PHYSICS

BOOKS - GK PUBLICATIONS PHYSICS (HINGLISH)

WAVES

Illustrative

1. A harmonic oscillation is represented by

$y = 0.34\cos(3000t + 0.74)$ where y and t are in mm and second respectively. Deduce

amplitude,

frequency and angular frequency,

time period and

intianl phase.

2. An observer standing at the sea coast observes $54 waves$ reaching the coast per minute. If the wavelength of a wave is $10m$, find the wave velocity.

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3. A progressive wave of frequency 500Hz is travelling with a velocity of 360 m / s. How far part are two points 60° out of phase ?

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4. A person standing between two parallel hills fires a gun. He hears the first echo after $\frac{3}{2}$ s, and a second echo after $\frac{5}{2}$ s. If speed of sound is $332m / s$, Calculate the distance between the hills. When will he hear the third echo?

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5. An aeroplane is going towrds east at a speed of $510 kmh^{-1}$ at a height of2000 m. At a certain instant, the sound o theh plane heard by a ground obserger appears to come from a point vertically above him. Where is the plane at this instant? Speed of sound in air $= 340 ms^{-1}$

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6. A light pointer fixed to one prong of a tuning fork touches gnetly a smoked vertical plate. The fork is set vibrating and the plate is allowed to fall freely. 8 complete oscilllations are counted when the plate falls through 10cm.What is the frequency of the tuning fork?

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7. An ultrasonic transducer used in sonar produces a frequency of 40 kHz. If the velocity of the sound wave in seawater is 5050 ft/s, what is the wavelength ?

The transducer is made to emit a short burst ofsound and is then turned off. The receiver is turned on. The pulse is reflected from a lurking submarine and received 5.0 s after it was first emitted. How far away is the submarine ?

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8. When a plane wave train transverses a medium, individual particles execute a periodic motion given

by the equation $y = 5 \sin \frac{\pi}{4}\left(4t + \frac{x}{16}\right)$

where the lengths are expressed in centimeters and time in seconds. The phase difference for two positions of the same particles which are occupied at a time interval 0.8 s apart is-

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9. A road runs midway between two parallel rows of buildings. A motorist moving with a speed of 36 km/hr sounds the horn. He hears the echo one second after he has sounded the horn. Then the distance between the two rows of buildings, will be (Velocity of sound is 330 m/s)

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10. An engine approaches a hill with a constant speed. When it is at a distance of 0.9 km, it blows a whistle whose echo is heard by the driver after 5 seconds. If the speed of sound in air is 330 m/s, then the speed of the engine is :

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11. Given the equetion for a wave on a string

$y = 0.03 \sin(3x - 2t)$

where y and x are in meters and t is in seconds.

(a). At t=0, what are the values of the displacement at x=0,0.1 m,0.2 m, and 0.3m ?

(b). At x=0.1 m what are the values of the displacement at t=0,0.1 s, and 0.2 s?

(c) what is the equetion for the velocity of oscillation of the particles of the string?

(d). what is the maximum velocity of oscillation?

(e). what is the velocity of propagation of the wave?

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12. Calculate the increase velocity of sound for $1^{\circ}C$ rise of temperature if the velocity of sound at $0^{\circ}C$ is $332\frac{m}{s}$.

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13. A 4.0 kg block is suspended from the ceiling of an elevator through a string having a linear mass desity of $19.2 \times 10^{-3} kgm^{-1}$. Find the speed (with respect to the string) with which a wave pulse can proceed on the string if the elavator accelerates up at the rate of $2.0ms^{-2}. Take g = 10ms^{-2}$.

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14. The temperature at which the speed of sound in air becomes double its value at $0^{\circ} C$ is

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15. The planet Jupiter has an atmosphere mainly of methane at a temperature- 130°C. Calculate the velocityof sound on this planet assumingyfor the mixturetobe 1.3(Gas constant = $8.3 \text{joules} / mol^{\circ} C$)

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16. How long will it take sound waves to travel a distance l between points A and B if the air temperature between them varies linearly from T_1 and T_2? (The velocity of sound in air at temperature T is given by $v = \alpha\sqrt{T}$, where α is a constant)

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17. The speed of a transverse wave going on a wire having a length 50 cm and maas 5.0 g is $80ms^{-1}$ The area of cross section of the wire is $1.0mm.^2$ and its Young modulus is $16 \times 10^{11} Nm^{-2}$. Find the extension of the wire over its natural lenth.

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18. Two blocks each having a mass of 3.2 kg are connected by a wire CD and the system is suspended from the ceiling by another wire AB . The linear mass density of the wire AB is $10gm^{-1}$ and that of CD is $8gm^{-1}$. Find the speed of a transverse wave pulse produced in AB and in CD.

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19. A heavy but uniform rope of lenth L is suspended from a ceiling. (a) Write the velocity of a transverse wave travelling on the string as a function of the distance from the lower end. (b) If the rope is given a sudden sideways jerk at the bottom, how long will it take for the pulse to reach teh celling ? (c) A particle is dropped from the ceiling at the instant the bottom end is given the jerk where will the particle meet the pulse ?

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20. In a large room, a person receives direct sound waves froma source 120 metres away from him. He also receives waves from the same source which reach him, being reflected from the 25 metre high ceiling at a point halfway between them. The two waves interfere constuctively for wavelength of

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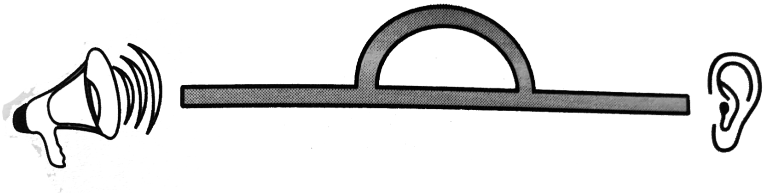
21. Figure 7.75 shows a tube structure in which a sound signal is bent from one end and is received at the other end . The semicircular part has a radius of $20.0cm$. The frequency of the sound source can be varied electronically between $1000 \text{ and } 4000Hz$. Find the frequencies at which maxima of intensity are detected. The speed of sound in air

$= 340 m / s.$



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22. Two sources S_1 and S_2 separated 2.0 m, vibrate according to equation $y_1 = 0.03 \sin \pi t$ and $y_2 = 0.02 \sin \pi t$ where y_1, y_2 and t are in M.K.S unit. They send out waves of velocity 1.5 m/s. Calculate the amplitude of the resultant motion of the particle co-linear with S_1 and S_2 and located at a point to the left of S_1.

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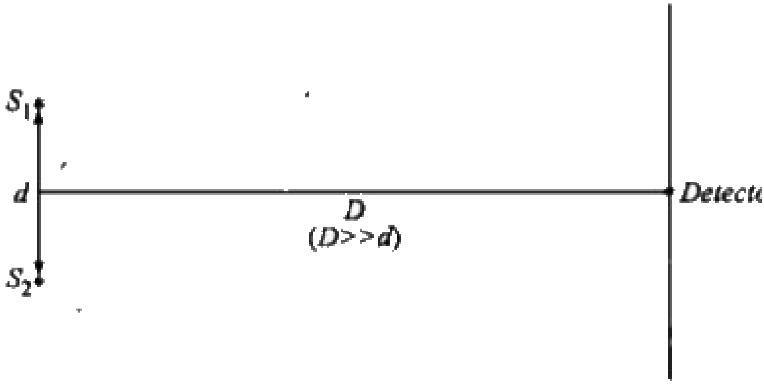
23. Two point sources ofsound are placed at a distance d and a detector moves on a straight line parallel to the line joining the sources as shown in figure-6.27 at a distance D away from sources. Initially Detector is situated on the line so that it is equidistant from both the sources. Find the displacement of detector when it detects n^{th} maximum sound and also find its displacement when it detects n^{th} minimum sound.



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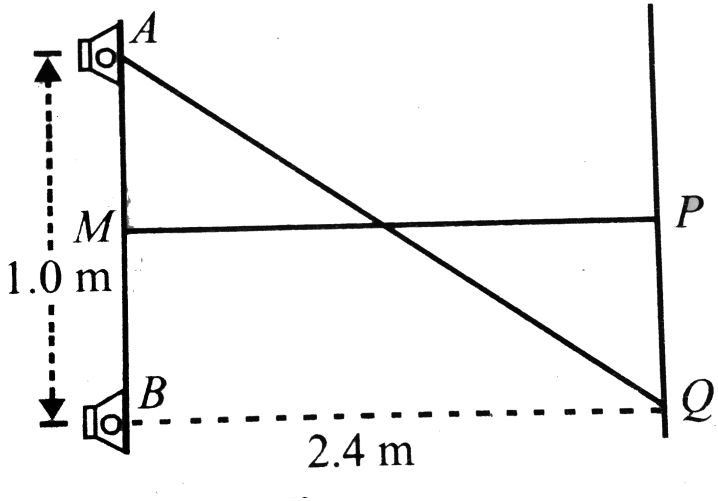
24. Two small loudspeakers A, B ($1m$ apart) are connected to the same oscillator so that both emit sound waves of frequency $1700Hz$ in phase . A sensitive detector , detects a maximum wave at P on the perpendicular bisector $MPofAB$ and another maximum wave when it first reaches a point Q directly opposite to B. Calculate the speed c

of the sound waves in air .



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25. A source emitting sound of frequency $180Hz$ is placed in front of a wall at distance of $2m$ from it . A detector is also placed in front of the wall at the same distance from it. From the minimum distance between the source and the detector for which the detector detects a maximum of sound. Speed of sound in air $= 360m/s$.

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26. Three plane sources of sound of frequency n_1 = 400 Hz, 401 Hz and n_3 = 402 Hz of equal amplitude a each, are sounded together. A detector receives waves from all the three sources simultaneously. It can detect signals of amplitude gt A. Calculate

(a) period ofone complete cycle of intensity received by the detector and

(b) time for which the detector remains idle in each cycle of intensity.

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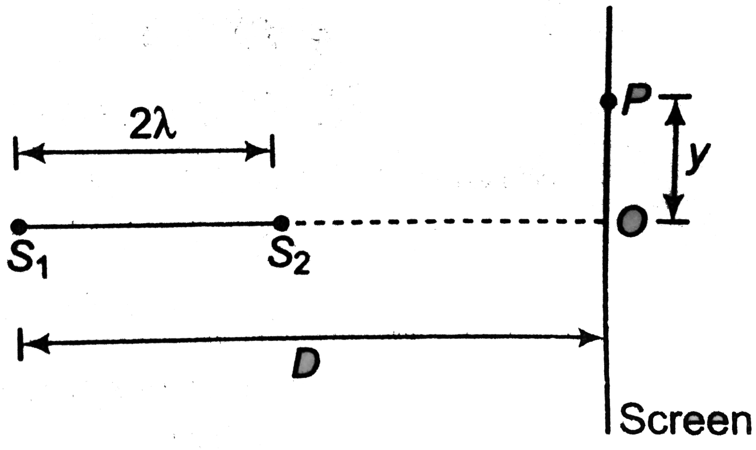
27. Two coherent narrow slits emitting sound of wavelength λ in the same phase are placed parallet to each other at a small separation of 2λ . The sound is delected by maving a delector on the screen at a distance $D(> \ > \lambda)$ from the slit S_1 as shows in figure. Find the distance y such that the intensity at P is equal to intensity at O.



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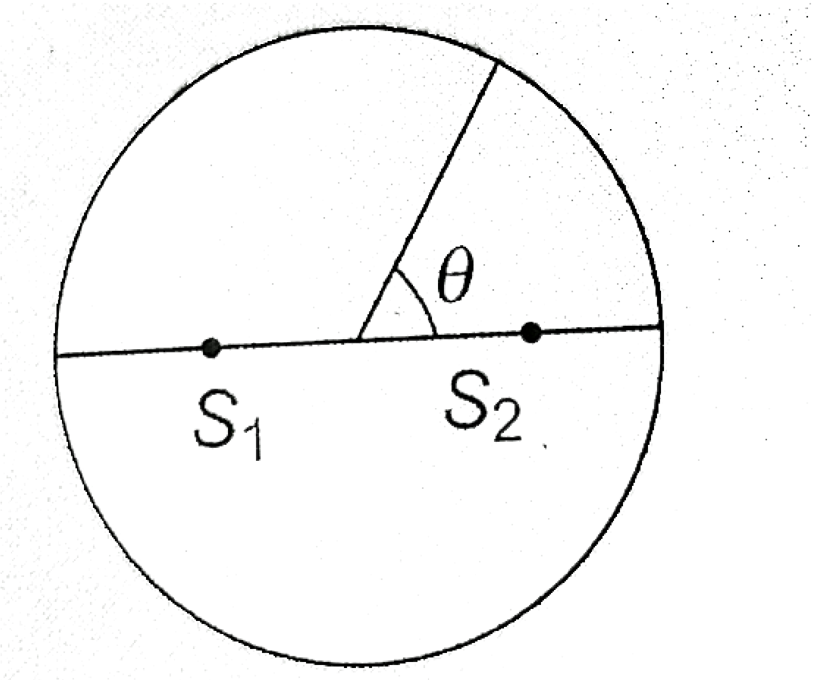
28. Figure shows two coherent sources S_1 and S_2 which emit sound of wavelength λ in phase. The separation between the sources is λ. A circular wire of large radius is placed in such a way that S_1S_2 lies in its plane and the middle point of S_1S_2 is at the centre of the wire. Find the angular positions θ, on the wire for which constructive interference takes place.



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29. (a) The power of sound from the speaker of a radio is 20 mW. By turning the knob of volume control the power of sound is increased to 400 mW, What is the power increase in dB as compared to original power? (b) How much more intense is an 80 dB sound than a 20 dB whisper?

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30. How many times intense is 80 dB sound than a 20 dB sound?

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31. A dog while barking delivers about 1 mW of power. If this power isuniformly distributed over a hemispherical area, what is the sound level at a distance of5 m? What would the sound level be if instead of 1dog 5 dog start barking at the same time delivering 1 mW of power?

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32. The sound level at a point is increased by 30 dB. What is factor is the pressure amplitude increased?

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33. What is the maximum possible sound level in dB of sound waves in air? Given that density of air is $1.3\frac{kg}{m^3}$, $v = 332\frac{m}{s}$ and atmospheric pressure $P = 1.01 \times 10^5 \frac{N}{m^2}$.

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34. A window whose area is $2m^2$ opens on street where the street noise result in an intensity level at the window of 60 dB. How much acoustic power enters the window via sound waves. Now if an acoustic absorber is fitted at the window, how much energy from street will it collect in 5 h?

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35. The following equation represents standing wave set up in a medium ,

$y = 4\frac{\cos(\pi x)}{3}\sin 40\pi t$

where x and y are in cm and t in second. Find out the amplitude and the velocity of the two component waves and calculate the distance adjacent nodes . What is the velocity of a medium particle at $x = 3cm$ at time $1/8s$?

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36. A wave is given by the equation

$y = 10\sin 2\pi(100t - 0.02x) + 10\sin 2\pi(100t + 0.02x)$

Find the loop length , frequency , velocity and maximum amplitude of the stationary wave produced.

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37. A progressive and a stationary simple harmonic wave each has the same frequency of250 Hz, and the same velocity of30 m/s. Calculat (0 the phase difference between two vibrating points on the progressive wave which are 10 cm apart,

(ii) the equation of motion of the progressive wave if its amplitude is 0.03 m

(iii) the distance between nodes in the stationary wave

(iv) the equation ofmotion, the stationarywave if its amplitude is 0.01 m.

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38. A wire of density $9 \times 10^3 kg/m^3$ is stretched between two clamps 1 m apart and is subjected to an extension of $4.9 \times 10^{-4} m$. The lowest frequency of transverse vibration in the wire is $(Y = 9 \times 10^{10} N/m^2)$

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39. The fundamental frequency ofa 1.5 m long, stretched steel wire is 175 Hz. The density of steel is $7.8 \times 10^3 kg/m^3$.(i) Find the speed of transverse waves in the wire.

(ii) Calculate the longitudinal stress ofthe wire,

(iii) Ifthe tension in the wire is increased by 3%, calculate the percentage change in the frequency ofthe wire.

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40. A wire having a linear density of $0.05gm/cm^3$. Is streched between two rigid supports with a tension 4.5×10^7 dynes. It is observed that the wire resonates at a frequency of420 Hz. Thenext highest frequency at which thesame wire resonatesis 490Hz. Find the length of the wire.

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41. In Melde's experiment itwas found that the string vibrates in 3 loops when 8 gm were placed inthepan. What mass should be placed in the pan to make the string vibrate in 5loops ?(Neglect the mass of string).

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42. Find the ratio of the fundamental tone frequencies of two identical strings after one of them was stretched by $\eta_1 = 2.0\%$ and the other, by $\eta_2 = 4.0\%$. The tension is assumed to be proportional to the elongation.

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43. The fundatmental frequency of a sonometer wire increases by $6Hz$ if its tension is increased by 44% keeping the length constant. Find the change in the fundamental frequency of the sonometer when the length of the wire is increased by 20% keeping the original tension in the wire.

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44. A sonometer wire is stretched by a solid mass M. It produces a fundamental note of a certain frequency in tune with a tuning fork when its length is 70 cm. When the mass is immersed in water it is found that the length has to be changed by 5 cm in order to bring it in tune with the same tuning fork. Calculate the relative density of the material of the hanging mass.

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45. The length of a sonometer wire between two fixed ends is 110cm. Where should the two bridges the placed so as to divide the wire into three segments, whose fundamental frequencies are in the ration $1:2:3$?

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46. A uniform rope of length $12m$ and mass $6kg$ hangs vertically from a rigid support. A block of mass $2kg$ is attached to the free end of the rope. A transverse pulse of wavelength $0.06m$ is produced at the lower end of the rope. What is the wavelength of the pulse when it reaches the top of the rope?

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47. A metallic rod of length 1m is rigidly clamped at its mid point. Longirudinal stationary wave are setup in the rod in such a way that there are two nodes on either side of the midpoint. The amplitude of an antinode is $2 \times 10^{-6}m$. Write the equation of motion of a point 2 cm from the midpoint and those of the constituent waves in the rod, (Young,s modulus of the material of the rod $= 2 \times 10^{11} Nm^{-2}$, density $= 8000kg - m^{-3}$). Both ends are free.

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48. A string $120 cm$ in length sustains a standing wave, with the points of the string at which the displacement amplitude is equal to $3.5 mm$ being separated by $15.0 cm$. Find the maximum displacement amplitude. To which overtone do these oscillations correspond ?

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49. A guitar string is 90 cm long and has a fundamental frequency of 124 Hz. Where should it be pressed to produce a fundamatal frequecy of 186 Hz?

