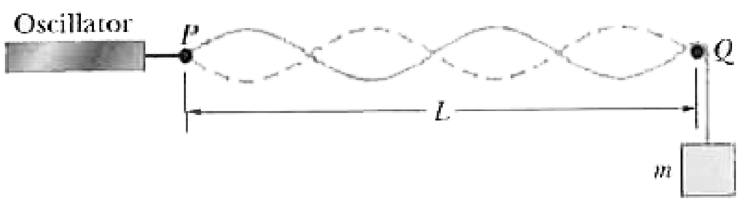
27. In Fig 16-45, a string, tied to a sinusoidal oscillator at P and running over a support at Q, is stretched by a block of mass m, Separation, L=1,20m,l linear density $\mu = 1.20g/m$, and the oscilator frequency f=120Hz. The amplitude of the motion at P is small enough for that point to be considered a node. A node also exists at Q. (a) What mass m allows the osciallator to set up the fourth harmonic on the string? (b) What standing wave mode, if any can be set up if m=1.00kg?



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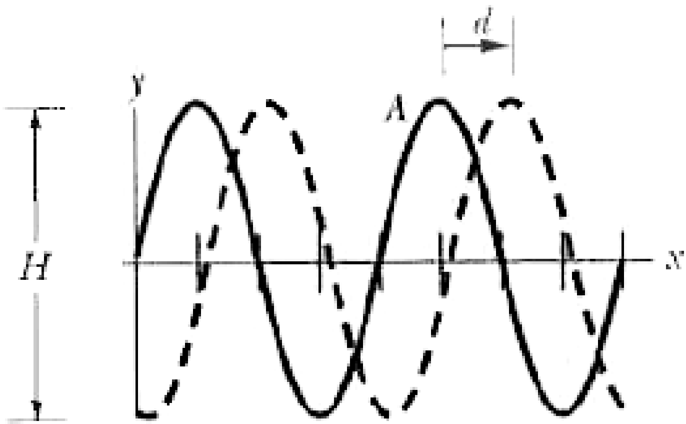
28. In Fig 16-46, a sinusoidal wave moving along a string is shown twice as crest A travels in the positive direction of any x axis by distance d=6.0 cm in 3.0 ms. The tick marks along the axis are separated by 10cm, height H=6.00MM. The equation for the wave is in the form y(x,t) = $y_m \sin(kx \pm \omega t)$. so what are (a) y_m, $(b) k$, $(c) \omega$ and (d) the correct choice of sign in front of ω?



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29. In Fig. 16-45, a string, tied to a sinusoidal oscillator at P and running over a support at Q, is stretched by a block of mass m. The separation L between P and Q is 1.20 m, and the frequency f of the oscillator is fixed at 120 Hz. The amplitude of the motion at P is small enough for that point to be considered a node. A node also exists at Q. A standing wave appears when the mass of the hanging block is 286.1 g or 4470g, but not for any intermediate mass. What is the linear density of the string?

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30. A sinusoidal wave of frequency 500 Hz has a speed of 320 m/s. (a) How far apart are two points that differ in phase by $\pi/3$ rad? (b) What is the phase difference between two displacements at a certain point at times 1.00 ms apart?

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31. Use the wave equation to find the speed of a wave given by $y(x, t) = (3.00mm)\sin\left[\left(3.00m^{-1}\right)x - \left(8.00s^{-1}\right)t\right]$.

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32. A string has mass 200 g. Wave speed 120 m/s, and tension 700N (a)What is its length? (b) What is the lowest resonant frequency of this string?

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33. One of the harmonic frequencies for a particular string under tension is 310 Hz. The next higher harmonic frequency is 400 Hz. What harmonic frequency is next higher after the hannonc frequency 850 Hz?

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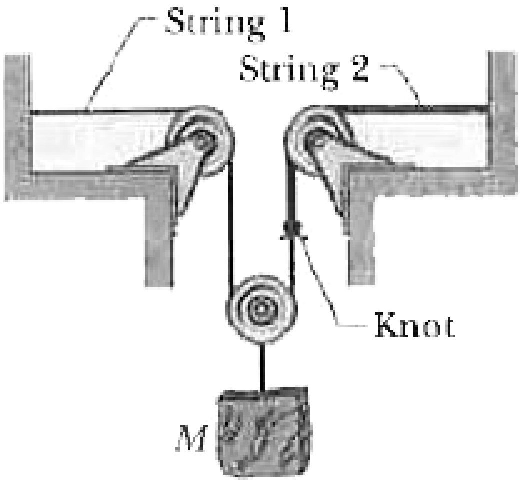
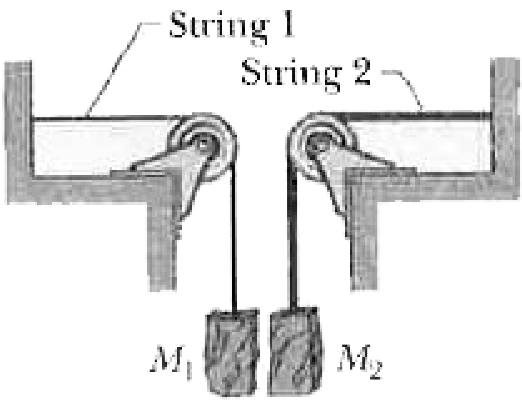
34. In fig. 16-47a, string 1 has a linear density of 3.00 g/m, and string 2 has a linear density of 5.00 g/m. They are under tension due to the hanging block of mass M= 800 g. Calculate the wave speed on (a) string 1 and (b) string 2 (Hint: When a string loops halfway around a pulley, it pulls on the pulley witii a net force that is twice the tension in the string) Next the block is divided into two blocks (with $M_1 + M_2 = M$) and the apparatus in tearranged as shown in fig. 16-47b. Find (c) M_1 and $(d) M_2$ such that the wave speeds in the two strings are equal.



(a)



(b)

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35. Two sinusoidal waves of the same frequency travel in the same direction along a string. If $y_{m1} = 2.0cm$, $y_{m2} = 4.0cm$, $\phi_1 = 0$, and $\phi_2 = \pi / 2rad$, what is the amplitude of the resultant wave?

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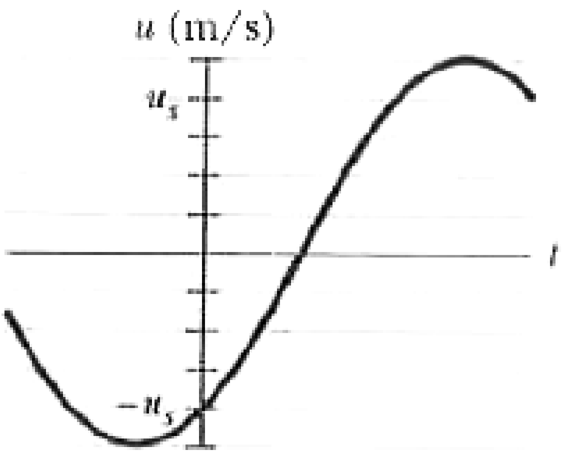
36. Figure 16-48 shows the transverse velocity u versus time t of the point on a string at x=0, as a wave passes through it. The scale on the vertical axis is set by $u_s = 12m / s$. The wave has the generic form y(x,t)= $y_m \sin(kx - \omega t + \phi)$. What them is ϕ?



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37. These two waves travel along the same string:

$y(x, t) = (4.00mm)\sin(2\pi x - 650\pi t)$

$y_2(x, t) = (6.20mm)\sin(2n\pi - 650\pi t + 0.60xrad)$. What are (a) the amplitude and (b) the phase angle (relative to wave 1) of the resultant wave? (c) If a third wave of amplitude 5.00 mm is also to be sent along the string in the same direction as the first two waves, what should be its phase angle in order to maximize the amplitude of the new resultant wave?

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38. A standing wave pattern on a string is described by

$y(x, t) = 0.040(\sin 4\pi x)(\cos 4\pi t)$.

where x and y are in meters and r is in seconds For $x \geq 0$ what is the location of the node with the (a) smallest, (b) second smallest, and (c) third smallest value of x? (d) What is the period of the oscillatory motion of any (nonnode) point? What are the (e) speed and (f) amplitude of the two traveling waves that interfere to produce this wave? For $t > 0$, what are the (g) first, (h) second, and (i) third time that all points on the string have zero transverse velocity?

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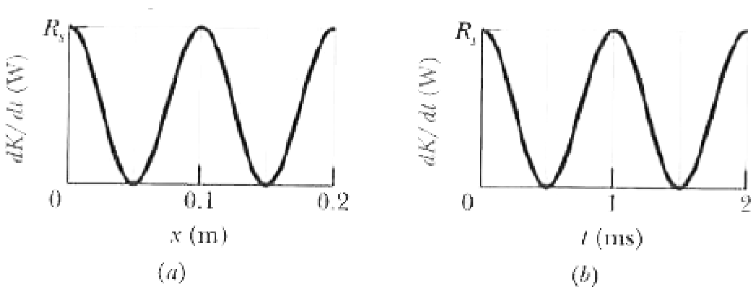
39. A sinusoidal wave is sent along a string with a linear density of 5.0 g/m. As it travels, the kinetic energies of the mass elements along the string vary Figure 10-49a gives the rate dk/dt at which kinetic energy passes through the string elements at a particular instant, plotted as a function of distance x along the string. Figure 1649b is similar except that it gives the rate at which kinetic energy passes through a particular mass element at a particular location) plotted as a function of time. For botle figures the scale in the vertical (rate) axis is set by $R_s = 10W$. What is the amplitude of the wave?



View Text Solution

40. The equation of a transverse wave traveling along a very long string is y 3.0 sin $(0.020\pi x - 4.0\pi t)$, where x and y are expressed in contimeters and t is in seconds. Determine (a) the amplitude. (b) the wavelength, (c) the frequency (d) the speed, (e) the direction of propagation of the wave, and (f) the maximum transverse speed of a particle in the string (g) What is the transverse displacement at x=3.5 cm when 0.26s ?

Watch Video Solution

41. What is the speed of a transverse wave in a rope of length 1.75 m and mass 60.0 g under a tension of 500 N?

Watch Video Solution

42. The function y(x,t) =(15.0 cm) $\cos(\pi x - 15\pi t)$, with x in meters and t in seconds, describes a wave on a taut string. What is the transverse speed for a point on the string at an instant when that point has the displacement y= +6.00 cm?

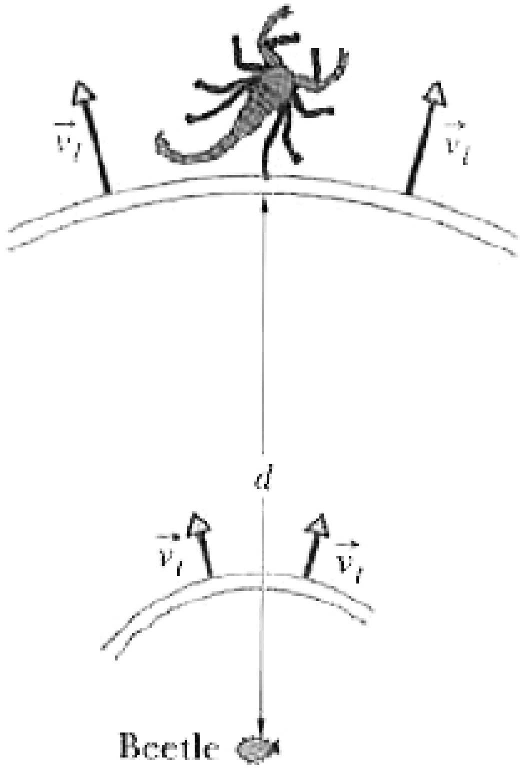
Watch Video Solution

43. What are (a) the lowest frequency. (b) the second lowest frequency, and (c) the third lowest frequency for standing waves on a wire that is 10.0 m long, has a mass of 100 g. and is stretched under a tension of 275 N?

Watch Video Solution

44. A sand scorpion can detect the motion of a nearby beetle (its prey) by the waves the motion sends along the sand surface (Fig, 16-50). The waves are of two types transverse waves traveling at $v_1 = 50$ m/s and longitudinal waves traveling at $V_1 = 150 m / s$. If a sudden motion sends out such waves a scorpion can tell the distance of the bestle from the difference ar in the arrival times of the waves at its leg nearest the beetle.

What is that time difference if the distance beetle is 37.5 cm?



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45. Two sinusoidal waves of the same period, with amplitudes of 5.0 and 7.0 mm, travel in the same direction along a stretched string, they produce a resultant wave with an amplitude of 10.0 mm. The phase constant of the 5.0mm wave is 0. What is the phase constant of the 7.0mm wave?

Watch Video Solution

46. Four waves are to be sent along the same string, in the same direction :

$y_1(x, t) = (5.00mm)\sin(4\pi x - 400\pi t)$

$y_2(x, t) = (5.00mm)\sin(4\pi x - 400\pi t + 0.8\pi)$

$y_3(x, t) = (5.00mm)\sin(4\pi x - 400\pi t + \pi)$

$y_4(x, t) = (5.00mm)\sin(4\pi x - 400\pi t + 1.8\pi)$

What is the amplitude of the resultant wave?