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50. In melde's experiment, when tension in the string is 100gm wt and the tuning fork vibrates transversely , then the number of loops are 4. then the string in turned through 90°, so that is vibrates longitudinally. What is the extra tension required to form one loop in the string ?

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51. The vibrations of a string of length $60cm$ fixed at both ends are represented by the equation--------------------------

$$y = 4\sin\left(\frac{\pi x}{15}\right)\cos(96\pi t)$$

Where x and y are in cm and t in seconds.

(i) What is the maximum displacement of a point at $x = 5cm$?

(ii) Where are the nodes located along the string?

(iii) What is the velocity of the particle at $x = 7.5cm$ at $t = 0.25\,\text{sec.}$?

(iv) Write down the equations of the component waves whose superpositions gives the above wave.

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52. A tube of a certain diameter and of length $48cm$ is open at both ends. Its fundamental frequency is found to be $320Hz$. The velocity of sound in air is $320m/\sec$. Estimate the diameter of the tube.

One end of the tube is now closed. Calculate the lowest frequency of resonance for the tube.

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53. An open organ pipe filled with air has a fundamental frequency 500 Hz. The first harmonic of another organ pipe closed at one end and filled with carbon dioxide has the same frequency as that of the first harmonic of the open organ pipe. Calculate the length of each pipe. Assume that the velocity of sound in air and in carbondioxide to be 330 and 264 m/s respectively.

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54. A tuning fork of frequency $340Hz$ is excited and held above a cylindrical tube of length $120cm$. It is slowly filled with water. The minimum height of water column required for resonance to be first heard(Velocity of sound $= 340ms^{-1}$) is.

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55. The funadamental frequency of a closed organ pipe is equal to the first overtone frequency of an open organ pipe. If the length of the open pipe is 60 cm, what is the length closed pipe?

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56. A pipe of length 1.5 m closed at one end is filled with a gas and it resonates at $30^{\circ}C$ in its fundamental with a tuning fork. Another pipe of the same length but open at both ends and filled with air and it resonates in its fundamental with the same tuning fork. Calculate the velocity of sound at $0^{\circ} C$ in the gas, given that the velocity of sound in air is $360 ms^{-1}$ at 30°.

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57. A certain organ pipe resonates in its fundamental mode at a frequency of 500 Hz in air. What will be the fundamental frequency if the air is replaced by hydrogen at the same temperature? The density of air is $1.20 kgm^{-3}$ and that of hydrogen is $0.089 kgm^{-3}$.

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58. Clamped at the middle a metal rod of length 1 meter and density 7.5gm/cc,gives dust heaps at intervals of 8cm" velocity of sound in the gas used is 400 meter/sec.then the young's modulus of material of the rod will be

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59. To determine the sound propagation velocity in air by acoustic resonance technical one can use a pipe with a piston and a sonic membrane closing one of its ends. Find the velocity of sound if the distance between the adjacent positions of the piston at which resonance is observed at a frequency $v = 2000Hz$ is equal to $l = 8.5cm$.

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60. A cylinder of length $1m$ is divided by a thin perfectly flexible diaphragm in the middle. It is closed by similar flexible diaphragams at the ends. The two chambers into which it is divided contain hydrogen and oxygen. The two diaphragms are set in vibrations of same frequency. What is the minimum frequency of these diaphragms for which the middle diaphragm will be motionless? Velocity of sound in hydrogen is $1100m/s$ and that in oxygen is $300m/s$.

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61. In Kundt's tube experiment the following observations were made : Length ofthe brass rod is 100 cm, average length of a loop in air is 10.3 cm and in carbon-di-oxide=8.0 cm. Calculate thevelocityofsound in brass and in CO^2. Whatisthefrequency ofthe note ?

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62. The air column in a pipe closed at one end is made to vibrate in its second overtone by a tuning fork of frequency $440 Hz$. The speed of sound in air is $330 ms^{-1}$. End corrections may be neglected. Let P_0 denote the mean pressure at any point in the pipe, and ΔP the maximum amplitude of pressure variation.

(a) What the length L of the air column.

(b) What is the amplitude of pressure variation at the middle of the column?

(c) What are the maximum and minimum pressures at the open end of the pipe?

(d) What are the maximum and minimum pressures at the closed end of the pipe?

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63. A pop-gun consistsofa cylindrical barrel $3cm^3$ in cross-section closed at one end by a cork and having a well fitting piston at the other. If the piston is pushed slowly in, the cork is finally ejected, giving a pop, the frequency of which is found to be 512 Hz. Assuming that the initial distance between the cork and the pistonwas25 cm and that there isno leakage of air,calculate the force required to eject the cork. Atmospheric pressure = `1kg wt//cm^(2), v = 340 m/s.

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64. Two identical sonometer wires have a fundamental frequency of $500Hz$ when kept under the same tension . The percentage change in tension of one of the wires that would cause an occurrence of $5 beats / s$, when both wires vibrate together is

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65. Two wires are fixed on a sonometer with their tensions are in the ratio 8:1, the length are in the ratio 36,35, the diameters in the ratio 4:1 and densities in the ratio 1:2. If the note of higher pitch has a frequency of 360Hz, then the frequency of other string will be

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66. A tuning fork of frequency 300Hzresonates with an air column closed at one end at 27°C. How many beats will be heard in the vibrations of the fork and the air column at 0°? End correction is negligible.

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67. A string under a tension of 129.6 N produces 10 beats persecond when it is vibrated along with a tuning fork. When the tension in the string is increased to 160 N, it sounds in unison with the same tuning fork. Calculate the fundamental frequency oftuning fork. .

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68. Two forks A and B when sounded together produce four beats s^{-1}. The fork A is in unison with 30 cm length of a sonometer wire and B is in unison with 25 cm length of the same wire at the same tension. The frequencies of the forks are

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69. A column of air at $51^{\circ} C$ and a tuning fork produce 4 beats per second when sounded together. As the temperature of the air column is decreased, the number of beats per second tends to decrease and when the temperature is $16^\circ C$ the two produce 1 beat per second. Find the frequency of the tuning fork.

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70. The first obertone of an open organ pipe beats with the first overtone of a closed organ pipe with a beat frequency of 2.2 Hz. The fudamental frequency of clos3ed organ pipe is 110 Hz. Find length of the open pipe. (Given, sound in air =330 m/s)

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71. The vibration portion of a wire which isstretched with a weight of6.48kg weighs 0.5 gm.When sounding in fundamental note, it isfound togive20 beats in5 seconds, witha vibrating tuning fork of frequency 256. If the length of the wire is slightly decreased, the note emitted by it is observed to be in unison withthat ofthe fork. Calculatethe original length of the wire.

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72. When 0.98m long metallic wire is stressed, an extension of 0.02 m is produced. An organ pipe 0.5 m long and open at both ends, when sounded with this stressed metallic wire, produces 8 beats in its fundamental mode. By decreasing the stress in the wire, the number of beats are found to decrease. Find the young's modulus of wire. The density of metallic wire is $10^4 kg/m^3$ and sound velocity in the air is 292 m/s.

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73. A string $25cm$ long and having a mass of $2.5gm$ is under tension. A pipe closed at one end is $40cm$ long. When the string is set vibrating in its first overtone and the air in the pipe in its fundamental frequency, 8 beats per second are heard. It is observed that decreasing the tension in the string decreases beat frequency. If the speed of sound in air is $320m/s$, find the tension in the string.

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74. A metal wire of diameter $1mm$ is held on two knife edges by a distance $50cm$. The tension in the wire is $100N$. The wire vibrating with its fundamental frequency and a vibrating tuning fork together produce $5beats/s$. The tension in the wire is then reduced to $81N$. When the two are excited, beats are heard at the same rate. Calculate

(a) frequency of a fork and

(b) the density of material of wire.

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75. A locomotive whistle 256 Hz is moying towards a stationary observerwith a velocity $\frac{1}{(20)^{th}}$ that ufsound. What will bethe frequencies of the notes heard by observer beforeand after the engine passes it ?

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76. Two tuning forks with natural frequencies of $340Hz$ each move relative to a stationary observer. One fork moves away form the observer, while the other moves towards him at the same speed. The observer hears beats of frequency $3Hz$. Find the speed of the tuning fork.

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77. A vibrating tuning fork tied to the end of a string 1.988 m long is whirled round a circle. If it makes two revolutions in a second, calculate the ratio of the frequencies of the highest and the lowest notes heard by an observer situated in the plane of the tuning fork. Valocity of sound is 350 m/s.

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78. A source of sonic oscillations with frequency $n = 1700Hz$ and a receiver are located on the same normal to a wall. Both the source and receiver are stationary, and the wall recedes from the source with velocity $u = 6.0\frac{m}{s}$. Find the beat frequency registered by the receiver. The velocity of sound is $v = 340\frac{m}{s}$.

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79. If the earth is moving towards a stationary star at a speed of 30 kilometres per second, find the apparent wavelength oflight emitted from thestar. Therealwavelength hasthevalue 5875 A.

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80. A source of sound of frequency $256 Hz$ is moving rapidly towards wall with a velocity of $5m / \sec$. How many beats per second will be heard if sound travels at a speed of $330m / \sec$.

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81. a radar wave has a frequency of $7.8 \times 10^{9} s^{-I}$. The reflected wave from an aeroplane shows a frequency shows a frequency difference of $2.7 \times 10^{3} \ s^{-1}$ on the higher side. Deduce the velocity of the aeroplane in the line of sight.

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82. Two distant sources situated together emit sound each of frequency 300cycles persecond. Ifoneofthemweretoapproach and the other to recede from a stationary observer each with a velocity of $1/100^th$ the velocity ofsound, calculate the number of beats per second heard by the observer.

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83. A source of sonic oscillations with frequency $v_0 = 1700Hz$ and a receiver are located at the same point. At the moment $t = 0$ the source starts receding from the receiver with constant acceleration $w = 10.0m/s^2$. Assuming the velocity of sound to be equal to $v = 340m/s$, find the oscillation frequency registered by the stationary receiver $t = 10.0s$after the start of motion.

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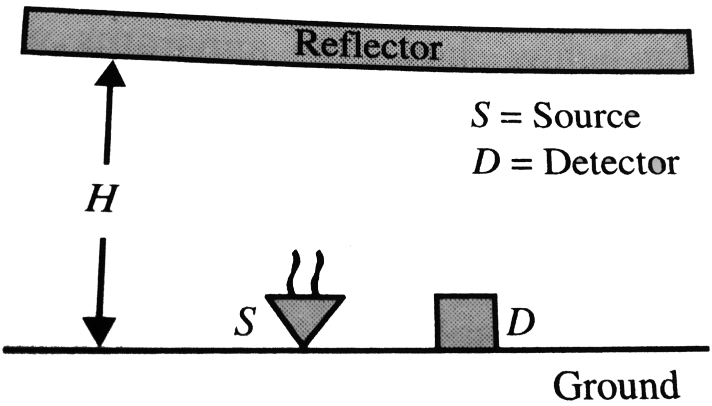
84. A source of sound with natural frequency $f_0 = 1800Hz$ moves uniformly along a straight line separated from a stationary observer by a distance $l = 250m$. The velocity of the source is equal to

$\eta = 0.80$ fraction of the velocity of the sound.

Q. Find the frequency of osund received by the observer at the moment when the source gets closest to him.



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85. A locomotive approaching a crossing at a speed of 80 mi/h sounds a whistle of frequency 400 Hz when 1 mi from the crossing. There is no wind, and the speed of sound in air is 0.200mi/s. What frequency is heard by an observer 0.60 mi from the crossing on the straight road which crosses the railroad at right angles?

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Practice Exercise 6 1

1. A displacement wave is represented by

$\xi = 0.25 \times 10^{-3} \sin(500t - 0.025x)$

Deduce (i) amplitude (ii) period (iii) angular frequency (iv)wavelength (v) amplitude of particle velocity (vi) amplitude of particle acceleration . ξ, t and x are in cm, sec, and metre respectively.

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2. From a cloud at an angle of 30° to the horizontal, we hear the thunder clap 8 s after seeing the lightening flash. What is the height of the cloud above the ground if the velocity of sound in air is $330m/s$?

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3. A wave is expressed by the equation

$y = 0.5 \sin \pi(0.01x - 3t)$

where y and x are in metre and t in seconds. Find the speed of propagation.

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4. A wave pulse is travelling on a string with a speed v towards the positive X-axis. The shape of the string at t = 0 is given by $g(x) = A \sin\left(\frac{x}{a}\right)$, where A and a are constants. (a) What are the dimensions of A and a ? (b) Write the equation of the wave for a general time 1, if the wave speed is v.

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5. A man seeinga lightningstarts countingseconds, until he hears thunder. He then claims to have found an approximate but simple rule that if the count of second is divided by an integer, the result directly gives, in km, the distance of the lightning sotirce. Whatis theinteger ? (Velocityofsound inair = 330 m/s)

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6. A man stands before a large wall at a distance of 50.0 m and claps his hands at regular intervals. Initially, the interval is large. He gradually reduces the interval and fixes it at a value when the echo of a clap merges with the next clap. If he has to clap 10 times during every 3 seconds, find the velocity of sound in air.

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7. A simple harmonic wave has the equation,

$\xi = 0.5 \sin(314t - 1.57x)$

where t, x and ξ are in second, metre and centimetres respectively. Find the frequency and wevelength of this wave. Another wave has the equation

$\xi = 0.1 \sin(314t - 1.57x + 1.57)$

Deduce the phase difference and ratio of intensities for the above two waves.

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8. A plane wave $\zeta = A \cos(\omega t - kx)$ propagates in the reference frame S. find the equation of this wave in a refreence frame S' moving in the +ve direction of x-axis with a constant velocity V relative to S.

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9. The equation of a travelling sound wave is $y = 6.0 \sin(600t - 1.8x)$ where y is measured in $10^{-5}m$, t in second and x in metre. (a) Find the ratio of the displacement amplitude of the particles to the wavelength of the wave. (b) Find the ratio of the velocity amplitude of the particles to the wave speed.

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10. The equation of a travelling plane sound wave has the form $y = 60 \cos(1800t - 5.3x)$, where y is in micrometres, t in seconds and x in metres. Find

(a). The ratio of the displacement amplitude with which the particle of the medium oscillate to the wavelength,

(b).the velocity oscillation ammplitude of particles of the medium and its ratio to the wave propagation velocity , (c). the particle acceleration amplitude.

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11. A man standing in front of a mountain beats a drum at regular intervals. The drumming rate is gradually increased and he finds that echo is not heard distinctly when the rate becomes 40 per minute. He then moves near to the mountain by 90 metres and finds that echo is again not heard distinctly when the drumming rate becomes 60 per minute. Calculate (a) the distance between the mountain and the initial position of the man and (b) the velocity of sound.

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12. A sound wave of frequency 100 Hz is travelling in air. The speed of sound in air is $350ms^{-1}$ (a) By how much is the phase changed at a given point in 2.5 ms ? (b) What is the phase difference at a given instant between two points separated by a distance of 10.0 cm along the direction of propagation ?

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Practice Exercise 6 2

1. A steel wire of length 64 cm weighs 5 g. If it is stretched by a force of 8 N, what would be the speed of a transverse wave passing on it ?

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2. A travelling wave is produced on a long horizontal string by vibrating an end up and down sinusoidally. The amplitude of vibration is 1.0cm and the displacement becomes zero 200 times per second. The linear mass denstiy of the string is$0.10 kgm^{-1}$ and it is kept under a tension of 90 N. (a) Find the speed and the wavelength of the wave. (b) Assume that the wave moves in the positeve x-directin and at t = 0 the end x= 0 is at its positive extreme position. Write the wave equation. (c) Find the velocity and acceleration of the particle at x = 50 cm at time t = 10ms.

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3. Two wires of different densities but same area of cross section are soldered together at one end and are stretched to a tension T. The velocity of a transverse wave in the first wire is double of that in the second wire. Find the ration of the denstiy of the first wire to that of the second wire.

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4. A particle on a stretched string supporting a travelling wave, takes 5.0 ms to move from its mean position to the extreme position. The distance between two consecutive particles, which are at their mean positions, is 2.0 cm. Find the frequency, the wavelength and the wave speed.

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5. The speed of sound as measured by a student in the laboratory on a winter day is 340 m s when the rdoobmy temperature is $17^{\circ} C$. What speed will be measure another student repeating the experiment on a day when the room temperature is $32^{\circ} C$?

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6. A string of length 40 cm and weighing 10 g is attached to a spring at one end and to a fixed wall at the other end. The spring has a spring constant of $160 Nm^{-1}$ and is stretched by 1.0 cm. If a wave pulse is produced on the string near the wall, how much time will it take to reach the spring ?

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7. Find the change in the volume of 1.0 litre kerosene when it is subjected to an extra pressure of $2.0 \times 10^{5} Nm^{-2}$ from the following data. Density of kerosene $= 800 kgm^{-3}$ and speed of sound in kerosene $= 1330 ms^{-1}$

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8. The constant γ of oxygen as well as for hydrogen is 1.40. If the speed of sound in oxygen is $470 ms^{-1}$, What wil be the speed in hydrogen at the same temperature and pressure?

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9. A tuning fork of frequency 440 Hz is attached to a long string of linear mass density $0.01 kgm^{-1}$ kept under a tension of 49 N. The fork produces transverse waves of amplitude 0.50 mm on the string. (a) Find the wave speed and the wavelength of the waves. (b) Find the maximum speed and acceleration of a particle of the string. (c) At what average rate is the tuning fork transmitting energy to the string ?

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10. Velocity of sound in a tube containing air at 27°C and at a pressure of 76 cm of Hg is 300 m/s. What will its velocity be when the pressure is increased to 100 cm of Hg and the temperature is keptconstant ?

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11. A blast given a sound of intensity $0.8W/m^2$ at frequency 1kHz. If the denstiy of air is 1.3 kg/m^3 and speed of sound in air is 330 m/s, then the amplitude of the sound wave is approximately

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Practice Exercise 6 3

1. A source emitting sound of frequency 180 Hz is alced in front of a wall at a distance of 2 m from it. A detector is also placed in front of the weal at the same distance from it. Find the minimum distance between the source and the detector for which the detector detects a maximum of sound. Speed of sound in air $= 360ms^{-1}$.

2. Two audio speakers are kept some distance apart and are driven by the same amplifier system. A person is sitting at a place 6.0 m from one of the speakers and 6.4 m from the other. If the sound signal is continuously varied from 500 Hz to 5000 Hz, what are the frequencies for which there is a destructive interference at the place of the listener? Speed of sound in air $= 320ms^{-1}$

3. Two point sources of sound are kept at a separation of 10 cm. They vibrate in phase to produce waves of wavelength 5.0 cm. What would be the phase difference between the two waves arriving at a point 20 cm from one source (a) on the line joining the sources and (b) on the perpendicular bisector of the line joining the sources ?

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4. Two sources of sound S_1 and S_2 vibrate at same frequency and are in phase. The intensity of sound detected at a point P as shown in the figure is I_0 . (a) If θ equals 45°, what will be the intensity of sound detected at this point if one of the sources is switched off ? (b) What will be the answer of the previous part if $\theta = 60^\circ$?

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5. Sound waves from a tuning fork A reacha point P by two separate paths ABP and ACP. When ACP is greater than ABP by $11.5cm$, there is silence at p. When the difference is $23cm$ the sound becomes loudest at P and $34.5cm$ there is silence again and so on. Calculate the minimum frequency of the fork if the velocity of sound is taken to be $331.2m/s$.

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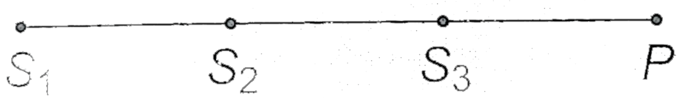
6. Three sources of sound S_1, S_2 and S_3 of equal intensity are placed in a straight line with $S_1S_2 = S_2S_3$ shown in the figure. At a point P, far away from the sources, the wave coming from S_2 is 120° ahead in phase of that from S_1, Also, the wave coming from S_3 is 120° ahead of that from S_2. What would be the resultant intensity of sound at P ?



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7. Sounds from two identical sources S_1 and S_2 reach a point P. When the sounds reach directly, and in the same phase, the intensity at P is I_0. The power of S_1 is now reduced by 64% and the phase difference between S_1 and S_2 is varied continuously. The maximum and minimum intensities recorded at P are now $I_{\max}$ and $I_{\min}$

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8. At two points S_1 and S_2 on a liquid surface two coherent wave sources are set in motion at t = 0 with the same phase. The speed of the waves in the liquid v = 0.5 m/s, the frequency of vibration $\eta = 5Hz$ and the amplitude A = 0.04 m. At a point P of the liquid surface which is at a distance x_1 = 0.30m from S_1 and x_2 = 0.34 m from S_2 a piece of cork floats:

(a) Find the displacement ofthe cork at t = 3 s.

(b) Find the time t_0 that elapse from the moment the wave sources were set in motion until the moment that the cork passes through the equilibrium position for the first time.

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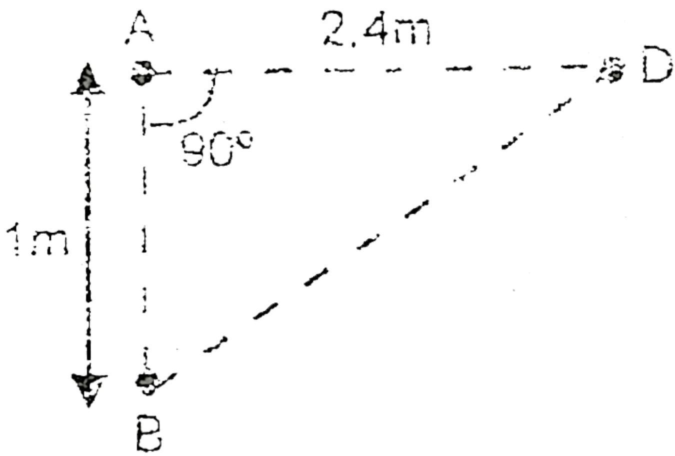
9. Two point sound sources A and B each to power $25\pi w$ and frequency $850Hz$ are $1m$ apart. The sources are in phase



(a) Determine the phase difference between the waves emitting from A and B received by detector D as shown in figure.

(b) Also determine the intensity of the resultant sound wave as recorded by detector D. Velocity of sound $= 340m/s$.

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10. Two sources of sound of the same frequency produce sound intensities I and $4I$ at a point P when used individually. If they are used together such that the sounds from them reach P with a phase differenceof $2\pi/3$, the intensity at P will be

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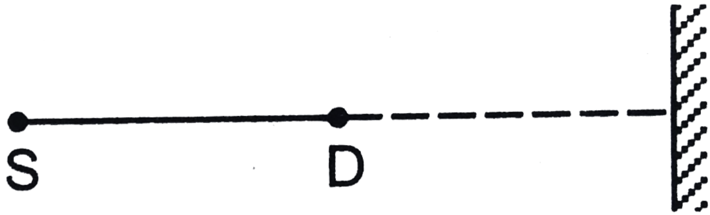
11. A source of sound S and a detector D are placed at some distance from one another. A big cardboard is placed near the detector and perpendicular to the line SD as shown in figure. It is gradually moved away and it is found that the intensity changes from a maximum to a minimum as the board is moved through a distance of 20 cm. Find the frequency of the sound emitted. Velocity of sound in air is

$336ms^{-1}$.



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Practice Exercise 6 4

1. If the intensity of sound is doubled, by how many decibels does the sound level increase ?

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2. A certain sound level is increased by an additional 30 dB, Find the factor by which

(a) its intensity increases and

(b) its pressure amplitude increases.

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3. If the sound level in a room is increased from 50 dB to 60 dB, by what factor is the pressure amplitude increased ?

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4. A typical loud sound wave with a frequency of $1Kh_Z$ has a pressure amplitude of about 10 Pa

(a) At $t=0$, the pressure is a maximum at some point X_1. What is the displacement at that point at $t=0$?

(b) What is the maximum value of the displacement at any time and place/ Take the density of air to be $1.29kg/m^3$ and speed of sound in air is $340m/s$.

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5. A source of sound operates at 2.0 kHz, 20 W emitting sound uniformly in all direction. The speed of sound in air is $340ms^{-1}$ at a distance of air is $1.2kgm^{-3}$ (a) What is the intensity at a distance of 6.0 m from the source ? (b) What will be the pressure amplitude at this point ? (c) What will be the displacement amplitude at this point ?

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6. The intensity of sound from a point source is $1.0 \times 10^{-8} Wm^{-2}$, at a distance of 5.0 m from the source. What will be the intensity at a distance of 25 m from the source ?

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7. The noise level in a classroom in absence of the teacher is 50 dB when 50 students are present. Assuming that on the average each student outputs same sound energy per second, what will be the noise level if the number of students is increased to 100 ?

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8. At a distance $r_0 = 20m$ form an isotropic point source of sound the loudness level is $L_0 = 30dB$. Neglicting the damping of the sound wave, find : (a) the loudness level at a distacne $r = 10m$ form the source, (b) the distance form the source at which sound is not heard.

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9. In a good FM radio receiver, the radio signal detected may be as much as 65 dB greater than the noise signal. What is the ratio of signal intensity to noise intensity ?

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10. two sound waves moves in the same direction .if the average power transmiitted across a cross - section by them are equal while their wavelengths are in the ratio of 1:2 . Their pressure amplitudes would be in the ratio of

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Practice Exercise 6 5

1. A steel wire of length $1m$ and density $8000kg/m^3$ is stretched tightly between two rigid supports . When vibrating in its fundamental mode , its frequency is $200Hz$.

a. What is the velocity of transverse wave along this wire ?

b. What is the longitudinal stress in the wire ?

c. If the maximum acceleration of the wire is $880m/s^2$, what is the amplitude of vibration at the midpoint ?

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2. A steel wire of length $1m$ and density $8000kg/m^3$ is stretched tightly between two rigid supports . When vibrating in its fundamental mode , its frequency is $200Hz$.

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a. What is the velocity of transverse wave along this wire ?

b. What is the longitudinal stress in the wire ?

c. If the maximum acceleration of the wire is $880m/s^2$, what is the amplitude of vibration at the midpoint ?

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4. A sonometer wire having a length of 1.50 m between the bridges vibrates in its second harmonic in resonance with a tuning fork of frequency 256 Hz. What is the speed of the transverse wave on the wire ?

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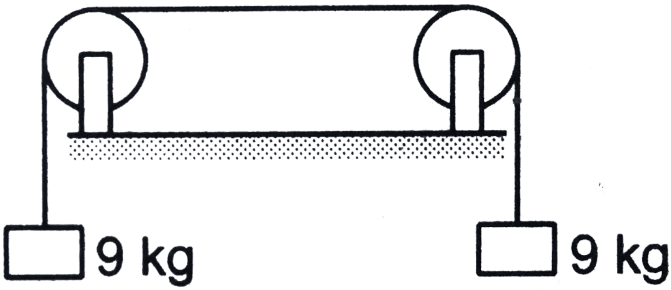
5. The length of the wire shown in figure between the pulley is 1.5 m and its mass is 12.0 g. Find the frequency of vibration with which the wire vibrates in two loops leaving the middle point of the wire between the pulleys at rest.



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6. A steel wire fixed at both ends has a fundamental frequency of 200 Hz. A person can hear sound of maximum frequency 14 kHz. What is the highest harmonic that can be played on this string which is audible to the person ?

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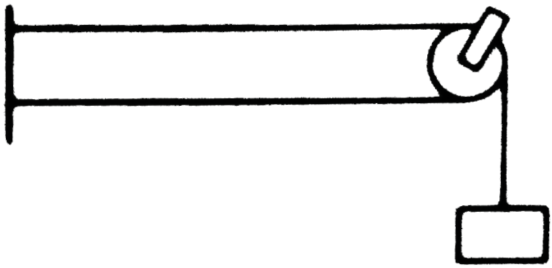
7. Figure shows a string stretched by a block going over a pulley. The string vibrates in its tenth harmonic in unison with a particular tuning fork. When a beaker containing water is brought under the block so that the block is completely dipped into the beaker, the string vibrates in its eleventh harmonic. Find the density of the material of the block.



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8. A wire of diameter $0.04cm$ and made of steel of density $8000kg/m^3$ is under a tension of $80N$. A fixed length of $50cm$ is set into transverse vibrations . How would you cause vibrations of frequency $840Hz$ to predominate in intensity ?

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9. The displacement of the medium in a sound wave is given by the equation $y_1 = A\cos(ax + bt)$ where A, a and b are positive constants. The wave is reflected by an obstacle situated at $x = 0$. The intensity of the reflected wave is 0.64 times that of the incident wave.

(a) What are the wavelength and frequency of incident wave?

(b) Write the equation for the reflected wave.

(c) In the resultant wave formed after reflection, find the maximum and minimum values of the particle speeds in the medium.

(d) Express the resultant wave as a superposition of a standing wave and a travelling wave. What are the positions of the antinodes of the standing wave ? What is the direction of propagation of travelling wave?

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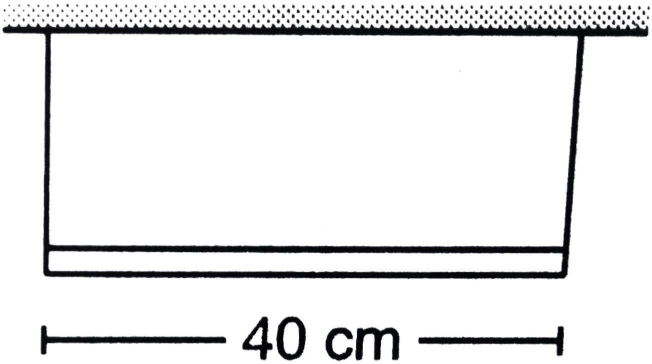
10. A uniform horizontal rod of length 40 cm and mass 1.2 kg is supported by two identical wires as shown in figure. Where should a mass of 4.8 kg be placed on the rod so that the same tuning fork may excite the wire on left into its fundamental vibrations and that on right into its first overtone ? Take $g = 10ms^{-2}$



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11. A 2 m-long string fixed at both ends is set into vibrations in its first overtone. The wave speed on the string is 200 m s and the amplitude is 0.5 cm. (a) Find the wavelength and the frequency. (b) Write the equation giving the displacement of different points as a function of time. Choose the X-axis along the string with the origin at one end and t = 0 at the instant when the point x= 50 cm has reached its maximum displacement.

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12. A 2 m-long string fixed at both ends is set into vibrations in its first overtone. The wave speed on the string is 200 m s and the amplitude is 0.5 cm. (a) Find the wavelength and the frequency. (b) Write the equation giving the displacement of different points as a function of time. Choose the X-axis along the string with the origin at one end and t = 0 at the instant when the point x= 50 cm has reached its maximum displacement.

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13. Three resonant frequencies of a string are 90, 150 and 210 Hz. (a) Find the highest possible fundamental frequency of vibration of this string. (b) Which harmonics of the fundamental are the given frequencies ? (c) Which overtones are these frequencies ? (d) If the length of the string is 80 cm, what would be the speed of a transverse wave on this string ?

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14. Three resonant frequencies of a string are 90, 150 and 210 Hz. (a) Find the highest possible fundamental frequency of vibration of this string. (b) Which harmonics of the fundamental are the given frequencies ? (c) Which overtones are these frequencies ? (d) If the length of the string is 80 cm, what would be the speed of a transverse wave on this string ?

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15. Three resonant frequencies of a string are 90, 150 and 210 Hz. (a) Find the highest possible fundamental frequency of vibration of this string. (b) Which harmonics of the fundamental are the given frequencies ? (c) Which overtones are these frequencies ? (d) If the length of the string is 80 cm, what would be the speed of a transverse wave on this string ?

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16. Three resonant frequencies of a string are 90, 150 and 210 Hz. (a) Find the highest possible fundamental frequency of vibration of this string. (b) Which harmonics of the fundamental are the given frequencies ? (c) Which overtones are these frequencies ? (d) If the length of the string is 80 cm, what would be the speed of a transverse wave on this string ?

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Practice Exercise 6 6

1. Find the fundamental frequency and the first four overtones of a $15cm$ pipe (a) if the pipe is closed at one end , and (b) if the pipe is open at both ends. (c) How many overtones may be heard by a person of normal hearing in each of the above cases ? velocity of sound in air $= 330m/s$.

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2. Find the fundamental frequency and the first four overtones of a $15cm$ pipe (a) if the pipe is closed at one end , and (b) if the pipe is open at both ends. (c) How many overtones may be heard by a person of normal hearing in each of the above cases ? velocity of sound in air $= 330m/s$.

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3. Find the fundamental frequency and the first four overtones of a $15cm$ pipe (a) if the pipe is closed at one end , and (b) if the pipe is open at both ends. (c) How many overtones may be heard by a person of normal hearing in each of the above cases ? velocity of sound in air $= 330m/s$.

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4. The separation between a node and the next antinode in a vibrating air column is 25 cm. If the speed of sound in air is $340ms^{-1}$, find the frequency of vibration of the air column.

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5. For a certain organ pipe, three successive resonance frequencies are observer at 425, 595 and $765H_Z$ respectively. Taking the speed of sound in air to be $340m/s$, (a) explain whether the pipe is closed at one or open at boyh ends. (b) determine the fundamental frequency and length of the pipe.

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6. For a certain organ pipe, three successive resonance frequencies are observer at $425, 595$ and $765H_Z$ respectively. Taking the speed of sound in air to be $340m/s$, (a) explain whether the pipe is closed at one or open at boyh ends. (b) determine the fundamental frequency and length of the pipe.

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7. A pipe is closed at one end by a membrane which may be considered a seat of displacement node and is set to sonic oscillations of frequency $2000Hz$. Find the velocity of sound if on moving the piston , resonance occurs at the interval of $8.5cm$.

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8. A 'pop' gun consists of a tube 25 cm long closed at one end by a cork and at the other end by a tightly fitted piston. The piston is pushed slowly in. When the pressure rises to one and half times the atmospheric pressure, the cork is violently blown out. Calculate the frequency of the 'pop' caused by its ejection. Speed ofsound in air is 340 m/s

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9. A cylindrical metal tube has a length of 50 cm and is open at both ends. Find the frequencies between 1000 Hz and 2000 Hz at which the air column in the tube can resonate. Speed of sound in air is $340ms^{-1}$.

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10. A uniform tube of length 60 cm stands vertically with its lower end dipping into water. When the length above water successively taken at 14.8 cm and 48.0 cm, the tube responds to a vibrating tuning fork of frequency 512 Hz. Find the lowest fi-equency to which the tube will respond when it is open at both ends.

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11. A tuning fork of frequency 340Hz vibrated above a cylindrical hallow tube closed at one end. The height of the tube is 120cm . Water is slowly poured in it. What is the minimum height of water required for resonance ?

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12. A tube closed at one end has a vibrating diaphragm at the other end , which may be assumed to be a displacement node . It is found that when the frequency of the diaphragm is $2000Hz$, a stationary wave pattern is set up in which the distance between adjacent nodes is $8cm$. When the frequency is gradually reduced , the stationary wave pattern reappears at a frequency of $1600Hz$. Calculate

i. the speed of sound in air ,

ii. the distance between adjacent nodes at a frequency of $1600Hz$,

iii. the distance between the diaphragm and the closed end ,

iv. the next lower frequencies at which stationary wave patterns will be obtained.

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13. A tube closed at one end has a vibrating diaphragm at the other end , which may be assumed to be a displacement node . It is found that when the frequency of the diaphragm is $2000Hz$, a stationary wave pattern is set up in which the distance between adjacent nodes is $8cm$. When the frequency is gradually reduced , the stationary wave pattern reappears at a frequency of $1600Hz$. Calculate

i. the speed of sound in air ,

ii. the distance between adjacent nodes at a frequency of $1600 Hz$,

iii. the distance between the diaphragm and the closed end ,

iv. the next lower frequencies at which stationary wave patterns will be obtained.

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14. A tube closed at one end has a vibrating diaphragm at the other end , which may be assumed to be a displacement node . It is found that when the frequency of the diaphragm is $2000 Hz$, a stationary wave pattern is set up in which the distance between adjacent nodes is $8 cm$. When the frequency is gradually reduced , the stationary wave pattern reappears at a frequency of $1600 Hz$. Calculate

i. the speed of sound in air ,

ii. the distance between adjacent nodes at a frequency of $1600 Hz$,

iii. the distance between the diaphragm and the closed end ,

iv. the next lower frequencies at which stationary wave patterns will be obtained.

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15. A tube closed at one end has a vibrating diaphragm at the other end , which may be assumed to be a displacement node . It is found that when the frequency of the diaphragm is $2000Hz$, a stationary wave pattern is set up in which the distance between adjacent nodes is $8cm$. When the frequency is gradually reduced , the stationary wave pattern reappears at a frequency of $1600Hz$. Calculate

i. the speed of sound in air ,

ii. the distance between adjacent nodes at a frequency of $1600Hz$,

iii. the distance between the diaphragm and the closed end ,

iv. the next lower frequencies at which stationary wave patterns will be obtained.

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Practice Exercise 6 7

1. A closed pipe and an open pipe sounding together produce 5 beats per second. If the length of the open pipe is 30 cm, find by how much the length of the closed pipe should be changed to bring the two pipes in unison. Take speed of sound in air is 330 m/s.