Watch Video Solution

47. If a wave y(x,t)=(5.0 mm) sin(kr +(600 rad/s) $t + \phi$) travels along a string, how much time does any given point on the string take to move between displacements y=+2.0 mm and y=-2.0 mm?

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48. A string along which waves can travel is 2.70 m long and has a mass of 130 g. The tension in the string is 36.0 N What must be the frequency of traveling waves of amplitude 7.70 mm for the average power to be 170 W?

Watch Video Solution

49. A uniform rope of mass m and length L hangs from a ceiling. (a) Show that the speed of a transverse wave on the rope is a function of y, the distance from the lower end, and is given by $v = \sqrt{gy}$. (b) Show that the time a transverse wave takes to travel the length of the rope is given by $t = 2\sqrt{L/g}$.

View Text Solution

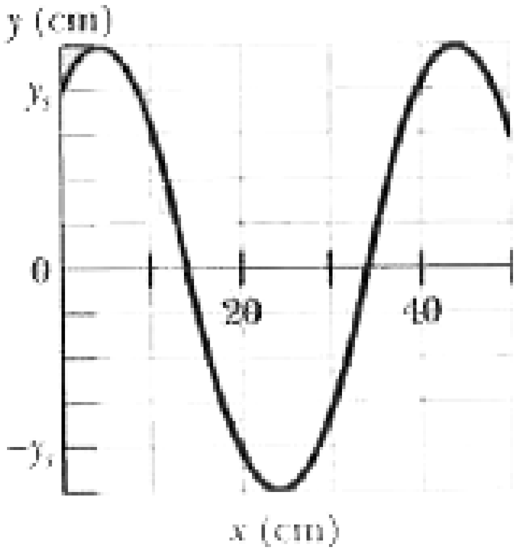
50. The speed of a transverse wave on a string is 115 m/s when the string tension is 200 N. To what value must the tension be changed to raise the

wave speed to 223 m/s?

Watch Video Solution

51. A sinusoidal transverse wave is traveling along a string in the negative direction of an x axis. Figure 16-S1 shows a plot of the displacement as a function of position at time t = 0, the scale of the y axis is set by y = 4.0 cm. The string tension is 3.6 N, and its linear density is 28 g/m. Find the (a) amplitude, (b) wavelength, (e) wave speed, and (d) period of the wave (e) Find the maximum transverse speed of a particle in the string. If the wave is of the form $y(x, t) = y_m \sin(kx \pm \omega t + \phi)$, what are (f) k, (g)

$\omega(h)\phi$, and (i) the correct choice of sign in front of ω?



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52. Use the wave equation to find the speed of a wave given in terms of the general function h(x,t):

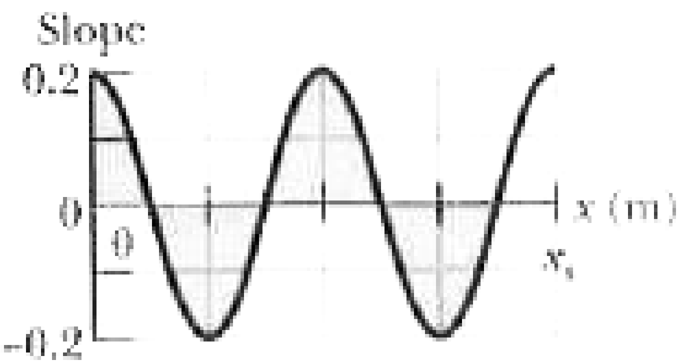
$y(x, t) = (4.00mm)\sin\left[\left(22.0m^{-1}\right)x + \left(8.00s^{-1}t\right]\right.$.

Watch Video Solution

53. A transverse sinusoidal wave is moving along a string in the opposite direction of an x axis with a speed of 70m/s. At t=0 the string particle at x=0 has a transverse displacement of 4.0 cm and is not moving. The maximum transverse speed of the string particle at x=0 is 16m/s. (a) What is the frequency of the wave? (b) What is the wavelength of the wave? If y(x,t) $= y_m \sin(kx \pm \omega t + \phi)$ is the form of the wave equation, what are (c) y_m, $(d) k$, $(e) \omega (f) \phi$, and (g) the correct of sign in front of ω?

View Text Solution

54. A sinusoidal wave travels along a string under tension. Figure 16-52 gives the slopes along the string at time t=0. The scale of the x axis is st by $x_s = 0.40$m What is the amplitude of the wave?



Watch Video Solution

55. A string oscillates according to the equation

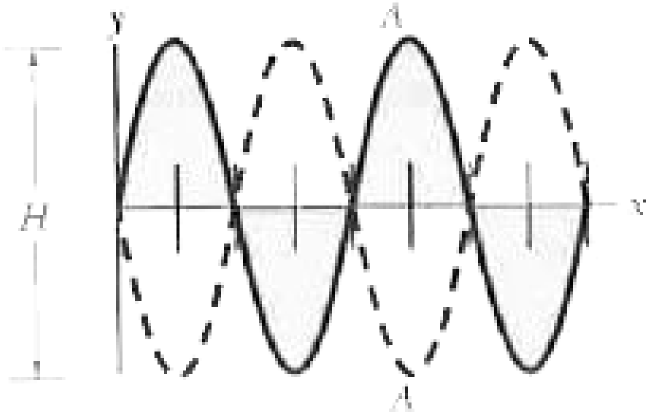
$$y' = (0.50cm)\sin\left[\left(\frac{\pi}{3}cm^{-1}\right)x\right]\cos\left[\left(40\pi s^{-1}\right)t\right].$$

What are the (a) amplitude and (b) speed of the two waves (identical except for direction of travel) whose superposition gives the oscillation? (c) what ist eht distance between nodes? (d) What is the transverse speed of particle of the string at the position $x = 1.5cm$ when $t = \frac{9}{8}s$?

Watch Video Solution

56. Two sinusoidal waves with the same amplitude and wavelength travel through each other along a string that is stretched along an x axis. Their resultant wave is shown twice in Fig. 16-53, as the antinode A travels from an extreme upward displacement to an extreme downward displacement in 6.0 ms. The tick marks along the axis are separated by 15 cm, height H is 1.20 cm. Let the equation for one of the two waves be of the form $y(x, t) = y_m \sin(kx + \omega)$. In the equation for the other wave, what are

$(a) y_m (b) k, (c) \omega,$ and (d) the sign in front of ω?