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2. (a) A tuning fork produces 4 beats per second with another tuning fork of frequency $256Hz$. The first one is now loaded with a little wax and the beat frequency is found to increase to 6 per second. What was the original frequency of the tuning fork ?

(b) A plano wire A vibrates at a fundamental frequncy of $600Hz$. A second identical wire B produces 6 betas per second with it, when of the tension in A is slightly increased. Find the ratio of the tension in A to the tension to B.

(c) A tunnig fork if frequency $256Hz$ produces 4 beats per second with a wire of length $25cm$ vibrating in its fundamental mode. The beat frequency decreases when the length is slightly shortened. What could be the minimum length by whech the wire be shortened so that it produces no beats with the tuning fork?

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3. If two sound waves, $y_1 = 0.3 \sin 596\pi[t - x / 300]$ and $y_2 = 0.5 \sin 604\pi[t - x / 330]$ are superimposed, what will be the

(a) frequencyof resultant wave

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4. If two sound waves, $y_1 = 0.3 \sin 596\pi[t - x / 300]$ and $y_2 = 0.5 \sin 604\pi[t - x / 330]$ are superimposed, what will be the

(b) frequencyat which beats are produced.

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5. If two sound waves, $y_1 = 0.3 \sin 596\pi[t - x/300]$ and $y_2 = 0.5 \sin 604\pi[t - x/330]$ are superimposed, what will be the

(c) Tlie ratio ofmaximum and minimum intensities of beats

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6. A set of 25 tuning forks is arranged in order of decreasing frequency. Each fork gives 3 beats with succeeding one. The first fork is octave of the last. Calculate the frequency of the first and 16th fork.

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7. A piano wire A vibrates at a fundamental frequency of 600 Hz. A second identical wire B produces 6 beats per second with it when the tension in A is slightly increased. Find the ratio of the tension in A to the tension in B.

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8. You are given four tuning forks, the lowest frequency of the forks is $300Hz$. By striking two tuning forks at a time any of $1, 2, 3, 5, 7$ & $8Hz$ beat frequencies are heard. The possible frequencies of the other three forks are -

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9. There are three sources of sound of equal intensity with frequencies 400, 401 and 402 vib/sec . The number of beats heard per second is

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10. A tunnig fork of frequency 256 Hz produces 4 beats per second with a wire of length 25 cm vibrating in its fundamental mode. The beat frequency decreases when the length is slightly shortened. What could be the minimum length by which the wire be shortened so that it produces no beats with the tuning fork ?

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Practice Exercise 6 8

1. A policeman on duty detects a drop detects a drop of 15% in the pitch of the horn of a motor car as it crossed him. If the velocity of sound is $330 metre / \sec.$, calculate speed of the car.

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2. A car travelling towards a hill at $10m/s$ sound its horn which a frequency $500H_Z$. This is heard in a second car travelling behind the first car in the same direction with speed $20m/s$. The sound can also be heard in the second car by reflections of sound the hill. The beat frequency heard by the driver of the sound car will be (speed of sound in air $= 340m/s$)

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3. The wavelength of light coming from a distant galaxy is found to be 0.5% more than that coming from a source on earth. Calculate the velocity of galaxy.

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4. A band playing music at a frequency f is moving towards a wall at a speed v_b. A motorist is following the band with a speed v_m. If v is the speed of sound, obtain an expression for the beat frequency heard by the motorist.

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5. An astronaut is approaching the moon. He sends a ratio signal of frequency $5 \times 10^9 Hz$ and find that the frequency shift in echo received is $10^3 Hz$. Find his speed of approach.

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6. If a vibrating fork is rapidly moved towards a wall, beats may beheard between the direct and reflected sounds. Calculate beat frequency if the frequency of fork is 512 Hz and approaches the wall with a velocity of 300 cm/s. The velocity of sound is 330 m/s. Consider observer is behind the fork.

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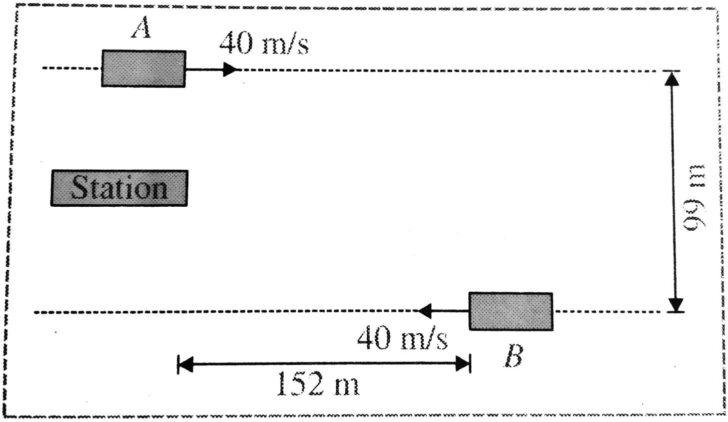

7.

A train A crosses a station with a speed of 40 m/s and whitles a short pulse of natural frequency $n_0 = 596Hz$ another train B is approaching towards the same station with the same speed along a parallel track, Two track are $d = 99m$ apart. When train A whistles. train B is 152 m away from the station as shown in Fig. If velocity of sound in air is $v = 300\frac{m}{s}$. calculate frequency of the pulse heard by driver of train B.

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8. How fast a person should drive his car so that the red signal fo light apperas green ?

(Wavelength for red colour = 6200 Å and wavelength for green colour = 5400 Å)

Watch Video Solution

Discussion Question

1. Is it possible to monitor the temperature of a wire by measuring its vibrational frequency?

Watch Video Solution

2. S_1: The particles speed can never be equal to the wave speed in sine wave if the amplitude is less then wavelength divided by 2π.

S_2: In transverse wave of amplitude A, the maximum particle velocity is four times its wave velocity. Then, the wave length of the wave is πA

S_3: the phase difference between two points separated by 1m in a wave of frequency 120 Hz is 90°. the velocity of the wave is 480 m/s

Watch Video Solution

3. Two wave pulses identical in shape but inverted with respect to each other are produced at the two ends of a stretched string. At an instant when the pulses reach the middle, the string becomes completely straight. What happens to the energy of the two pulses ?

Watch Video Solution

4. The voice of a person, who has inhaled helium, has a remarkably high pitch. Explain on the basis of resonant vibration of vocal cord filled with air and with helium.

Watch Video Solution

Watch Video Solution

5. Distinguish between sound waves and radio waves of same frequency, say 15kHz.

Watch Video Solution

6. Where will a person hear maximum sound, at node or antinode?

Watch Video Solution

7. If you are walking on the moon, can you hear the sound of stones cracking behind you ? Can you hear the sound of your own footsteps ?

Watch Video Solution

8. If oil of density higher than that of water is used in place of water in a resonance tube its frequency will be

Watch Video Solution

9. Two organ pipes of same length, open at both ends produce sound of different pitch, if their radii are different. Why?

Watch Video Solution

10. Does the change in frequency due to Doppler effect depend on (i) distance between source and observer? (ii) the fact that source is moving towards observer or observer is moving towards the source?

Watch Video Solution

11. What is the evidence in support of the fact that (a) sound is a wave (b) sound is a mechanical wave (c) sound waves are longitudinal.

Watch Video Solution

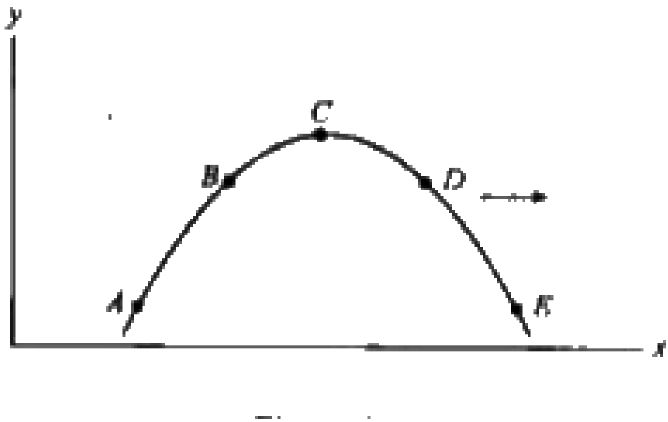
12. The source of energy of sun is fusion of hydrogen which provides energy in the form of heat, light and sound. Explain why sound from sound from sun does not reach earth while heat and light do.

Watch Video Solution

13. Explain clearly why the ifsound from an open pipe is different than from a closed pipe of same fundamental frequency.

Watch Video Solution

14. A graph of part of awave pulse onastring at a particular instant is shown in figure-6.96, Which are the points marked with letters is instantaneously at rest? What are the directions of velocities of the points marked in figure. Do any of your answers dependon the direction of propagation ?



Watch Video Solution

15. The speed of sound waves depends on temperature but speed of ligth waves does not. Why?

Watch Video Solution

16. Two loudspeakers are arranged facing each other at some distance. Will a person standing behind one of the loudspeakers clearly hear the sound of the other loudspeaker or the clarity will be seriously damaged because of the 'collision' of the two sounds in between ?

Watch Video Solution

17. Two tuning forks vibrate with the same amplitude but the frequency of the first is double the frequency of the second. Which fork produces more intense sound in air ?

Watch Video Solution

18. Can we ever construct an organ pipe whose frequency does not change with temperature? If no why? If yes, under what condition?

Watch Video Solution

19. What type of mechanical waves do you expect to exist in (a) vacuum (b) air (c) inside the water (d) rock (e) on the surface of water ?

Watch Video Solution

20. Can a great singer cause a glass object to shatter byhis singing? Explain with reason

Watch Video Solution

21. Sometimes when an airplane flies near a house, the television signal received at the house fades periodically. Why?

Watch Video Solution

22. A plane wave of sound travelling in air is incident upon a plane water surface. The angle of incidence is 60°. Assuming snell's law to be valid for sound waves, it follows that the sound wave will be refracted into water away from the normal.

Watch Video Solution

23. Which factors determine the frequency of a tuning fork ?

Watch Video Solution

24. The distance from the sun to Mars is about $3/2$ that from the sun to the earth. Compare the intensity ofsunlight at Mars with the intensity ofsunlight at the earth.

Watch Video Solution

25. Explain why

(a) velocityofsoundis generallygreater in solids than in gases,

(b) the velocity of sound in oxygen is lesser than in hydrogen.

Watch Video Solution

26. The radio and TV programmes, telecast at the studio, reach our antenna by wave motion. Is it a mechanical wave or nonmechanical ?

Watch Video Solution

Conceptual Mcqs Single Option Correct

1. Two starts P and Q have slightly different surface temperature T_P and T_Q respectively, with $T_P > T_Q$. Both starts are receding from the earth with speeds v_P and v_Q relative to the earth. The wavelength of light at which they radiate the maximum energy is found to be the same for both.

A. $v_p > v_Q$

B. $v_p < v_Q$

C. $v_P = v_Q$ and the size of Q gt the size of P

D. Nothing can be said regarding v_P and v_Q from the given data

Answer: A

Watch Video Solution

2. In the water a of a lakea blastoccurs. Thewaves produced in water will be,

A. Transverse

B. Longitudinal

C. Stationary

D. Both transverse and longitudinal

Answer: D

View Text Solution

3. Two standing bodies producing progressive waves are given by

$y_1 = 4\sin 400\pi t$ and $y_2 = 3\sin 404\pi t$

One of these bodies situated very near to the ears of a person who will hear :

A. 2 beats persecond with intensity ratio $\frac{4}{3}$ between maxima andminima

B. 2 beats per second with intensity ratio 49 betweenmaxima and minima

C. 4 beats per second with intensity ratio 7 between maxima and minima

D. 4 beats per second with intensity ratio $\frac{4}{3}$ between maxima andminima

Answer: B

Watch Video Solution

4. Two harmonic waves travelling in the same medium have frequency in the ratio 1:2 and intensity in the ratio 1:36. Their amplitude ratio is:

A. $1:6$

B. $1:8$

C. $1:72$

D. 1:3`

Answer: D

Watch Video Solution

5. A pipe of length 20 cm is closed at one end.Which harmonic mode ofthe pipe is resonantly excited by a 425 Hz source ? The speed of sound = $340m / s^{-1}$

A. First harmonic

B. Second harmonic

C. Third harmonic

D. Fourth harmonic

Answer: A

Watch Video Solution

6. The frequency of a wave is reduced to one quarter and its amplitude is made twice. The intensity ofthe wave:

A. Increases by a factor of 2

B. Decreases by a factor of 4

C. Decreasesbyafectorof2

D. Remain unchanged

Answer: B

Watch Video Solution

7. Radio waves of frequency 600 MHz are sent by a radar towards an enemy aircraft. The frequency of the radio waves reflected from the aircraft as measured at the radar station is found to increase by 6 kHz. It follows that the aircraft is :

A. Approaching the radar station with a speed $1.5kms^{-1}$

B. Going away from the radar station with a speed $1.5kms^{-1}$

C. Approaching the radar station with a speed $3kms^{-1}$

D. Going away from the radar station with a speed $3kms^{-1}$

Answer: A

Watch Video Solution

8. The velocity of sound in dry air is V_d, and in moist air it is V_m. The velocities are measured under the same conditions of temperature and pressure. Which of the following statements is fully correct?

A. $V_d > V_m$ because dry air has lower density than moistair

B. $V_d < V_m$ because moistair has lower density than dry air

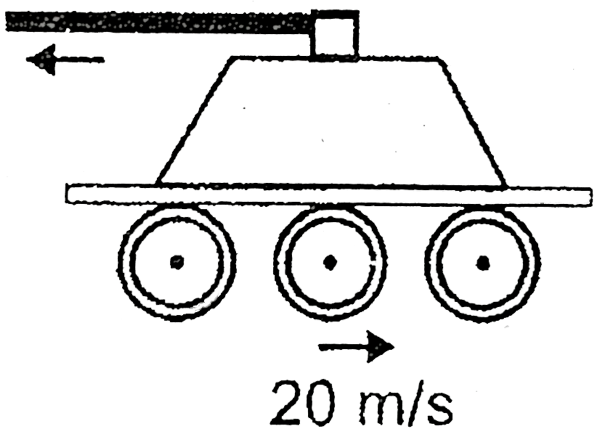
C. $V_d > V_m$ because the bulk modulus of dry air is greater than that of moist air

D. $V_d < V_m$ because the bulk modulus of moist air is greater than that of dry air

Answer: B

Watch Video Solution

9. A machine gun is mounted on an armored car moving with a speed of $20ms^{-1}$. The gun point against the direction of motion of car. The muzzle speed of bullet is equal to speed of sound in air i.e., $340ms^{-1}$. The time difference between bullet actually reaching and sound of firing reaching at a target $544m$ away from car at the instant of firing is reaching at a target $544m$ away from car at the instant of firing is



A. The sound arrives at the target later than the bullet

B. The sound arrives at the target earlier than the bullet

C. Both sound and bullet arrive at the target at the same time

D. The bullet will never arrive at the target

Answer: A

Watch Video Solution

10. Out of the fourchoicesgiven in Q. No. 6-9 above, choose the correct choice,if the gun points in a direction oppositeto the direction of motion of the tank.

A. The sound arrives at the target later than the bullet

B. The sound arrives at the target earlier than the bullet

C. Both sound and bullet arrive at the target at the same time

D. The bullet will never arrive at the target

Answer: B

View Text Solution

11. When we hear a sound, we can identify its source from

A. The frequency of the sound

B. The amplitude of the sound

C. The wavelength of the sound

D. The overtones present in the sound

Answer: D

Watch Video Solution

12. The wavelength of light of a particular wavelength received from a galaxy is measured on earth and is found to be 5% more that its wavelength. It follows that the galaxy is:

A. Approaching the earth with a speed $3 \times 10^7 ms^{-1}$

B. Going away from the earth with a speed $1.5 \times 10^7 ms^{-1}$

C. Approaching the earth with a speed $1.5 \times 10^7 ms^{-1}$

D. Going away from the earth with a speed $1.5 \times 10^7 ms^{-1}$

Answer: D

Watch Video Solution

13. Consider a wave rpresented by $y = a\cos^2(\omega t - kx)$ where symbols have their usual meanings. This wave has

A. An amplitude a, frequency ω and wavelength λ

B. An amplitude a, frequency 2ω and wavelength 2λ

C. An amplitude $\frac{1}{2}a$ frequency 2ω and wavelength $\frac{1}{2}\lambda$

D. An amplitude $\frac{1}{2}$a, frequency 2ω and wavelength X

Answer: C

Watch Video Solution

14. A pipe of length 20 cm is open at both ends. Which harmonic mode ofthe pipe is resonantly excited by a 1700 Hz source? The speed of sound= $340ms^{-1}$

A. First harmonic

B. Second harmonic

C. Third harmonic

D. Fourth harmonic

Answer: B

Watch Video Solution

15. A sine wave has an amplitude A and wavelength λ. Let V be the wave velocity and v be the maximum velocity of a particle in the medium. Then

A. V cannot be equal to v

B. V = v, if A lambda//2pi

C. $V = v, \quad \text{if} \quad A = 2\pi\lambda$

D. V =v, lambda = A//pi

Answer: B

Watch Video Solution

16. At t=0, a transverse wave pulse in a wire is described by the function $y = 6/(x^2 - 3)$ where x and y are in metres. The function y(x,t) that describes this wave equation if it is travelling in the positive x direction with a speed of $4.5m/s$ is

A. $y = \dfrac{6}{(x + 4.5t)^2 - 3}$

B. $y = \dfrac{6}{(x - 4.5t)^2 + 3}$

C. $y = \dfrac{6}{(x + 4.5t)^2 + 3}$

D. $y = \frac{6}{(x - 4.5t)^2 - 3}$

Answer: D

Watch Video Solution

17. A motion is described by $y = 3e^x . e^{-3t}$ where y,x are in metre and t is in second :

A. This represents equation of progressive wavepropagating along - X direction with $3ms^{-1}$

B. This represents equation of progressive wave propagating along + X direction with $3ms^{-1}$

C. This does not represent a progressive wave equation

D. Data is insufficient to arrive at any conclusion ofthis short

Answer: B

Watch Video Solution

18. Two waves ofsame frequency, constant phase difference but different amplitude superpose at a point:

A. The resultant intensity varies periodically as a function of time

B. There will be no interference

C. There will be interference in which the minimum intensity will not be zero

D. There will be interference in which the minimum intensity is zero

Answer: C

View Text Solution

19. A wave equation is represented as

$$r = A\sin\left[\alpha\left(\frac{x-y}{2}\right)\right]\cos\left[\omega t - \alpha\left(\frac{x+y}{2}\right)\right]$$

where x and y are in metres and t in seconds . Then ,

A. The wave is a stationary wave

B. The waveis a progressive wave propagating along + x axis

C. The wave is a progressive wave propagating at right angle to the+ x axis

D. All points lying on line $y = x + \frac{4\pi}{\alpha}$ are always at rest

Answer: D

Watch Video Solution

20. A wave source of frequency v and an observer are located a fixed distance apart. Both the source and observer are stationary. However, the propagation medium (through which the waves travel at speed v) is moving at a uniform velocity v_m in an arbitrary direction. If v' is the frequency received by the observer then :

A. $v' \neq v$

B. $v' = v$ as the transit time from source to observer is the same for all wave fronts

C. $v' < v$ as the transit time from source to observer is the same for all wave fronts

D. Data Insufficient

Answer: B

Watch Video Solution

21. Two wave function in a medium along x direction are given by

$$y_1 = \frac{1}{2 + (2x - 3t)^2} m, y_2 = -\frac{1}{2 + (2x + 3t - 6)^2} m$$

Where x is in meters and t is in seconds

A. There is no position at which resultant displacement will be zero at all times

B. There is no time at which resultant displacement will be zero everywhere

C. Both waves travel along the same direction

D. Both waves travel in opposite directions

Answer: D

Watch Video Solution

22. Mark correct statement(s):

A. Maximum pressure variation takes place at nodes

B. In case ofstationary wave, relative deformation at a point u is given by $\Delta P = \frac{u}{v}$ where u is particle's velocity at that point.

C. When a stationarywave is established maximum intensity is obtained at antinodes

D. None of these

Answer: A

Watch Video Solution

23. A sine wave of wavelength λ is travelling in a medium. The minimum distance between the two particles always having same speed is.

A. $\lambda/4$

B. $\lambda/3$

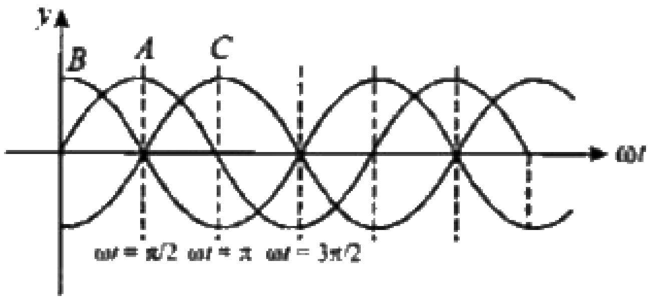
C. $\lambda/2$

D. λ

Answer: C

Watch Video Solution

24. The figure shows four progressive waves A, B, C 8 l D. It can be concluded from the figure that with respectto wave A:



A. The wave C is ahead by a phase angle of $\pi/2$ & the waveB lags behind by a phase angle $\pi/2$

B. The wave C lags behind by a phase angle of $\pi/2$ & the wave B is ahead by a phase angle of $\pi/2$

C. he wave C is ahead by a phase angle of π the wave B lags behind by the phase angle of π

D. The wave C lags behind by a phase angle of (π)& the wave B is ahead by a phase angle of (π)

Answer: B

View Text Solution

Numerical Mcqs Single Options Correct

1. A man sets his watch by the sound of a siren placed at a distance 1 km away . If the velocity of sound is $330m/s$

A. His watch is set 3s faster

B. His watch is set 3s slower

C. His watch is set correctly

D. None of the above

Answer: B

Watch Video Solution

2. The frequency of a tunning fork is 384 per second and velocity of sound in air is 352 m/s . How far the sound has traversed while fork completes 36 vibration

A. 3m

B. 13m

C. 23m

D. 33m

Answer: D

Watch Video Solution

3. The equation of displacement of two waves are given as

$$y_1 = 10\sin\left(3\pi t + \frac{\pi}{3}\right), \; y_2 = 5\left[\sin 3\pi t + \sqrt{3}\cos 3\pi t\right]$$

Then what is the ratio of their amplitudes

A. $1:2$

B. $2:1$

C. $1:1$

D. None of these

Answer: C

Watch Video Solution

4. Consider ten identical sources of sound. All giving the same frequency but having phase angles which are random.If the average intensity of each source is I_0 the average of resultant intensity I due to all these ten sources will be

A. $I = 100I_0$

B. $I = 10I_0$

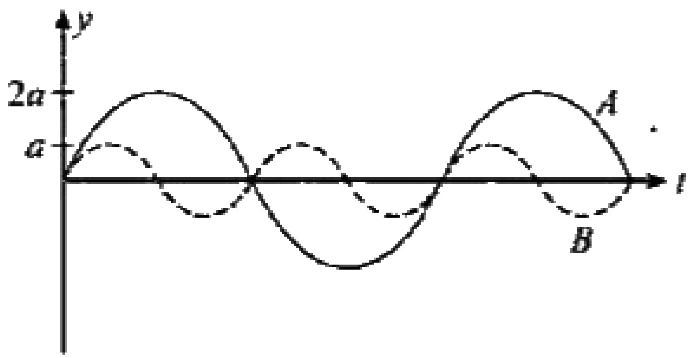
C. $I = I_0$

D. $I = \sqrt{10}I_0$

Answer: B

Watch Video Solution

5. The displacement-time graphs for two sound waves A and 5 are shown in the figure-6.98, then the ratio oftheir intensities I_A / I_B is



equal to:

A. $1:4$

B. $1:16$

C. $1:2$

D. $1:1$

Answer: D

Watch Video Solution

6. A tuning fork of frequency 340 Hz is vibrated just above the tube of 120 cm height. Water is poured slowly in the tube. What is the minimum height of water necessary for the resonance? (speed of sound in the air = 340m/s)

A. 15 cm

B. 25 cm

C. 30 cm

D. 45 cm

Answer: D

Watch Video Solution

7. Two monoatomic ideal gases 1 and 2 of molecular masses m^1 and m^2 respectively are enclosed in separate containers kept at the same temperature. The ratio of the speed of sound in gas 1 to that in gas 2 is given by :-

A. $\sqrt{\frac{A_1}{A_2}}$

B. $\sqrt{\frac{A_2}{A_1}}$

C. $\frac{A_1}{A_2}$

D. $\frac{A_2}{A_1}$

Answer: B

Watch Video Solution

8. An organ pipe is closed at one end has fundamental frequency of 1500 Hz. The maximum number of overtones generated by this pipe which a normal person can hear is

A. 14

B. 13

C. 6

D. 9

Answer: C

Watch Video Solution

9. The speed of a wave in a medium is 760 m/s. If 3600 waves are passing through a point in the medium in 2 min, then their wavelength is

A. 13.8 m

B. 25.3m

C. 41.5m

D. 57.2m

Answer: B

Watch Video Solution

10. A tuning fork sounded together with a tuning fork of frequency 256 emits two beats. On loading the tuning fork of frequency 256, the number of beats heard are 1 per second. The frequency of tuning fork is

A. 257

B. 258

C. 256

D. 254

Answer: D

Watch Video Solution

11. (a) The power of sound from the speaker of a radio is 20 mW. By turning the knob of volume control the power of sound is increased to 400 mW, What is the power increase in dB as compared to original power? (b) How much more intense is an 80 dB sound than a 20 dB whisper?

A. 13dB

B. 10dB

C. 20dB

D. 800dB

Answer: A

Watch Video Solution

12. In the experiment for the determination of the speed of sound in air using the resonance column method, the length of the air column that resonates in the fundamental mode, with a tuning fork is $0.1m$. When this length is changed to $0.35m$, the same tuning fork resonates with the first overtone. Calculate the end correction.

A. 0.012m

B. 0.025m

C. 0.05m

D. 0.024m

Answer: B

Watch Video Solution

13. An observer moves towards a stationary source of sound, with a velocity one-fifth of the velocity of sound. What is the percentage increase in the apparent frequency?

A. 0.05

B. 0.2

C. Zero

D. 0.005

Answer: B

Watch Video Solution

14. The intensity of sound from a radio at a distance of 2 metres from its speaker is $1 \times 0^{-2} \mu W / m^2$. The intensity at a distance of 10 meters would be

A. $0.2 \times 10^{-2} \mu W / m^2$

B. $1 \times 10^{-2} \mu W / m^2$

C. $4 \times 10^{-2} \mu W / m^2$

D. $5 \times 10^{-2} \mu W / m^2$

Answer: C

Watch Video Solution

15. A closed organ pipe of length L and an open organ pipe contain gass of densities ρ_1 and ρ_2, respectively. The compressibility of gass are equal in both the pipes. Both the pipes are vibrating in their first overtone with same frequency . The length of the open orange pipe is

(a) $\frac{L}{3}$

$\frac{4l}{3}$

(c) $\frac{4l}{3}\sqrt{\frac{\rho_1}{\rho_2}}$

(d) $\frac{4l}{3}\sqrt{\frac{\rho_2}{\rho_1}}$

A. $\frac{L}{3}$

B. $\frac{4L}{3}$

C. $\frac{4L}{3}\sqrt{\frac{\rho_1}{\rho_2}}$

D. $\frac{4L}{3}\sqrt{\frac{\rho_2}{\rho_1}}$

Answer: C

Watch Video Solution

16. In Melde's experiment, the string vibrates in 4 loops when a 50 gram weight is placed in the pan of weight 15 gram . To make the string to vibrates in 6 loops the weight that has to be removed from the pan is

A. 0.0007 kg wt

B. 0.0021 kg wt

C. 0.036 kg wt

D. 0.0029 kg wt

Answer: C

Watch Video Solution

17. The displacement of a wave disturbance propagating in the positive x-direction is given by

$y = \frac{1}{1+x^2}$ at $t = 0$ and $y = \frac{1}{1+(x-1)^2}$ at $t = 2s$

where, x and y are in meter. The shape of the wave disturbance does not change during the propagation. what is the velocity of the wave?

A. 0.5

B. 1

C. 2

D. 4

Answer: A

Watch Video Solution

18. The equation of a progressive wave is given by

$y = a\sin(628t - 31.4x)$

If the distances are expressed in cms and time in seconds, then the wave velocity will be

A. 314 cm/sec

B. 628 cm/sec

C. 20 cm/sec

D. 400 cm/sec

Answer: C

Watch Video Solution

19. Two waves are approaching each other with a velocity of $20m/s$ and frequency n. The distance between two consecutive nudes is

A. $\frac{20}{n}$

B. $\frac{10}{n}$

C. $\frac{5}{n}$

D. $\frac{n}{10}$

Answer: B

Watch Video Solution

20. Consider the three waves z_1, $z_2 \text{and} z_3$ as

$z_1 = A\sin(kx - \omega t)$

$z_2 = A\sin(kx + \omega t)$

$z_3 = A\sin(ky - \omega t)$

Which of the following represents a standing wave?

A. $z_1 + z_2$

B. $z_2 + z_3$

C. $z_3 + z_1$

D. $z_1 + z_2 + z_3$

Answer: A

Watch Video Solution

21. Equation of a progressive wave is given by $y = a \sin \pi \left[\frac{t}{2} - \frac{x}{4}\right]$, where t is in seconds and x is in meters. The distance through which the wave moves in 8 sec is (in meter)

A. 8

B. 16

C. 2

D. 4

Answer: B

Watch Video Solution

22. The phase difference between two waves represented by $y_1 = 10^{-6} \sin[100t + (x/50) + 0.5]m$, $y_2 = 10^{-6} \cos[100t + (x/50)]m$ where x is expressed in metres and t is expressed in seconds, is approximately

A. 1.5 rad

B. 1.07 rad

C. 2.07 rad

D. 0.5 rad

Answer: B

Watch Video Solution

23. Two waves are given by$y_1 = a\sin(\omega t - kx)$ and $y_2 = a\cos(\omega t - kx)$. The phase difference between the two waves is

A. $\frac{\pi}{4}$

B. π

C. $\frac{\pi}{8}$

D. $\frac{\pi}{2}$

Answer: D

Watch Video Solution

24. Two identical sonometer wires have a fundamental frequency of $500Hz$ when kept under the same tension . The percentage change in tension of one of the wires that would cause an occurrence of $5beats/s$, when both wires vibrate together is

A. 0.01

B. 0.02

C. 0.03

D. 0.04

Answer: B

Watch Video Solution

25. A source of sound is travelling towards a stationary observer. The frequency of sound heard by the observer is of three times the original frequency. The velocity of sound is v m / sec . The speed of source will be

A. $\frac{2}{3}v$

B. v

C. $\frac{3}{2}v$

D. $3v$

Answer: A

Watch Video Solution

26. A tuning fork of frequency 480 Hz produces 10 beats per second when sounded with a vibrating sonometer string. What must have been the frequency of the string if a slight increase in tension produces lesser beats per second than before

A. 460 Hz

B. 470Hz

C. 480 Hz

D. 490 Hz

Answer: B

Watch Video Solution

27. A string is producing transverse vibration whose equation is y = 0.021 sin (x + 30 t) , where x and y are in metre and t is in second . If the linear density of the string is $1.3 \times 10^{-4} kg/m$, then tension in string in newton will be

A. 10

B. 0.5

C. 1

D. 0.117

Answer: D

Watch Video Solution

28. In a large room, a person receives direct sound waves froma source 120 metres away from him. He also receives waves from the same source which reach him, being reflected from the 25 metre high ceiling at a point halfway between them. The two waves interfere constuctively for wavelength of

A. $20, 20/3, 20/5$ etc

B. $10, 5, 0/3, 2.5$

C. $10, 20, 30$ etc

D. $15, 25, 35$ etc

Answer: B

Watch Video Solution

29. A sound source is moving towards a stationary observer with 1/10 of the speed of sound. The ratio of apparent to real frequency is

A. $10/9$

B. $11/10$

C. $(11/10)^2$

D. $(9/10)^2$

Answer: A

Watch Video Solution

30. A string of length $0.4m$ and mass $10^{-2}kg$ is tightly clamped at its ends. The tension in the string is $1.6N$. Identical wave pulse are produced at one end at equal intervals of time, Δt. The minimum value of Δt which allows constructive interference of successive pulse is

A. 0.05s

B. 0.10s

C. 0.20s

D. 0.40s

Answer: B

Watch Video Solution

31. An earthquake generates both transverse (S) and longitudinal (P) sound waves in the earth. The speed of S waves is about 4.5 km /s and that of P waves is about 8.0 km/s . A seismograph records P and S waves from an earthquake. The first P wave arrives 4.0 min before the first S wave. The epicenter of the earthquake is located at a distance about

A. 25km

B. 250 km

C. 2500 km

D. 5000 km

Answer: C

Watch Video Solution

32. Two waves are propagating to the point P along a straight line produced by two sources A and B of simple harmonic and of equal frequency. The amplitude of every wave at P is a and the phase of A is ahead by $\pi / 3$ than that of B and the distance AP is greater than BP by $50 cm$. Then the resultant amplitude at the point P will be if the wavelength 1 meter

A. 2a

B. $a\sqrt{3}$

C. $a\sqrt{3}$

D. a

Answer: D

Watch Video Solution

33. The superposing waves are represented by the following equations :

$y_1 5 \sin 2\pi(10t - 0.1x), y_2 = 10 \sin 2\pi(20t - 0.2x)$ Ratio of intensities $\frac{I_{\max}}{I_{\min}}$ will be

A. 1

B. 9

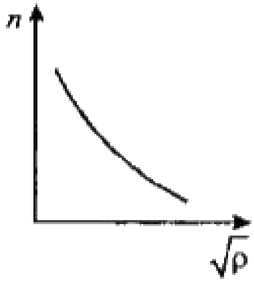
C. 4

D. 16

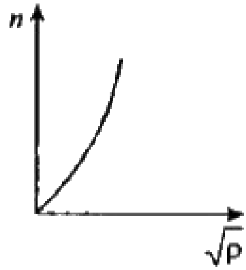
Answer: B

Watch Video Solution

34. The correct graph between the frequency n and square root of density ρ of a wire, keeping its length, radius and tension constant, is

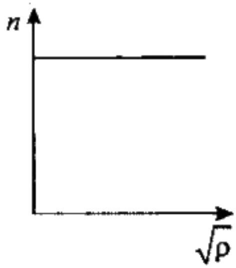


A.



B.

C.



D.

Answer: C

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35. Two identical stringed instruments have frequency 100 Hz . If tension in one of them is increased by 4% and they are sounded together then the number of beats in one second is

A. 1

B. 8

C. 4

D. 2

Answer: D

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36. which of the following function corrtly represent the traveling wave equation for finite values of x and t ?

A. $y = x^2 - t^2$

B. $y = \cos x^2 \sin t$

C. $y = \log(x^2 - t^2) - \log(x - t)$

D. $y = e^{2x} \sin t$

Answer: C

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37. A violin string oscillation in its fundamental mode, generates a sound wave with wavelength λ. To generate a sound wave with wavelength $\frac{\lambda}{2}$. By the string still oscillating is its fundamental mode, tension must be changed by the multiple.

A. 2

B. $1/2$

C. 4

D. $1/4$

Answer: C

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38. Sinusoidal waves $5.00cm$ in amplitude are to be transmitted along a string having a linear mass density equal to $4.00 \times 10^{-2} kg/m$. If the source can deliver a maximum power of $90W$ and the string is under a tension of $100N$, then the highest frequency at which the source can operate is (take $\pi^2 = 10$)

A. 45.3 Hz

B. 50 Hz

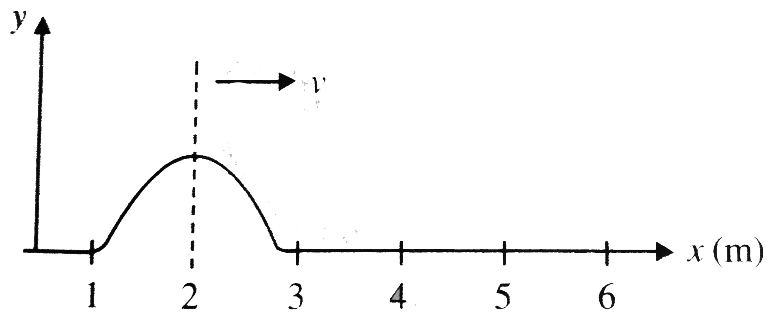
C. 30 Hz

D. 62.3 Hz

Answer: C

Watch Video Solution

39. Wave pulse on a string shown in figure is moving to the right without changing shape. Cosider two particle at positions $x_1 = 1.5m$ and $x_2 = 2.5m.$ Their transverse velocities at the moment shown in figure are along direction



A. positive y-axis and positive y-axis respectively

B. negative y-axis and positive_y-axis respectively

C. positive y-axis and negative y -axis respectively

D. negative y-axis and negative y-axisrespectively

Answer: B

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40. What is the percentage change in the tension necessary in a somometer of fixed length to produce a note one octave lower (half of original frequency) than before?