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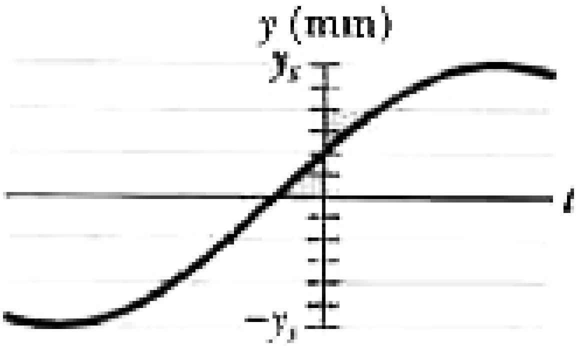
57. A 40 cm wire having a mass of 3.2 g is stretched between two fixed supports 40.05 cm apart. In its fundamental mode, the wire vibrates at 220 Hz. If the area of cross section of the wire is $1.0 mm^2$, find its Young modulus.

Watch Video Solution

58. A string, fixed at both ends, vibrates in a resonant mode with a separation of 2.0 cm between the consecutive nodes. For the next higher resonant frequency, this separation is reduced to 1.6 cm. Find the length of the string.

Watch Video Solution

59. Figure 16-54 shows the displacement y versus time t of the point on a string at x=0, as a wave passes through that point. The scale of the y axis is set by $y_s = 6.0mm.$ The wave has form $y(x, t) = y_{\ln} \sin(kx - \omega t + \phi)$. What is the ϕ?



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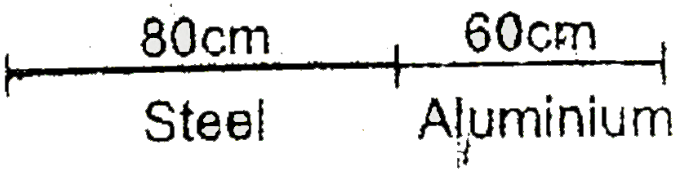
60. Figure shows an aluminium wire of length $60cm$ joined to a steel wire of length $80cm$ and stretched between two fixed supports. The tension produced is $40N$. The cross-sectional area of the steel wire is $1.0mm^2$ and that of the aluminimum wire is $3.0mm^2$ The minimum frequency of a tuning fork which can produce standing waves in the system with the joint as a node is $10P$ (in Hz) the find P. Given density of aluminimum is $2.6g/cm^3$ and that of steel is $7.8g/cm^3$.



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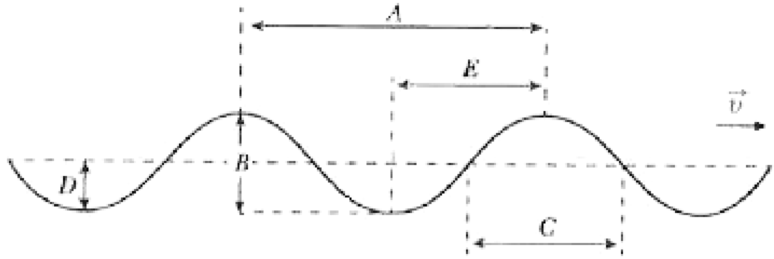
Practice Questions Single Correct Choice Type

1. A sinusoidal wave is traveling toward the right as shown in the figure. Which letter correctly labels the wavelength of the wave?



A. A

B. B

C. C

D. D

Answer: A

Watch Video Solution

2. Which one of the following waves is purely longitudinal?

A. Sound waves in air.

B. Radio waves traveling through air.

C. Light waves traveling through vacuum.

D. Waves on a plucked guitar string.

Answer: A

Watch Video Solution

3. A periodic wave is produced on a stretched string. Which one of the following properties is not related to the speed of the wave?

A. Frequency

B. Amplitude

C. Period

D. Wavelength

Answer: B

Watch Video Solution

4. A sinusoidal transverse wave is traveling on a string. Any point on the string

A. moves in the same direction as the wave.

B. moves in simple harmonic motion with a different frequency than that of the wave.

C. moves in simple harmonic motion with the same angular frequency as the wave

D. moves in uniform circular motion with a different angular speed than the wave.

Answer: C

Watch Video Solution

5. A transverse periodic wave described by the expression. $y = \sin\left[2x\left(\frac{x}{2} + \frac{t}{10}\right)\right]$ (where y and rare in meters and is in seconds) is established on a string. Which one of the following statements concerning this wave is false?

A. The wave is traveling in the negative x direction.

B. The amplitude is 1.0 m.

C. The frequency of the wave is 0.10 Hz.

D. The wave travels with speed 5.0 m/s.

Answer: D

Watch Video Solution

6. When a certain string is clamped at both ends, the lowest four resonant frequencies are measured to be 100, 150, 200, and 250 Hz. One of the resonant frequencies (below 200 Hz) is missing. What is it?

A. 25Hz

B. 50Hz

C. 75Hz

D. 125Hz

Answer: B

Watch Video Solution

7. A string of length 0.4 m and mass 10^{-2} kg is clamped at its ends. The tension in the string is 1.6 N. When a pulse travels along the string the shape of the string is found to be the same at times t and $t + \triangle t$. The value $\triangle t$ is

A. 0.05s

B. 0.1s

C. 0.2s

D. 0.4s

Answer: B

Watch Video Solution

8. A woman is standing in the ocean, and she notices that after a wave crest passes, five more crests pass in a time of 50.0 s. The distance between two successive crests is 32 m. Determine, if possible, the wave's period and wavelength.

A. 0.0200s, 64m

B. 0.100s, 16m

C. 10.1s, 32m

D. 50.0s, 8.0m

Answer: C

Watch Video Solution

9. What is the wavelength of a wave with a speed of 12 m/s and a period of 0.25 s?

A. 0.25m

B. 1.5m

C. 3.0m

D. 24m

Answer: C

Watch Video Solution

10. The mass of a string is $5.0 \times 10^{-3} kg$, and it is stretched so that the tension in it is 180 N. A transverse wave traveling on this string has a frequency of 260 Hz and a wavelength: of 0.60 m. What is the length of the string?

A. 1.1m

B. 0.68m

C. 0.47m

D. 0.22m

Answer: B

Watch Video Solution

11. A steel cable of cross-sectional area $2.83 \times 10^{-3} m^2$ is kept under a tension of $1.00 \times 10^4 N$. The density of steel is 7860 $\mathrm{kg/m^3}$ (this is not the linear density). At what speed does a transverse wave move along the cable?

A. 22.7m/s

B. 21.2m/s

C. 19.9m/s

D. 17.6m/s

Answer: B

Watch Video Solution

12. A copper wire, whose cross-sectional area is $1.1 \times 10^{-6} m^2$, has a linear density of 70×10^{-3} kg/m and is strung between two walls. At the ambient temperature, a transverse wave travels with a speed of 46 m/s on this wire. The coefficient of linear expansion for copper is $17 \times 10^{-6} (^\circ C)$, and Young's modulus for copper is $1.1 \times 10^{11} N / m^2$. What will be the speed of the wave when the temperature is lowered by $14^\circ C$? Ignore any change in the linear density caused by the change in temperature.

A. 84m/s

B. 79m/s

C. 61m/s

D. 55m/s

Answer: B

Watch Video Solution

13. A transverse wave on a string has an amplitude of 0.2 m and a frequency of 175 Hz. Consider a particle of the string at x=0. it begins with a displacement y=0, at t=0, according to equation $y = 0.2\sin(kx \pm \omega t)$. How much time passed between the first two instant when this particle has a displacement of y=0.1 m?

A. $1.9 \times 10^{-3}s$

B. $2.9 \times 10^{-3}s$

C. $3.8 \times 10^{-3}s$

D. $5.7 \times 10^{-3}s$

Answer: A

Watch Video Solution

14. The displacement (in meters) of a wave is given according to y =0.26 sin $(\pi t - 3.7\pi x)$, where t is in seconds and x is in meters. What is the displacement y when t =38 s and x= 13 m?

A. $-0.14m$

B. $-0.080m$

C. $-0.041m$

D. $-0.019m$

Answer: B

Watch Video Solution

15. A wire is stretched between two posts. Another wire is stretched between two posts that are twice as far apart. The tension in the wires is the same, and they have the same mass. A transverse wave travels on the shorter wire with a speed of 240m/s. What would be the speed of the wave on the longer wire?

A. 170m/s

B. 240m/s

C. 290m/s

D. 340m/s

Answer: D

Watch Video Solution

16. A person lying on an air mattress in the ocean rises and falls through one complete cycle every five seconds. The crests of the wave causing the motion are 20.0 m apart. Determine the frequency and the speed of the wave.

A. 0.150 Hz, 15.0 m/s

B. 0.100 Hz, 8.00 m/s

C. 0.350 Hz, 2.00 m/s

D. 0.200 Hz, 4.00 m/s

Answer: D

Watch Video Solution

17. The amplitude of a transverse wave on a string is 4.5 cm. The ratio of the maximum particle speed to the speed of the wave is 3:1. What is the wavelengtlı (in cm) of the wave?

A. 4.5 cm

B. 70 cm

C. 9.1 cm

D. 14 cm

Answer: C

Watch Video Solution

18. A jet skier is moving at 8.4 m/s in the direction in which the waves on a lake are moving. Each time he passes over a crest, he feels a bump. The bumping frequency is 1.2 Hz, and the crests are separated by 5.8 m. What is the wave speed?

A. 1.4m/s

B. 2.1m/s

C. 7.0m/s

D. 8.4m/s

Answer: A

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19. A certain string on a piano is tuned to produce musical note of frequency f =261.63 Hz by carefully adjusting the tension in the string. For a fixed wavelength, what is the frequency when this tension is doubled?

A. 130.08 Hz

B. 185.00 Hz

C. 370.00 Hz

D. 446.63 Hz

Answer: C

Watch Video Solution

20. Of the three traveling waves listed below, which one(s) is(are) traveling in the + x direction?

(1) $y= +3.2 \sin (4.1t +2.3x]$

(2) $y= -6.8 \sin [-3.0t +1.5x]$

(3) $y=+4.9 \sin (12.0t + 18x]$

A. 1 only

B. 2 only

C. 3 only

D. 1,2, and 3

Answer: B

Watch Video Solution

21. A transverse periodic wave is established on a string. The wave is described by the expression

$y = 0.005 \sin(20.0x - 2.4\pi ft)$

where y is in meters when x and t are in meters and seconds, respectively. If the wave travels with a speed of 20.0 m/s, what is its frequency: f?

A. 0.16 Hz

B. 0.64 Hz

C. 31.9 Hz

D. 63.7 Hz.

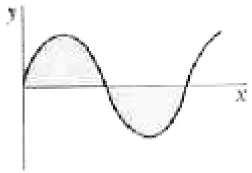
Answer: D

Watch Video Solution

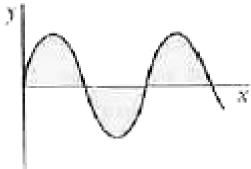
22. Three traveling sinusoidal waves are on identical strings. with the same tension. The mathematical forms of the waves are $y_1(x, t) = y_m \sin(3x - 6t), y_2(x, t) = y_m \sin(4x - 8t),$ and $y_3(x, t)\sin(6x$

where x is in meters and t is in seconds. Match each mathematical form to the appropriate graph below:

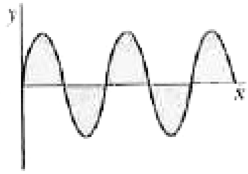
(i)



(ii)



(iii)



A. $y_1 - (i), y_2 - ii, y_3 - (iii)$

B. $y_1 - (iii), y_2 - (ii), y_3 - (i)$

C. $y_1 - (i), y_2 - (iii), y_3 - (ii)$

D. $y_1 - (ii), y_2 - (i), y_3 - (iii)$

Answer: A

Watch Video Solution

23. The displacement of a string carrying a travelling sinusoidal wave is given by $y(x, t) = y_m \sin(kx - \omega t - \phi)$

At time t=0 the point at x=0 has a velocity of 0 and a positive displacement. The phase constant ϕ is

A. 90°

B. 135°

C. 180°

D. 270°

Answer: D

Watch Video Solution

24. The tension in a string with a linear density of 0.0010 kg/m iş 0.40 N. A 100 Hz sinusoidal wave on this string has a wavelength of

A. 0.05cm

B. 2.0cm

C. 5.0cm

D. 20cm

Answer: D

Watch Video Solution

25. A long string is constructed by joining the ends of two shorter strings. The tension in the strings is the same but string I has 4 times the linear mass density of string II. When a sinusoidal wave passes from string I to string II:

A. the frequency decreases by a factor of 4.

B. the frequency decreases by a factor of 2.

C. the wavelength decreases by a factor of 4.

D. the wavelength decreases by a factor of 2.

Answer: D

Watch Video Solution

26. Two identical but separate strings, with the same tension, carry sinusoidal waves with the same frequency. Wave A has an amplitude that is twice that of wave B and transmits energy at a rate that is ....that of wave B.