A. 0.25

B. 0.5

C. 0.67

D. 0.75

Answer: D

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41. A wire having a linear mass density 5.0×10^{-3} kg/m is stretched between two rigid supports with a tension of 450 N. The wire resonates at a frequency of 420 Hz. The next higher frequency at which the same wire resonates is 480 Hz. Find the length of the wire.

A. 2.0 m

B. 2.1 m

C. 2.5 m

D. 3m

Answer: B

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42. A $20cm$ long rubber string fixed at both ends obeys Hook's law. Intially when it is stretched to make its total length of $24cm$, the lowest frequency resonance is v_0. It is further stretched to make its total length of $26cm$. The lowest frequency of resonance will now be :

A. The same as n_0

B. Greater than n_0

C. Lower than n_0

D. None of these

Answer: B

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43. The equation of a wave is given by (all quantity expressed in S.I units) $y = 5 \sin 10\pi(t - 0.01x)$ along the x-axis. The magnitude of phase difference between the points separated by a distance of 10 m along x-axis is

A. $\pi / 2$

B. π

C. 2π

D. $\pi / 4$

Answer: B

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44. Which of the following travelling wave will produce standing wave , with nodes at $x = 0$, when superimosed on $y = A\sin(\omega t - kx)$

A. $A\sin(\omega t + kx)$

B. $A\sin(\omega t + kx + \pi)$

C. $A\cos(\omega t + kx)$

D. $A\cos(\omega t + kx + \pi)$

Answer: B

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45. Equation of a standing wave is generally expressed as $y = 2A\sin\omega t\cos kx$. In the equation quantity $\frac{\omega}{k}$ represents

A. The transverse speed of the particles of the string

B. The speed of either of the component waves

C. The speed of the standing wave

D. A quantity that is independent of the properties of the string

Answer: B

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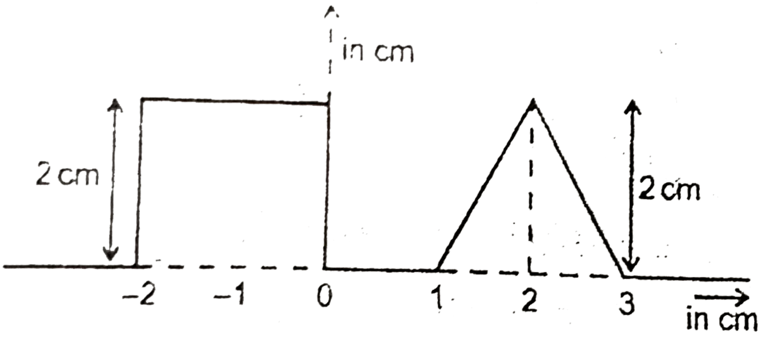
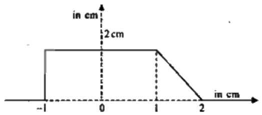
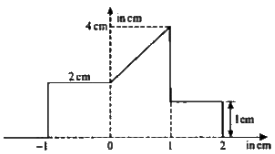
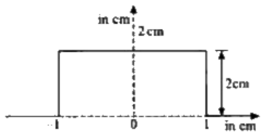
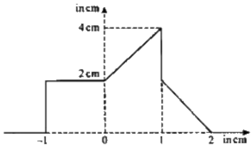
46. The figure shown at time $t = 0$ second, a rectangular and triangular pulse on a uniform wire are approcaching other. The pulse speed is $0.5 cm / s$. The resultant pulse at $t = 2$ second is



A. 

B. 

C. 

D. 

Answer: D

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47. [Q. Nos. 3-4] Difference in frequencies between 3rd overtone of closed pipe and 5th haronic of the same pipe is 400 Hz. Futher 3rd hormonic of this closed pipe os equal to 6th hormonic of another open pipe.

Fundamental frequencies of closed pipe and open pipe are

A. 200Hz,400Hz

B. Hz,75Hz

C. 200Hz,100Hz

D. 400Hz,300Hz

Answer: C

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48. If speed of sound is 330 m/s. The lengths of closed pipe and open pipe are :

A. 0.4125 m, 1.65m

B. 3.3m, 1.65m

C. 0.825m, 0.825m

D. 1.65m, 0.825m

Answer: A

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49. The angular frequency is:

A. 120 rad/s

B. 754 rad/s

C. 386 rad/s

D. 820 rad/s

Answer: B

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50. The wave speed is :

A. 62.9 m/s

B. 96.8 m/s

C. 7.28 m/s

D. 9.25 m/s

Answer: D

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51. The rate at which the wave transports energy is :

A. 50 W

B. 180 W

C. 100 W

D. 25 W

Answer: D

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52. The equation of resultant wave due to the two waves is $y'(x, t)$

A. $2ym(\sin\phi)[\sin(kx - \omega t + \phi)]$

B. $y_m(\sin\phi)\left[\sin\left(kx - \omega t + \frac{\phi}{2}\right)\right]$

C. $2y_m\left(\cos\frac{\phi}{2}\right)\left[\sin\left(kx - \omega t + \frac{\phi}{2}\right)\right]$

D. $2y_m(\cos\phi)[\sin(kx - \omega t + \phi)]$

Answer: C

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53. Out of the three wave equations $y'(x, t)$ and the resultant $y'(x, t)$, which wave would you actually see on the string?

A. y'(x,t)

B. $y_1(x, t)$

C. $y_2(x, t)$

D. All of these

Answer: A

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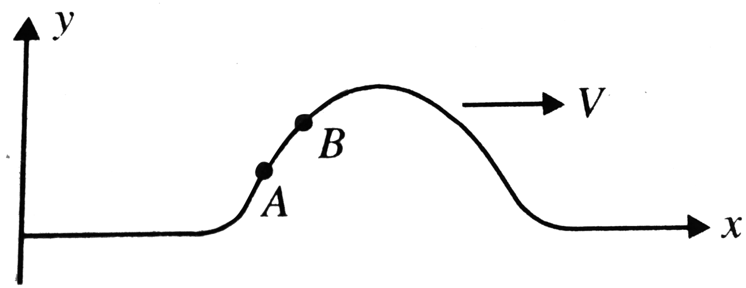
54. A wave pulse is generated in a string that lies along $x-$ axis. At the points A and B, as shown in figure, if R_A and R_B are ratio of magnitudes of wave speed to the particle speed, then



A. $R_A > R_B$

B. $R_B > R_A$

C. $R_A = R_B$

D. Information is not suficient to decide.

Answer: A

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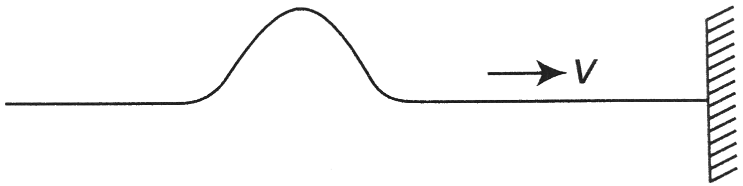

55.

When a wave pulse travelling in a string is reflected from rigid wall to which string is tied as shown in figure. For this situation two statements are given below.

(1) The reflected pulse will be in same orientation of incident pulse due to a phase change of π radians

(2) During reflection the wall exert a force on string in upward directon for the above given two statements choose the correct option given below

A. Only(1) is true

B. Only (2) is true

C. Both are ture

D. Both are wrong

Answer: D

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56. A transverse wave described by equation $y = 0.02 \sin(x + 30t)$ (where x and t are in metres and seconds, respectively) is travelling along a wire of area of cross-section $1mm^2$ and density $8000kg/m^2$. What is the tension in the string?

A. 20N

B. 7.2N

C. 30N

D. 14.4N

Answer: B

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57. Two vibrating strings of same material stretched under same tension and vibrating with same frequency in the same overtone have radii 2r and r. Then the ratio of their lengths is:

A. $1:2$

B. $1:4$

C. $1:3$

D. $2:3$

Answer: A

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58. A wave moving with constant speed on a uniform string passes the point $x = 0$ with amplitude A_0, angular frequency ω_0 and average rate of energy transfer P_0. As the wave travels down the string it gradually loses energy and at the point $x = l$, the average rate of energy transfer becomes $P_0/2$. At the point $x = l$. Angular frequency and amplitude are respectively:

A. ω_0 and $A_0/\sqrt{2}$

B. $\omega_0/\sqrt{2}$ and A_0

C. Less than ω_0 and A_0

D. $\omega_0/\sqrt{2}$ and $A_0/\sqrt{2}$

Answer: A

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59. A standing wave pattern is formed on a string.One of the waves is given by equation $y_1 = a\cos\left(\omega t - kx + \frac{\pi}{3}\right)$,then the equation of the other wave such that $x = 0$ a node is formed is-

A. $y_2 = a\sin\left(\omega t + kx + \frac{\pi}{3}\right)$

B. $y_2 = a\cos\left(\omega t + kx + \frac{\pi}{3}\right)$

C. $y_2 = a\cos\left(\omega t + kx + \frac{2\pi}{3}\right)$

D. $y_2 = a\cos\left(\omega t + kx + \frac{4\pi}{3}\right)$

Answer: D

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60. The (x, y) co-ordinates of the corners of a square plate are $(0, 0)$, (L, L) and $(0, L)$. The edges of the plate are clamped and transverse standing waves are set up in it. If $u(x, y)$ denotes the displacement of the plate at the point (x, y) at some instant of time, the possible expression (s) for u is (are) $(a = positivecons\tan t)$

A. $a\cos\left(\frac{\pi x}{2L}\right)\cos\left(\frac{\pi}{2L}\right)$

B. $a\sin\left(\frac{\pi x}{2L}\right)\cos\left(\frac{\pi}{2L}\right)$

C. $a\sin\left(\frac{\pi x}{L}\right)\cos\left(\frac{\pi}{L}\right)$

D. $a\sin\left(\frac{2\pi x}{L}\right)\cos\left(\frac{\pi}{L}\right)$

Answer: C

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61. The paritcle displacement (in cm) in a stationary wave is given by $y(x, t) = 2\sin(0.1\pi x)\cos(100\pi t)$. The distance between a node and the next antinode is

A. 2.5 cm

B. 7.5 cm

C. 5 cm

D. 10 cm

Answer: C

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62. A wire of length l having tension T and radius r vibrates with fundamental frequency f. Another wire of the same metal with length $2l$ having tension $2T$ and radius $2r$ will vibrate with fundamental frequency :

A. First harmonic

B. 2f

C. $\frac{f}{2\sqrt{2}}$

D. $\frac{f}{2}\sqrt{2}$

Answer: C

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63. A transverse wave is propagating along $+x$ direction. At $t = 2$ sec the particle at $x = 4$m is at $y = 2$ mm. With the passage of time its y

coordinate increases and reaches to a maximum of 4 mm. The wave equation is (using ω and k with their usual meanings)

A. $y = 4\sin\left[\omega(t+2) + k(x-2) + \frac{\pi}{6}\right]$

B. $y = 4\sin\left[\omega(t+2) + k(x) + \frac{\pi}{6}\right]$

C. $y = 4\sin\left[\omega(t-2) - k(x) + \frac{\pi}{6}\right]$

D. $y = 4\sin\left[\omega(t-2) - k(x-4) + \frac{\pi}{6}\right]$

Answer: D

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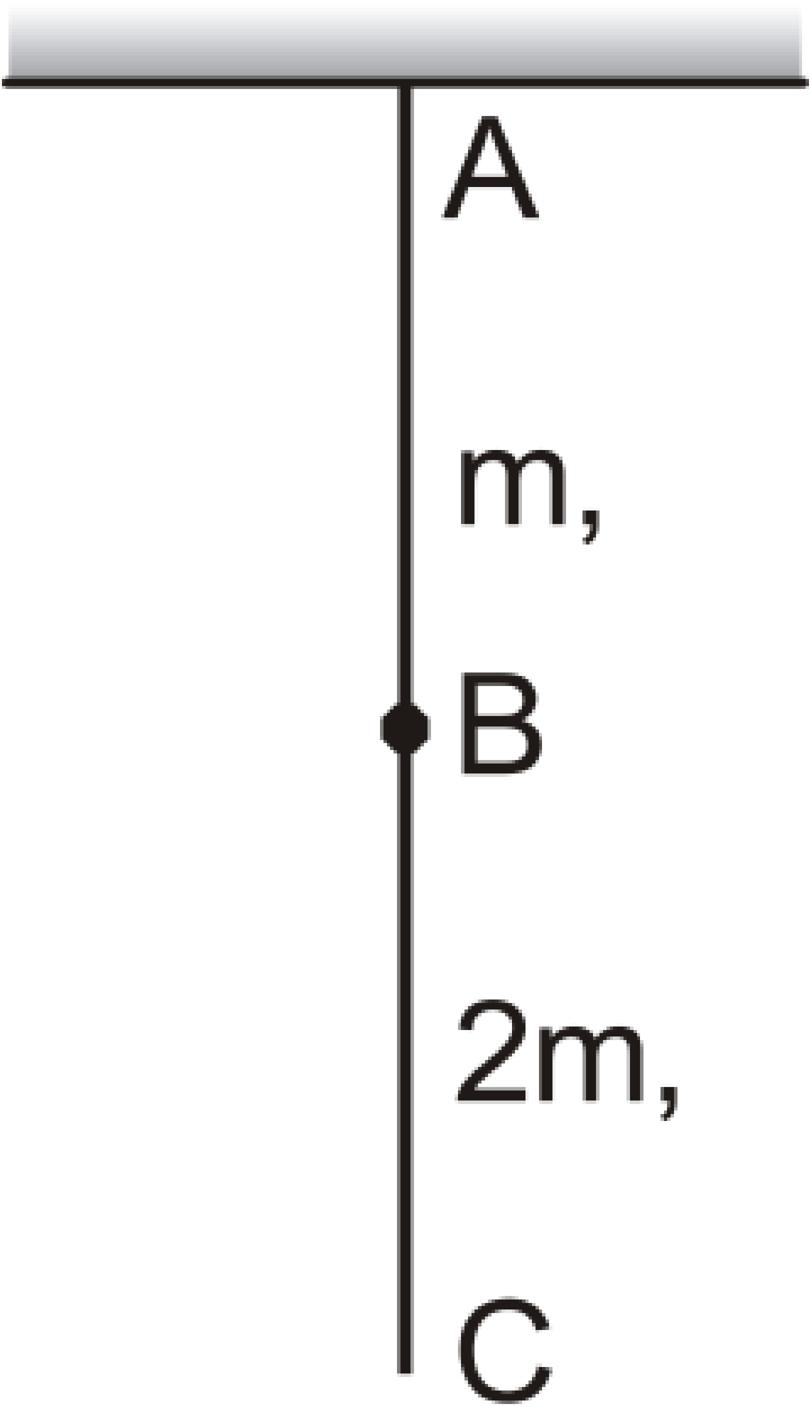
64. In the figure shown strings AB and BC have masses m and 2m respectively. Both are of same length l.Mass of each string is uniformly distributed on its length. The string is suspended vertically from the ceiling of a room.A small jerk wave pulse is given at the end 'C'.It goes up to upper end 'A' in time 't' .If the value of t is given by

$a\sqrt{\frac{l}{g}}+b\sqrt{\frac{l}{g}}(\sqrt{c}-\sqrt{d})$ then a+b+c+d is



A. $\frac{620}{670}s$

B. $\frac{434}{205}s$

C. 2s

D. None of thse

Answer: C

Watch Video Solution

65. A $75cm$ string fixed at both ends produces resonant frequencies $384Hz$ and $288Hz$ without there being any other resonant frequency between these two . Wave speed for the string is

A. 144 m/s

B. 216 m/s

C. 108 m/s

D. 72 m/s

Answer: A

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66. A string of length 'L' is fixed at both ends . It is vibrating in its $3rd$ overtone with maximum amplitude 'a'. The amplitude at a distance $L/3$ from one end is

A. a

B. 0

C. $\frac{\sqrt{3}a}{2}$

D. $\frac{a}{2}$

Answer: C

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67. A $40cm$ long wire having a mass $3.2g$ and area of cross - section $1mm^2$ is stretched between the support $40.05cm$ apart. In its fundamental mode , it vibrates with a frequency $1000/64Hz$. Find the young's modulus of the wire.

A. 1

B. 2

C. 3

D. 4

Answer: A

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68. A string of length 1.5 m with its two ends clamped is vibrating in fundamental mode. Amplitude at the centre of the string is 4 mm. Minimum distance between the two points having amplitude 2 mm is:

A. 1 m

B. 75 cm

C. 60 cm

D. 50 cm

Answer: A

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69. A string is fixed at both ends. The tension in the string and density of the string are accurately known but the length and the radius of cross section of the string are known with some errorl If maximum errors made in the measurements of length and radius are 1% and 0.5% respectively them what is the maximum possible percentage error in the calculation of fundamental frequencyof the that string ?

A. 0.005

B. 0.01

C. 0.015

D. 0.02

Answer: C

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70. A string of length l' fixed at both ends vibrates in resonance with a tuning fork of frequency 'f' at two successive values of tension T_1 and T_2 inthe string. Findthe specificmass (mass per unit length) ofthe string:

A. $\frac{T_1T_1}{f^2l^2\left(\sqrt{T_1}-\sqrt{T_2}\right)^2}$

B. $\frac{2T_1T_1}{f^2l^2\left(\sqrt{T_1}-\sqrt{T_2}\right)^2}$

C. $\frac{T_1T_1}{2f^2l^2\left(\sqrt{T_1}-\sqrt{T_2}\right)^2}$

D. None of these

Answer: D

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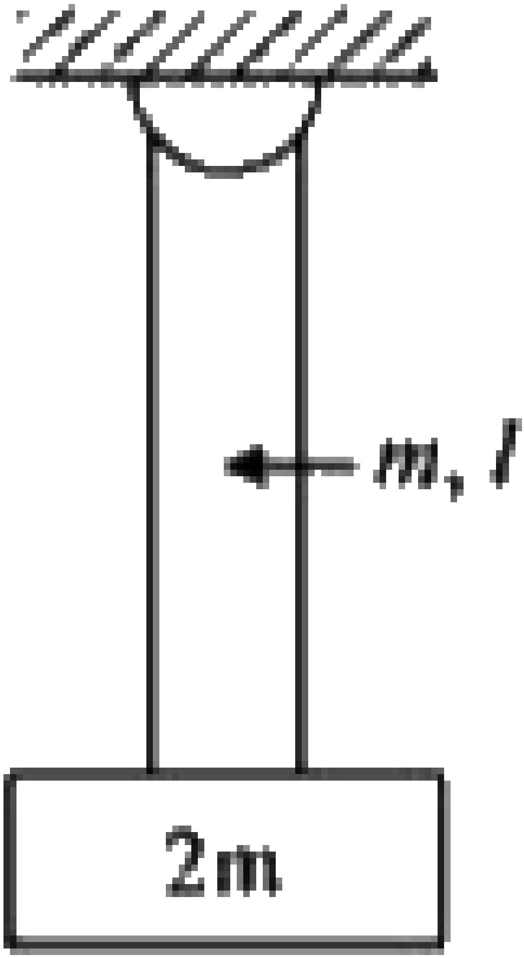
71. A block of mass 2m is hanging at the lower and of a ropeof mass m and length the l, the other end being fixed to the ceililng. A pulse of wavelength λ_0 is produced at the lower of the rope.