A. half

B. twice

C. one-fourth

D. four times

Answer: D

Watch Video Solution

27. Fully constructive interference between two sinusoidal waves of the same frequency occurs only il they

A. travel in opposite directions and are in phase.

B. travel in opposite directions and are 180° out of phase.

C. travel in the same direction and are in phase,

D. travel in the same direeetion and are 180° out of phase.

Answer: C

Watch Video Solution

28. Two sinusoidal waves have the same angular frequeny the same amplitude y_m, and travel in the same direction in the same medium. If they differ in phase by 50° the amplitude the resultant wave is given by

A. $0.64y_m$

B. $1.3y_m$

C. $0.91y_m$

D. $1.8y_m$

Answer: D

Watch Video Solution

29. A wave on a stretched string is reflected from a fixed end P of the string. The phase difference, at P, between the incident and reflected waves is

A. zero

B. π rad

C. $\pi / 2$ rad

D. depends on the velocity of the wave

Answer: B

Watch Video Solution

30. Which of the following represents a standing wave?

A.

$$y = (6.0mm)\sin\left[\left(3.0m^{-1}\right)x + \left(2.0s^{-1}t\right] - (6.0mm)\cos\left[\left(3.0m^{-1}\right)x\right.\right.$$

B.

$$y = (6.0mm)\cos\left[\left(3.0m^{-1}\right)x - \left(2.0s^{-1}t\right] + (6.0mm)\cos\left[\left(2.0s^{-1}\right)t\right.\right.$$

C.

$$y = (6.0mm)\cos\left[\left(3.0m^{-1}\right)x - \left(2.0s^{-1}t\right] - (6.0mm)\cos\left[\left(2.0s^{-1}\right)t\right.\right.$$

D.

$$y = (6.0mm)\sin\left[\left(3.0m^{-1}\right)x - \left(2.0s^{-1}t\right] - (6.0mm)\cos\left[\left(2.0m^{-1}\right)x\right.\right.$$

Answer: B

Watch Video Solution

31. Standing waves are produced by the interference of two traveling sinusoidal waves, each of frequency 100 Hz. The distance from the 2nd node to the 5th node is 60 cm. The wavelength of each of the two original waves is

A. 50cm

B. 40cm

C. 30cm

D. 20cm

Answer: B

Watch Video Solution

32. When a string is vibrating in a standing wave pattern , the power transmitted across an antinode , compared to the power transmitted across a node , is

A. more

B. less

C. the same (zero)

D. the same (non-zero)

Answer: C

Watch Video Solution

33. Two strings A and B made of same material are stretched by same tension. The radius of string A is double of the radius of B. A transverse wave travels on A with speed v_A and on B with speed v_B. The ratio $\frac{v_A}{v_B}$ is

A. $\frac{1}{2}$

B. 2

C. $1/4$

D. 4

Answer: A

Watch Video Solution

Practice Questions More Than One Coorect Choice Type

1. At nodes in stationary waves

A. change in pressure and density are maximum.

B. change in pressure and density are minimum.

C. strain is zero.

D. energy is maximum.

Answer: A::D

Watch Video Solution

2. Two particles A and B have a phase diference of π when a sine wave passes through the regin

A. A oscillates at half the frequency of B.

B. A and B move in opposite direction.

C. A and B must be separated by half of the wavelength.

D. The displacement at A and B have equal magnitudes

Answer: C::D

Watch Video Solution

3. A plane progressive wave of frequency 25 Hz, amplitude $2.5 \times 10^{-5} m$ and initial phase zero moves along the negative x-direction with a velocity of 300 m/s. A and B are two points 6 m apart on the line of propagation of the wave. At any instant the phase different between A and B is ϕ. The maximum difference in the displacements of particle at A and B is Δ

A. $\phi = \pi$

B. $\phi = 0$

C. $\triangle = 0$

D. $\triangle = 5 \times 10^{-5} m$

Answer: A::D

Watch Video Solution

4. In a stationary wave system, all the particles of the medium

A. have zero displacement simultaneously at some instant.

B. have maximum displacement simultaneously at some instant.

C. are at rest simultaneously at some instant

D. reach maximum velocity simultaneously at some instant

Answer: A::B::C::D

Watch Video Solution

5. A string of length L is stretched along the x-axis and is rigidly clamped at its two ends. It undergoes transverse vibration. If n an integer, which of the following relations may represent the shape of the string at any time :-

A. $y = y_m \sin\left(\frac{n\pi x}{L}\right)\cos\omega t$

B. $y = y_m \sin\left(\frac{n\pi x}{L}\right)\sin\omega t$

C. $y = y_m \cos\left(\frac{n\pi x}{L}\right)\cos\omega t$

D. $y = y_m \cos\left(\frac{n\pi x}{L}\right)\sin\omega t$

Answer: A::B

Watch Video Solution

6. It is desired to increase the fundamental resonance frequency in a tube which is closed at one end. This can be achieved by

A. replacing the air in the tube by hydrogen gas.

B. increasing the length of the tube.

C. decreasing the length of the tube.

D. opening the closed end of the tube,

Answer: A::C::D

Watch Video Solution

7. A wave disturbance in a medium is described by $y(x, t) = 0.02\cos\left(50\pi t + \frac{\pi}{2}\right)\cos(10\pi x)$ where x and y are in meter and t is in second`

A. A displacement node occurs at x =0.15 m.

B. An antinode occurs at x =0.3 m.

C. The wavelength of the wave is 0.2 m.

D. The speed of the wave is 5.0 m/s.

Answer: A::B::C::D

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8. As a wave propagates,

A. the wave intensity remains constant for a plane wave.

B. the wave intensity decreases as the inverse of the distance from the source for a spherical wave.

C. the wave intensity decreases as the inverse square of the distance from the source for a spherical wave.

D. total intensity of the spherical wave over the spherical surface centered at the source remains constant at all times.

Answer: A::B::D

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9. A transverse sinusoidal wave of amplitude a, wavelength λ and frequency f is travelling on a stretched string. The maximum speed of any point in the string is $v/10$, where v is the speed of propagation of the wave. If $a = 10^{-3}m$ and $v = 10ms^{-1}$, then λ and f are given by

A. $\lambda = 2\pi \times 10^{-2}m$

B. $\lambda = 10^{-3}m$

C. $n = \dfrac{10^3}{2\pi}Hz$

D. $n = 10^4 Hz$

Answer: A::C::D

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10. A wave represented by the given equation $Y = A\sin\left(10\pi x + 15\pi t + \frac{\pi}{3}\right)$, where x is in meter and t is in second. The expression represents

(1) A wave travelling in the negative X direction with a velocity of 1.5 m/sec

(2) A wave travelling in the negative X direction with a wavelength of 0.2

m

(3) A wave travelling in the positive X direction with a velocity of 1.5 m/sec.

(4) A wave travelling in the positive X direction with a wavelength of 0.2 m

A. a wave travelling in the positive x direction with a velocity of 1.5m/s

B. a wave traveling in the negative x direction with a velocity of 1.5 m/s

C. a wave traveling in the negative x direction with a wavelength of 0.2m

D. a wave traveling in the positive x direction with a wavelength of 0.2m

Answer: B::C

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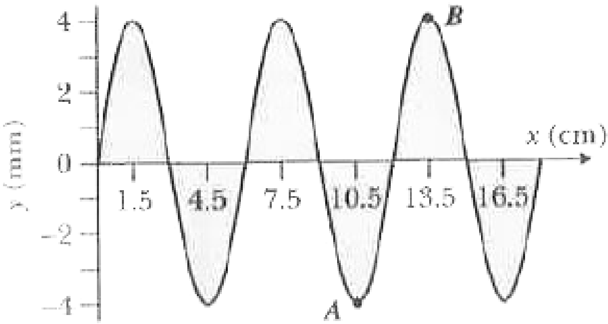
Practice Questions Linked Comprehension

1. The displacement of a vibrating string versus position along the string is shown in the figure. The periodic wave have a speed of 10.0cm/s. A and B are two points on the string.



What is the amplitude of the wave?

A. 2 mm

B. 4 mm

C. 12 mm

D. 8 mm

Answer: B

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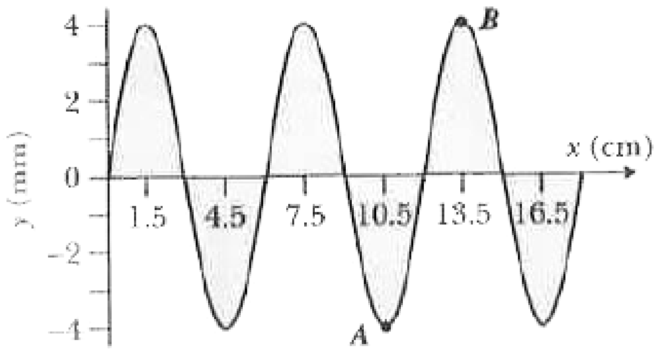
2. The displacement of a vibrating string versus position along the string is shown in the figure. The periodic wave have a speed of 10.0cm/s. A and B are two points on the string.



What is the wavelength of the wave?

A. 3.0 cm

B. 6.0 cm

C. 9.0 cm

D. 12 cm

Answer: B

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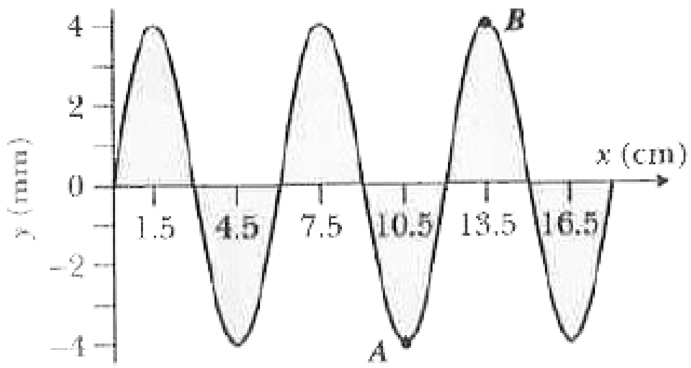
3. The displacement of a vibrating string versus position along the string is shown in the figure. The periodic wave have a speed of 10.0cm/s. A and B are two points on the string.



What is the frequency of the wave?

A. 0.60Hz

B. 0.90Hz

C. 1.7Hz

D. 1.3Hz

Answer: C

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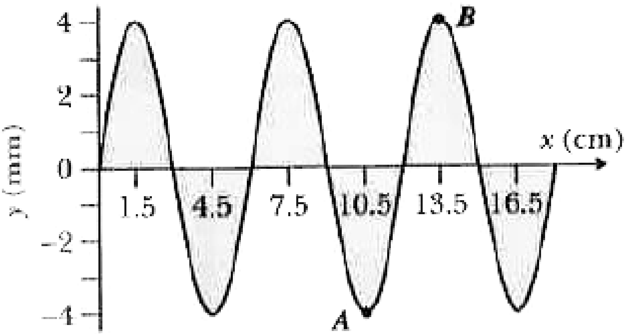
4. The displacement of a vibrating string versus position along the string is shown in the figure. The periodic wave have a speed of 10.0cm/s. A and B are two points on the string.



What is the difference in phase between the points A and B?

A. $(\pi/4)$ radians

B. $(\pi/2)$ radians

C. π radians

D. $(3\pi/4)$ radians

Answer: C

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5. A periodic transverse wave is established on a string such that there are exactly two cycles traveling along a 3.0-m section of the string. The crests move at 20.0 m/s.

What is the frequency of the wave?

A. 0.67 Hz

B. 1.33 Hz

C. 13 Hz.

D. 30 Hz

Answer: C

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6. A periodic transverse wave is established on a string such that there are exactly two cycles traveling along a 3.0-m section of the string. The crests move at 20.0 m/s.

What is the shortest horizontal distance from a crest to a point of zero acceleration?

A. 0.38m

B. 0.75m

C. 1.5m

D. 3.0m

Answer: A

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7. A periodic transverse wave is established on a string such that there are exactly two cycles traveling along a 3.0-m section of the string. The crests move at 20.0 m/s.

How long does it take a particle at the top of a crest to reach the bottom of an adjacent trough?

A. 0.018s

B. 0.038s

C. 0.075s

D. 0.150s

Answer: B

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8. A periodic transverse wave is established on a string such that there are exactly two cycles traveling along a 3.0-m section of the string. The crests move at 20.0 m/s.

How could the speed of the wave be incresed?

A. By increasing the period

B. By increasing the tension in the string

C. By decreasing the amplitude

D. By decreasing the frequency

Answer: B

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Practice Questions Matrix Match

1. One end of a steel wire is attached to a fixed support and the other end is attached to a string, which is going over a pulley and is connected to a block, whch is hanging vertically. It is observed that the wire vibrates in its fundamental mode with frequency of 200 Hz. When the block is submerged in water, the same wire vibrates in its 1 harmonic with frequency of 100 Hz. Density of steel wire is $8000kg/m^3$ and length of wire is 1 m.

Column I	Column II
(a) Longitude stress in the wire (in 10^7 N/m^2)	**(p)** 400
(b) Velocity of transverse waves along this wire (in m/s)	**(q)** 128
(c) Longitudinal stress in the wire in submerged condition in (10^7 N/m^2)	**(r)** 0.002
(d) If maximum acceleration of the wire is 800 m/s^2, amplitude of vibration at the midpoint (in m)	**(s)** 32

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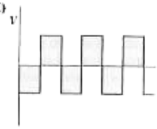
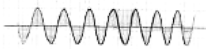
2. In the given table, Column I gives frequencies of different waves, Column II gives their examples and Column III gives their graphical representation.