The wavelength of the pulse when it reaches the other end of the rope is :

A. $\sqrt{3}\lambda_0$

B. $\sqrt{\frac{3}{2}}\lambda_0$

C. λ_0

D. $\frac{\lambda_0}{2}$

Answer: B

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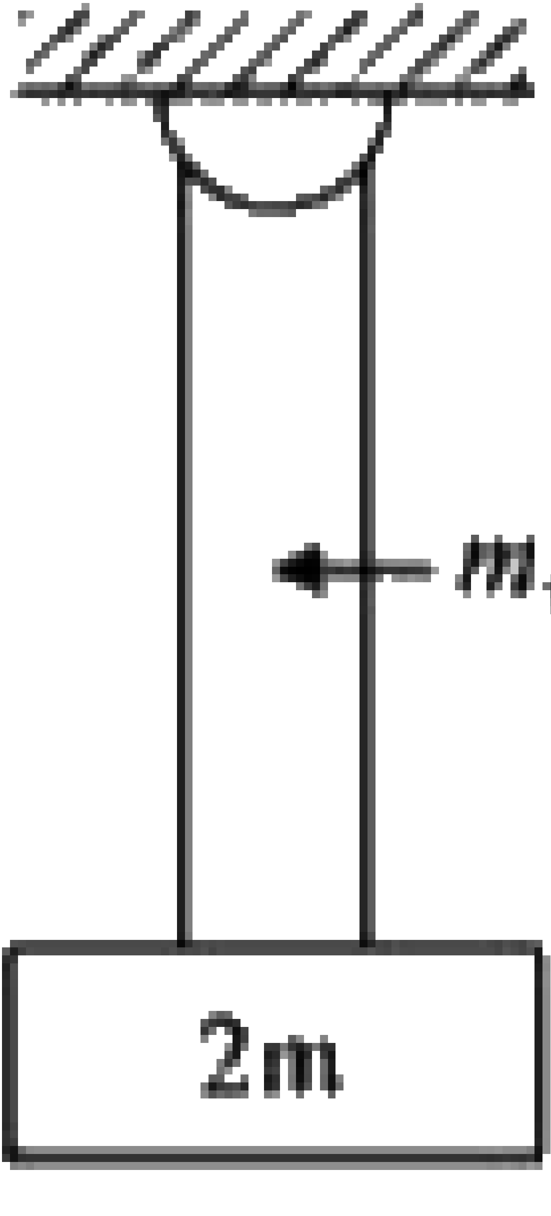
72. A block of mass 2m is hanging at the lower and of a ropeof mass m and length the l, the other end being fixed to the ceililng. A pulse of wavelength λ_0 is produced at the lower of the rope.



The speed of the pulseat the mid point of rope is:

A. $\sqrt{\frac{5}{2}gl}$

B. $\sqrt{\frac{3}{3}gl}$

C. $\sqrt{\frac{2}{5}gl}$

D. $\sqrt{\frac{gl}{2}}$

Answer: A

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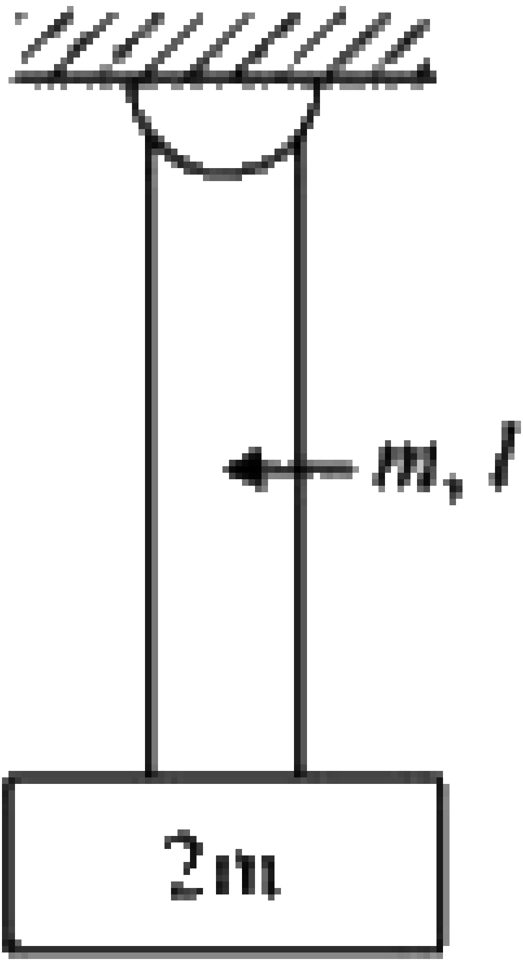
73. A block of mass 2m is hanging at the lower and of a ropeof mass m and length the l, the other end being fixed to the ceililng. A pulse of wavelength λ_0 is produced at the lower of the rope.



The time taken by the pulse to reach the other end of the rope is:

A. $2\sqrt{\frac{l}{g}}(\sqrt{3}-1)$

B. $2\sqrt{\frac{l}{g}}(\sqrt{3}-2)$

C. $2\sqrt{\frac{l}{g}}$

D. $2\sqrt{\frac{l}{g}}(\sqrt{3}-\sqrt{2})$

Answer: D

View Text Solution

74. A standing wave exists in string of length 150 cm fixed at both ends. The displacement amplitude of a point at a distance of 10 cm from one of ends if $5\sqrt{3}mm$. The distance between two nearest points, within the same loop having the same displacement amplitude of $5\sqrt{3}$ is 10 nm.

The maximum displacement amplitude of the particle in the string is,:

A. 10 mm

B. $(20/\sqrt{3})$ mm

C. $10\sqrt{3}$

D. 20 mm

Answer: A

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75. A standing wave exists in string of length 150 cm fixed at both ends. The displacement amplitude of a point at a distance of 10 cm from one of ends if $5\sqrt{3}mm$. The distance between two nearest points, within the same loop having the same displacement amplitude of $5\sqrt{3}$ is 10 nm.

The maximum displacement amplitude of the particle in the string is,:

A. 2

B. 3

C. 4

D. 6

Answer: C

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76. A standing wave exists in string of length 150 cm fixed at both ends. The displacement amplitude of a point at a distance of 10 cm from one of ends if $5\sqrt{3}mm$. The distance between two nearest points, within the same loop having the same displacement amplitude of $5\sqrt{3}$ is 10 nm.

The maximum displacement amplitude of the particle in the string is,:

A. $10\sqrt{3}$ cm

B. 15 cm

C. 20 cm

D. 30 cm

Answer: B

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77. A transverse sinusoidal wave is generted at one end of long, horizontal string by a bar that moves up and down through a distance of $1.00cm$. The motion is continuous and is repreated regularly 120 times per second. The string has linear density $90gm/m$ and is kept under a tension of $900N$. Find :

What is the maximum power (in watt) transferred along the string.

A. 10.884 m/s

B. 8. 44 m/s

C. 844 m/s

D. None of these

Answer: B

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78. A transverse sinusoidal wave is generted at one end of long, horizontal string by a bar that moves up and down through a distance of $1.00 cm$. The motion is continuous and is repreated regularly 120 times per second. The string has linear density $90 gm / m$ and is kept under a tension of $900 N$. Find :

What is the maximum power (in watt) transferred along the string.

A. zero

B. 3.77N

C. 37.7 N

D. 377 N

Answer: C

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79. A transverse sinusoidal wave is generated at one end of a long horizontal string by a bar is continuous and is repeated regularly 120 times per second. The string has linear density of 117g/m. the other end of the string is attached to a mass 4.68kg. the string passes over a smooth pulley and the mass attached to the other end of the string hangs freely under gravity.

The maximum power transferred along the string is:

A. 3.845 kW

B. 34.85 kW

C. $348.5kW / d$

D. None of these

Answer: B

View Text Solution

80. The wave-function for a certain standing wave on a string fixed at both ends is $y(x, t) = 0.5 \sin(0.025\pi x)\cos 500t$ where x and y are in centimeters and t is seconds. The shortest possible length of the string is :

A. 126 cm

B. 160 cm

C. 40 cm

D. 80 cm

Answer: C

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81. A loop of a string of mass per unit length μ and radius R is rotated about an axis passing through centre perpendicular to the plane with an angular velocityco. A small disturbance is created in the loop having the same sense of rotation. The linear speed of the disturbance for a stationary observer is :

A. ωR

B. $2\omega R$

C. $3\omega R$

D. Zero

Answer: B

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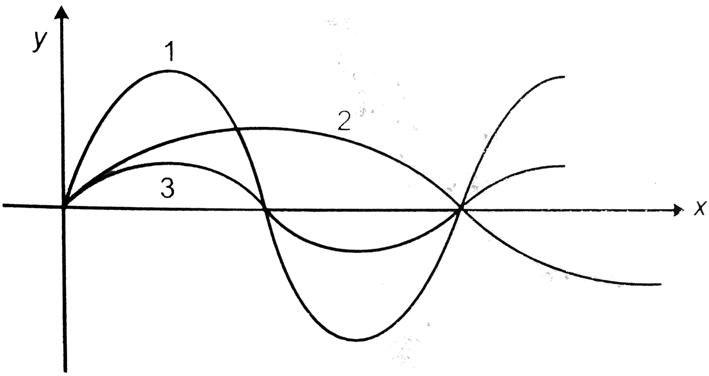
82. Graph shows three waves that are separately sent along a string that is stretched under a certain tension along x-axis. If ω_1, ω_2 and ω_3 are their angular frequencies, respectively, then:



A. $\omega_1 = \omega_3 > \omega_2$

B. $\omega_1 > \omega_2 > \omega_3$

C. $\omega_2 > \omega_1 = \omega_3$

D. $\omega_1 = \omega_2 = \omega_3$

Answer: A

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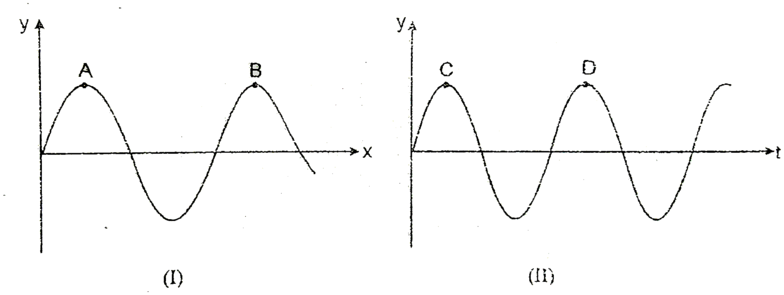
83. The same progressive wave is represented by two graphs I and II. Graph I shows how the displacement $'y'$ varies with the distance x along the wave at a given time. Graph I shows how y varies with time t at a given point on the wave. The ratio of measurements AB to CD, marked on the curves, represents :



A. Wave number k

B. Wave speed V

C. Frequency v

D. Angular frequency ω

Answer: B

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84. A transverse periodic wave on a string with a linear mass density of $0.200 kg/m$ is described by the following equation

$y = 0.05 \sin(420t - 21.0x)$

where x and y are in meters and t is in seconds.

The tension in the string is equal to :

A. 32 N

B. 42N

C. 66N

D. 80N

Answer: D

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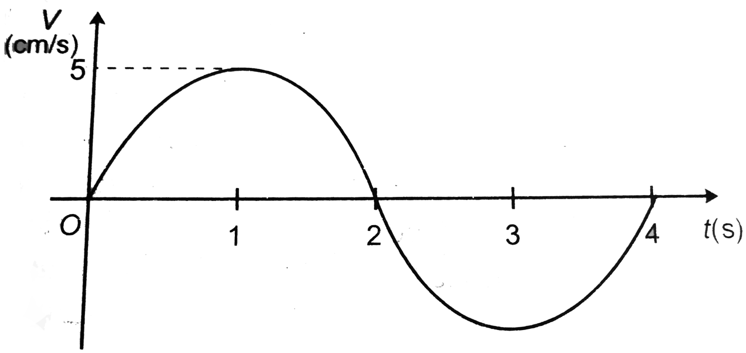
85. A certain transverse sinusoidal wave of wavelength 20 cm is moving in the positive x direction. The transverse velocity of the particle at x=0 as a function of time is shown. The amplitude of the motion is:



A. $\frac{5}{\pi}$

B. $\frac{\pi}{2}$

C. $\frac{10}{\pi}$

D. $2\pi cm$

Answer: C

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86. two particle of medium disturbed by the wave propagation are at $x_1 = 0$ and $x_2 = 1cm$. The respective displacement (in cm) of the particles can be given by the equation:

$y_1 = 2\sin 3\pi t$, $y_2 \sin(3\pi t - \pi/8)$ the wave velocity is

A. 16 cm/sec

B. 24 cm/sec

C. 12 cm/sec

D. 8 cm/sec

Answer: B

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87. A travelling wave $y = A\sin(kx - \omega t + \theta)$ passes from a heavier string to a lighter string. The reflected wave has amplitude $0.5A$. The junction of the strings is at $x = 0$. The equation fo the refelcted wave is :

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88. In the above question, the displacement of particle at t = 1 sec and x = 4 cm is:

A. 4 cm

B. 2cm

C. 1cm

D. Zero

Answer: B

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89. Spacing between two successive nodes in a standing wave on a string is x. If frequency of the standing wave is kept unchanged but tension in the string is doubled, then new sapcing between successive nodes will become:

A. $x / \sqrt{2}$

B. $\sqrt{2}x$

C. $x / 2$

D. 2x

Answer: B

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90. Two small boats are $10m$ apart on a lake. Each pops up and down with a period of 4.0 seconds due to wave motion on the surface of water. When one boat is at its highest point, the other boat is its lowest point. Both boats are always within a single cycle of the waves. The speed of the waves is:

A. 2.5 m/s

B. 5.0 m/s

C. 14 m/s

D. 40 m/s

Answer: B

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Advance Mcqs With One Or More Options Correct

1. A sound wave propagates in a medium of Bulk's modulus B by means of compressions and rarefactions. If P_c and P_r are the pressures at compression and rarefaction respectively,a be the wave amplitude and k be the angular wave number then

A. P_c is maximum and P_r is minimum

B. p_c is minimum and $p(r)$ is maximum

C. The pressure amplitude is Bak

D. If the displacement wave is $y = a \sin(\omega t - kx)$ which leads displacement wave by a phase angle of $\frac{\pi}{2}$

Answer: A::C::D

View Text Solution

2. A driver in a stationary car blows a horn which produces monochromatic sound waves of freqeuncy 1000 Hz normally towards a reflecting wall. The wall approaches the car with a speed of $3.3\frac{m}{s}$.

A. The frequency ofsound reflected from wall and heard by the driver is 1020 Hz

B. The frequency ofsound reflected from wall and heard by the driver is 980 Hz

C. The percentage increase in frequency of sound after reflected from wall is 2%

D. The percentage decrease in frequency of sound after reflected from wall is 2%

Answer: A::C

Watch Video Solution

3. The equation of a wave is

$$y = 4\sin\left[\frac{\pi}{2}\left(2t + \frac{1}{8}x\right)\right]$$

where y and x are in centimeres and t is in seconds.

A. The amplitude, wavelength, velocityand frequency of wave are $4cm, 16cm, 32cm^{-1}$ and 1 Hz respectively with wave propagating along + x direction

B. The amplitude, wavelength, velocityand frequency ofwave are $4cm, 32cm, 16cm^{-1}$ and 0.5 Hz respectively with wave propagating along -x direction

C. Two positions occupied by the particle at time interval of 0.4 s have a phase difference of 0.4 π radian

D. Two positions occupied by the particle at separation of 12 cmhaveaphasedifferenceof 135°

Answer: B::C::D

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4. A sinusoidal wave $y_1 = a\sin(\omega t - kx)$ is reflected from a rigid support and superpose with the incident wave y_1 . Assume the rigid support to be at $x = 0$.

A. Stationary wave are obtained with antinode at the rigid support

B. Stationarywave are obtained with node at the rigid support

C. Stationary waves are obtained with intensity varying periodically with distance

D. Stationary wave are obtained with intensity varying periodicallywith time

Answer: B::C

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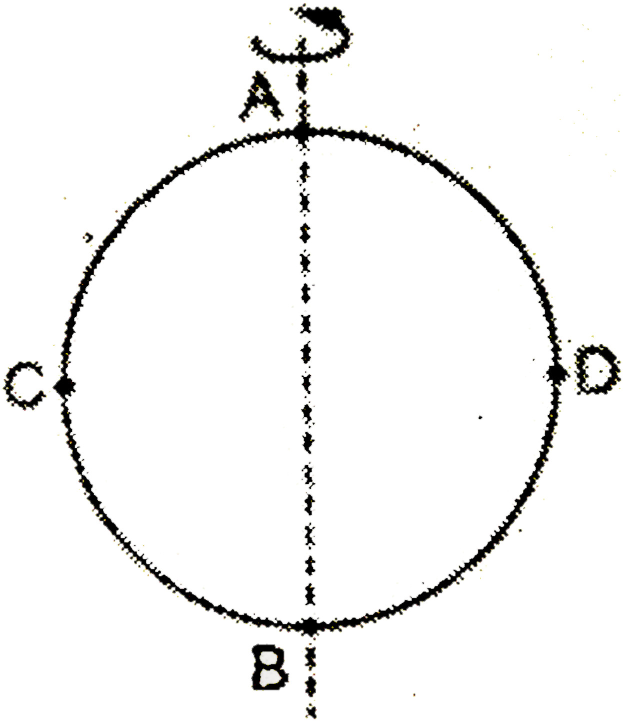

5.