Column I	Column II	Column III
(I) Frequency range = 20 Hz to 20 kHz	(i) waves produced by ocean waves	(J) Infrasoud (below 16 Hz) 
(II) Frequency range = 20 Hz	(ii) dog whistle that cannot be heard by humans	(K) 
(III) Frequency range < 20 Hz	(iii) waves produced during earth quake	(L) Audible frequencies (16 Hz-20 kHz) 
(IV) Frequency range >20 KHz	(iv) waves produced by vibrating sitar	(M) Ultrasound (over 20 kHz) 

What are the characteristics of auible waves?

A. (I) (iv) (L)

B. (II) (iv) (J)

C. (II) (i) (M)

D. (II) (i) (K)

Answer: A

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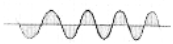
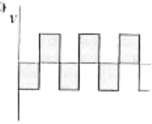
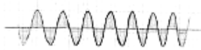
3. In the given table, Column I gives frequencies of different waves, Column II gives their examples and Column III gives their graphical representation.

Column I	Column II	Column III
(I) Frequency range = 20 Hz to 20 kHz	(i) waves produced by ocean waves	(J) Infrasoud (below 16 Hz) 
(II) Frequency range = 20 Hz	(ii) dog whistle that cannot be heard by humans	(K) 
(III) Frequency range < 20 Hz	(iii) waves produced during earth quake	(L) Audible frequencies (16 Hz-20 kHz) 
(IV) Frequency range >20 KHz	(iv) waves produced by vibrating sitar	(M) Ultrasound (over 20 kHz) 

What are the characteristics of ultrasonic waves?

A. (IV) (ii) (M)

B. (I) (iii) (L)

C. (II) (iv) (L)

D. (III) (ii) (M)

Answer: A

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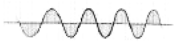
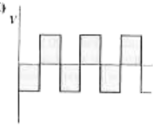
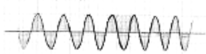
4. In the given table, Column I gives frequencies of different waves, Column II gives their examples and Column III gives their graphical representation.

Column I	Column II	Column III
(I) Frequency range = 20 Hz to 20 kHz	(i) waves produced by ocean waves	(J) Infrasoud (below 16 Hz) 
(II) Frequency range = 20 Hz	(ii) dog whistle that cannot be heard by humans	(K) 
(III) Frequency range < 20 Hz	(iii) waves produced during earth quake	(L) Audible frequencies (16 Hz-20 kHz) 
(IV) Frequency range >20 KHz	(iv) waves produced by vibrating sitar	(M) Ultrasound (over 20 kHz) 

What are the characteristics of infrasonic waves?

A. (II) (i) (K)

B. (I) (i) (L)

C. (III) (iii) (J)

D. (I) (iv) (L)

Answer: C

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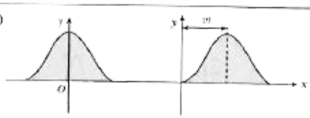
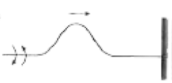
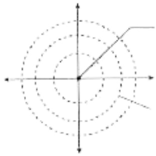
5. In the given table, Column I gives description of waves characteristics, Column II gives their characteristic and Column II shows their graphical representation.

Column I	Column II	Column III
(I) Short wave produced in a medium	(i) displacement for sound waves	(J) 
(II) Mathematical description of the disturbance created by a wave	(ii) the disturbance has the same phase at all points	(K) 

Column I	Column II	Column III
(III) A group of waves of equal or similar wavelengths	(iii) traveling in the same direction.	(L) 
(IV) A line or surface on which	(iv) when the disturbance is created for a short time	(M) 

What are the characteristics of a wave pulse?

A. (I) (iii) (L)

B. (IV) (ii) (M)

C. (II) (iv) (J)

D. (I) (iv) (K)

Answer: D

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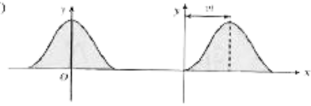
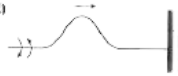
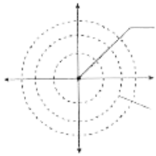
6. In the given table, Column I gives description of waves characteristics, Column II gives their characteristic and Column II shows their graphical representation.

Column I	Column II	Column III
(I) Short wave produced in a medium	(i) displacement for sound waves	(J) 
(II) Mathematical description of the disturbance created by a wave	(ii) the disturbance has the same phase at all points	(K) 

Column I	Column II	Column III
(III) A group of waves of equal or similar wavelengths	(iii) traveling in the same direction.	(L) 
(IV) A line or surface on which	(iv) when the disturbance is created for a short time	(M) 

What are the characteristics of a wave front?

A. (III)(ii) (J)

B. (IV) (ii) (L)

C. (II) (iii) (K)

D. (I) (i) (M)

Answer: B

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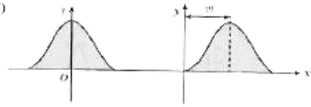
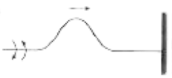
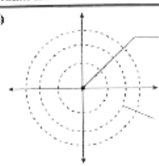
7. In the given table, Column I gives description of waves characteristics, Column II gives their characteristic and Column II shows their graphical representation.

Column I	Column II	Column III
(I) Short wave produced in a medium	(i) displacement for sound waves	(J) 
(II) Mathematical description of the disturbance created by a wave	(ii) the disturbance has the same phase at all points	(K) 

Column I	Column II	Column III
(III) A group of waves of equal or similar wavelengths	(iii) traveling in the same direction.	(L) 
(IV) A line or surface on which	(iv) when the disturbance is created for a short time	(M) 

What are the characteristics of a wave function?

A. (II) (i) (J)

B. (I) (i) (K)

C. (III) (iii) (L)

D. (I) (ii) (L)

Answer: A

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Practice Questions Integer Type

1. A progressive and a stationary simple harmonic wave each has the same frequency 250Hz and the same velocity of 30m/s. Calculate the distance between consecutive nodes (in cm) in the stationary wave.

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2. When a force F_1 acts on a particle, frequency is 6 Hz and when a force F_2 acts, frequency is 8 Hz. What is the frequency when both the forces act simultaneously in the same direction?

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3. The speed of a transverse wave on a string is 450 m/s, and the wavelength is 0.18 m. The amplitude of the wave is 2.0 mm. How much time is required for a particle of the string to move through a total distance of 1.0 km?

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4. A sinusoidal wave of angular frequency 1200 rad/s and amplitude 3.00 mm is sent along a cord with linear density 2.00 g/m and tension 1200 N. What is the average rate at which energy is transported by the wave to the opposite end of the cord?

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