Assume that the sun rotates about an axis through its centre and perpendicular to the plane of rotatin of the earth about the sun. The appearange of the sun, from any one pont on the earth, is shown. Light belonging to a particular spectral line, as received from the points A, B, C and D on the edge of the sun, are analyzed

A. Light from all four points have the same wavelength

B. Light from C has greater wavelength than the light from D

C. Light from D has greater wavelength than the light from C

D. Light from A has the same wavelength as the light from B

Answer: C::D

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6. When the open organ pipe resonates in its fundamental mode then at the centre of the pipe

A. The gas molecules undergo vibrations of maximum amplitude

B. The gas molecules are at rest

C. The pressure ofthe gas is constant

D. The pressure ofthe gas undergoes maximum variation

Answer: B::D

Watch Video Solution

7. $y(x, t) = 0.8 / \left[(4x + 5t)^2 + 5\right]$ represents a moving pulse, where x and y are in meter and t in second. Then

A. Pulse is moving in+ x direction

B. In 2 s It will travel adistance of 2.5 m

C. Its maximum displacement is 0.16m

D. It is a symmetric pulse

Answer: B::C

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8. In a wave motion $y = a\sin(kx - \omega t)$, y can represent

A. Electric field

B. Magnetic field

C. Displacement

D. Pressure

Answer: A::B::C

Watch Video Solution

9. A travelling wave in a stretched string is described by the equation $y = A\sin(kx - \omega t)$ the maximum particle velocity is

A. $A\omega$

B. $\frac{\omega}{k}$

C. $\frac{d\omega}{dk}$

D. $\frac{x}{t}$

Answer: A

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10. In Q.No. 6-9

A. Wave velocity is $\frac{\omega}{k}$

B. Group velocity is $\frac{d\omega}{dk}$

C. Wave velocity is $A\omega$

D. Group velocity is $A\omega$

Answer: A::B

View Text Solution

11. 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 ofthe distance from the source for a spherical wave

D. Total power of the spherical wave overthespherical surlace centred at the source remains constant at all times

Answer: A::C::D

Watch Video Solution

12. Any progressive wave equationin differential form is :

A. $\frac{1}{\omega^2}\frac{\partial^2 y}{\partial t^2} = \frac{1}{k^2}\frac{\partial^2 y}{\partial x^2}$

B. $\frac{1}{\omega}\frac{\partial y}{\partial t} = -\frac{1}{k}\frac{\partial y}{\partial x}$

C. $\frac{1}{\omega^2}\frac{\partial^2 y}{\partial t^2} = -\frac{1}{k^2}\frac{\partial^2 y}{\partial x^2}$

D. $\frac{1}{\omega}\frac{\partial y}{\partial t}=\frac{1}{k}\frac{\partial y}{\partial x}$

Answer: A::B

Watch Video Solution

13. Two waves of nearly same amplitude , same frequency travelling with same velocity are superimposing to give phenomenon of interference . If a_1 and a_2 be their respectively amplitudes , ω be the frequency for both , v be the velocity for both and $\Delta\phi$ is the phase difference between the two waves then ,

A. The resultant intensity varies periodically with time and distance

B. The resultant intensity with $\frac{I_{\min}}{I_{\max}}=\left(\frac{a_1-a_2}{a_1+a_2}\right)^2$ is obtained for coherent waves travelling in the same direction.

C. Both the waves must have constant phase difference at any point all the time.

D. $I_R = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos(\Delta\phi)\Big)$, where constructive interference is obtained for path differences that are odd for path differences that are even multiple of $\frac{1}{2}\lambda$

Answer: B::C

Watch Video Solution

14. Two waves of slightly different frequencies f_1 and $f_2(f_1 > f_2)$ with zero phase difference , same amplitudes ,travelling in the same direction superimpose .

A. Phenomenon of beats is always observed by human ear

B. Intensity of resultant wave is a constant

C. Intensity of resultant wavevariesperiodically with time withmaximumintensity4

D. A maxima appears at a time $\frac{1}{2(f_1 - f_2)}$ later (or earlier) than a minima appears

Answer: C::D

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15. The displacement of a particle in a medium due to a wave travelling in the $x-$direction through the medium is given by $y = A\sin(\alpha t - \beta x)$, where $t =$ time, and α and β are constants:

A. The frequency of the wave is α

B. The frequency of the wave is $\alpha / (2\pi)$

C. The wavelength is $(2\pi) / \beta$

D. The velocity of the wavve is α / β

Answer: B::C::D

Watch Video Solution

16. A wave is represented by the equation

$$y = A\sin\left(10\pi x + 15\pi t + \frac{\pi}{3}\right)$$

where x is in meter and t is in seconds. The expression represents :

A. A wave travelling in the positive x-direction with a velocity of $1.5ms^{-1}$

B. A wave travelling in the negative x-direction with a velocity of $1.5ms^{-1}$

C. A wave travelling in the negative x-direction with a wavelength of 0.2 m

D. A wave travelling in the positive x-direction with a wavelength of 0.2 m

Answer: B::C

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17. Consider a harmonic wave travelling on a string of mass per unit length p.The wave has a velocity v, amplitude A and frequency f The power transmitted by a harmonic wave on the string is proportional to (take constant of proportionality as $2\pi^2$

A. μ

B. v

C. A^2

D. f_2

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

View Text Solution

18. Standing waves can be produced

A. In a string clampedat both the ends

B. In a string clamped at one end and free at the other

C. When incident wave gets reflected from the wall superimpose

D. When two identical waves with aphase difference ofn are movingin the samedirectionsuperimpose

Answer: A::C

Watch Video Solution

19. For a sine wave passing through a medium, let y be the displacement of a particle, v be its velocity and a be its acceleration :-

A. y, V and a are always in the samephase

B. y and a are always in opposite phase

C. Phase difference between y and v is $\pi/2$

D. Phase difference between v and a is $\pi/2$

Answer: B::C::D

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20. P,Q and R are three particle of a medium which lie on the x-axis. A sin wave of wavelength λ is travelling through the medium in the x-direction. P and Q always have the same speed. Whilem P and R always have the same velocity. The minimum distance between :-

A. P and Q is $\frac{\lambda}{2}$

B. P and Qislambda`

C. P and Ris(lambda)/(2)`

D. P and Rislambda`

Answer: A::D

Watch Video Solution

21. transverse simple harmonic wave is travelling on a string. The equation of the wave:

A. Is the general equation for displacement of a particle of the string at any instant t

B. Is the equation ofthe shape ofthe string at any instant t

C. Must have sinusoidal form

D. Is an equation ofdisplacement for the particle at any one end at a particular time t

Answer: A::B

View Text Solution

22. A sound waves passes from a medium A to a medium B. The velocity of sound in B is greater than in A. Assume that there is no absorption or reflection at the boundary . As the wave moves across the boundary :

A. The frequency of sound will not change

B. The wavelength will increase

C. The wavelength will decrease

D. The intensity of sound will not change

Answer: A::B::D

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23. 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 simultaneouslyat some instant

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

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24. In the previous Q.No. 6-23, all the particles:

A. Of the medium vibrate in the same phase

B. In the region between two antinodes vibrate in the same phase

C. In the region betweentwonodes vibrate in the same phase

D. On either side ofa node vibrate in opposite phase

Answer: C::D

View Text Solution

25. Two simple harmonic waves are represented by the equations given as

$y_1 = 0.3 \sin(314t - 1.57x)$

$y_2 = 0.1 \sin(314t - 1.57x + 1.57)$

where x, y_1 and y_2 are in metre and t is in second, then we have

A. $v_1 = v_2$ = 50 Hz

B. $\lambda_1 = \lambda_2$ = 4 m

C. Ratio of intensity is 9

D. y_2 leadsy_1 by a phase of $\frac{\pi}{2}$

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

Watch Video Solution

26. Two waves $y_1 = a\sin(\omega t - kx)$ and $y_2 = a\cos(\omega t - kx)$ superimpose at a point :

A. The resultant amplitude is $\sqrt{2}a$

B. If I is the intensity of each source then $I_{\max} = 2l$

C. The resultant wave leads y_1 by a phase angle of $\frac{\pi}{4}$

D. Data insufficient to arrive at options (B) and ("C")

Answer: A::B::C

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27. Plane harmonic waves of frequency 500 Hz are produced in air with displacement amplitude of $10\mu m$. Given that density of air is $1.29\frac{kg}{m^3}$ and speed of sound in air is $340\frac{m}{s}$. Then

A. The pressure amplitude is $13.76Nm^{-2}$

B. The energy density is $6.45 \times 10^{-4} J m^{-3}$

C. The energy flux is $0.22 J m^{-2} s^{-1}$

D. Only (A) and (C) are correct

Answer: A::B::C

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28. Two waves travelling in opposite directions produce a standing wave . The individual wave functions are given by $y_1 = 4\sin(3x - 2t)$ and $y_2 = 4\sin(3x + 2t)cm$, where x and y are in cm

A. The maximum displacement of the motion at x = 2.3 cm is 4.63 cm

B. The maximum displacement of the motion at x = 2.3 cm is 5.32 cm

C. Nodes are formed at x values given by $0, \frac{\pi}{3}, \frac{2\pi}{3}, \pi, \frac{4\pi}{3}$

D. Antinodes are formed at x values given by $\frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{7\pi}{6}$

Answer: A::C::D

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29. Two waves travelling in a medium in the x-direction are represented by $y_1 = A\sin(\alpha t - \beta x)$ and $y_2 = A\cos\left(\beta x + \alpha t - \frac{\pi}{4}\right)$, where y_1 and y_2 are the displacements of the particles of the medium t is time and α and β constants. The two have different :-

A. Speeds

B. Directions of propagation

C. Wavelengths

D. Frequencies

Answer: B

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30. Velocity of sound in air is

A. Faster in dry air than in moist air

B. Directly proportional to pressure

C. Directlyproportional to temperature

D. Independent of pressure of air

Answer: D

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Unsolved Numerical Problems For Preparation Of Nse Inpho Ipho

1. Write down the equation of a wave travelling in the negative direaction along x-axis with an amplitude $0.01m$, a frequency $550Hz$

and a speed $330m/s$.

Watch Video Solution

2. Calculate the velocity of sound in a gas in which two waves of wavelength 1 m and $1.01m$ produce 20 beats in 6 seconds.

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3. The speed of sound in hydrogen is $1270ms^{-1}$ at temperature T. the speed at the same T in a mixture of oxygen and hydrogen mixed in a volume ratio 1:4 will be ?

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4. When a train is approaching the observer, the frequency of the whistle is 100 cps. When it has passed observer, it is 50 cps. Calculate the frequncy when the observer moves with the train.

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5. The speed of longitudinal wave is 100 times, then the speed of transverse wave in a brass wire. What is the stress in wire ? TheYoung's modulus of brass Is $1.0 \times 10^{11} N/m^2$

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6. A copper wire is held at the two ends by rigid supports. At $30^\circ C$, the wire is just taut with negligible tension. Find the speed of transverse waves in the wire at $10^\circ C$. Given $\alpha = (1.7 \times 10^{-5})^\circ C^{-1}$, $Y = 1.4 \times 10^{11} Nm^{-2}$ and $\rho = 9 \times 10^3 kgm^{-3}$.

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7. A train approaching a hill at a speed of $40 km / hr$ sounds a whistle of frequency $580 Hz$ when it is at a distance of $1 km$ from a hill. A wind with a speed of $40 km / hr$ is blowing in the direction of motion of the train Find

(i) the frequency of the whistle as heard by an observer on the hill,

(ii) the distance from the hill at which the echo from the hill is heard by the driver and its frequency.

(Velocity of sound in air $= 1,200 km / hr$)

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8. A train approaching a hill at a speed of $40 km / hr$ sounds a whistle of frequency $580 Hz$ when it is at a distance of $1 km$ from a hill. A wind with a speed of $40 km / hr$ is blowing in the direction of motion of the train Find

(i) the frequency of the whistle as heard by an observer on the hill,

(ii) the distance from the hill at which the echo from the hill is heard by the driver and its frequency.

(Velocity of sound in air $= 1, 200km / hr$)

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9. A wave of frequency $500Hz$ has a phase velocity of $350m / s$. (a) How far apart are two points 60° out of phase? (b) What is the phase difference between two displacement at a certain point at times $10^{-3}s$ apart?

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10. A wave of frequency 500 Hz has a phase velocity.of 350 m/s

(ii) What is the phase difference between two displacements at a certain point at time 10^{-3}s apart?

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11. The velocity of sound in air at $14^{\circ} C$ is $340 ms^{-1}$.What will it be when the pressure is doubled and temperature is raised to $157.5^{\circ} C$?

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12. A steel wire of length $1m$, mass $0.1kg$ and uniform cross-sectional area $10^{-6} m^2$ is rigidly fixed at both ends. The temperature of the wire is lowered by $20^{\circ} C$. If transverse waves are set up by plucking the string in the middle.Calculate the frequency of the fundamental mode of vibration.

Given for steel $Y = 2 \times 10^{11} N / m^2$

$\alpha = 1.21 \times 10^{-5} per^{\circ} C$

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13. The equation $y = A \sin 2\pi (500t - x / \lambda)$ represents a wave. Speed of wave is 360 m/s. Calculate

(a) wavelength of wave **(b) distance between two points which are $\pi/3$ out of phase.**

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14. Which of the following represents (a) a progressive wave and (b) a stationary wave ?

(a)$y = 2\cos 5x \sin 9t$,

(b) $y = 2\sqrt{x - vt}$,

(c) $y = \sin(5x - 0.5t) + 4\cos(5x - 0.5t)$

(d) $y = \cos x \sin t + \cos 2x \cdot \sin 2t$. **If progressive , and its velocity .**

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15. The velocity of sound in hydrogen is $1270ms^{-1}$ at $0^{\circ}C$ and the frequency of a fork is $335Hz$. Find the distance travelled by sound in hydrogen at $0^{\circ}C$ and $30^{\circ}C$ in the time in which the fork completes 71 vibrations.

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16. At what temperature is the velocity of sound in nitrogen equal to its velocity in oxygen at 20° C? The atomic weights of oxygen and nitrogen are in the ratio $16:14$

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17. Calculate the velocity of sound in a mixture of two gases obtained by mixing V_1 and V_2 volumes of them if the velocity of sound in them be C_1 and C_2. The atomicity of the gases is the same.

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18. Calculate the velocity of sound in a mixture of two gases obtained by mixing m_1 and m_2 of them if the velocity of sound in them be C_1 and C_2. The atomicity of the two gases is the same.

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19. Calculate the frequency of a ntoe emitted by a wire 20cm in length when stretched by a weight 8 kg, If 2m of the wore is found to weight 4g. Also calculate the velocity of transverse waves along the string

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20. In the spectrum of light of a luminous heavenly body the wavelength of a spectral line is measured to be 4747Å while actual wavelength of the line is 4700Å. The relative velocity of the heavenly body with respect to earth will be (velocity of light is $3 \times 10^8 m / s$)

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21. A wire 50cm long vibrates 100 times per second .If the length is shortened to 30 cm and the stretching force is quadrupled, what will

be the frequency ?

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22. A sensitive microphone with its receiving surface turned towards a long vertical wall is placed at a distance of 2 m from the wall. A strong source of sound of $500Hz$ is placed between the wall and microphone on the line perpendicular to the wall and passing through the position of microphone. Find the position of the source where no sound will be heard in the microphone. (Velocity of sound in air $= 350ms^{-1}$)

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23. A tuning fork of frequency 341 Hz is vibrated just over a tube of length 1m. Water is being poured gradually in the tube. What height of water colume will be required for resonance?Speed of sound in air is 341 m $/$ s.

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24. A man sets his watch by the noon-whistle of a factory at a distance of 1.5 kilometers. By how many seconds is his watch slower than the clock of the factory? (Velocity of sound in air is $332ms^{-1}$)

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25. Two tuning frok when sounded together give 4 beats per second.One is in unison with a length of 96 cm of a sonometer wire under a certain tension and the with 97 cm of the same wire under tension.Find the frequencies of the forks

Watch Video Solution

26. A bridges is placed under the string the of a monochord at a point near the middle and it is found that the parts produce 3 beats per

second when the streching force is 8 kg.if the load be then increased to 12 kg , determene the ratio of beating of the two parts of the string

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27. A whistle emitting a sound of frequency $440Hz$ is tied to a string of $1.5m$ length and rotated with an angular velocity of $20rads^{-1}$ in the horizontal plane. Calculate the range of frequencies heard by an observer stationed at a large distance from the whistle.

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28. An under-water swimmer sends a sound signal to the surface. If it produces 5 beats per second when compared with the fundamental tone of a pipe of 20 cm length closed at one end, what is the wavelength of sound in water ?

$\left(v_{air} = 360\frac{m}{s} \text{ and } v_{water} = 1500\frac{m}{s}\right)$

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29. One end of a string of length 120 cm is tied to a peg and other is attached to a weightless ring that can slide along a frictionless vertical rod fixed at a distance slightly greater then 120 cm .Find the three longest possible waveleghts

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30. The minimum intensity of audibility of a source is $10^{-12} \text{watt} / m^2$. If the frequency of the note is 1000 Hz, calculate the amplitude of vibrations of air particles. Density of air $= 1.293 kgm^{-3}$ and velocity of sound $= 340 ms^{-1}$

$$\left[\text{Hint} \quad a = \sqrt{\frac{I}{2\pi^2 n^2 \rho C}}\right]$$

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31. A plane wave $\zeta = A\cos(\omega t - kx)$ propagates in the reference frame S. find the equation of this wave in a refreence frame S' moving in the +ve direction of x-axis with a constant velocity V relative to S.

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32. The intensity of a sound wave 20 m away from the sound source is $3 \times 10^{-9} W/m^2$. Find the intensity of the wave 32m away from the source, if the half thickness for sound of this frequency is 120m.

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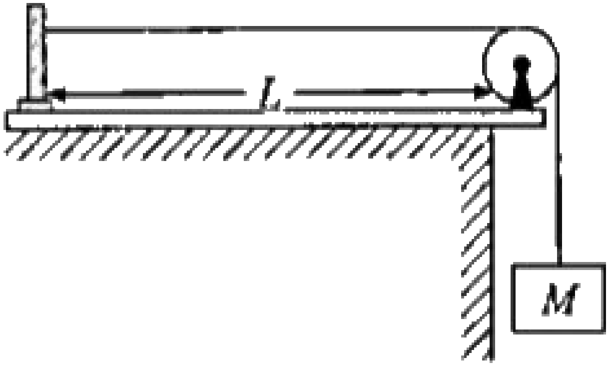
33. A load of 20 kg is suspended by a steel wire as shown in figure-6.109. Velocity of wave when rubbed with a resined cloth along the length is 20 times the velocity of the wave in the same string when it is plucked. Find the area of cross - section of the wire if Y for streel is

$19.6 \times 10^{10} N / m^2$ **and** $g = 9.8 m / s^2$



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34. A policemen blows a whistle of frequency 330 Hz as a car speeds and passed him with avelocity 18 km per hour. Find the change in frequency as heard by the driver of the car just as he passes the police man (Velocity of sound = 320 m//s)

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35. A wire ofuniform cross-section is suspended vertically from a fixed point , with a load attached at the lower end. Show that the change in frequency related to the altered frequency of the wire due to rise in temperature is approx $\frac{1}{2}\alpha$t, Where α is the linear coefficient of expansion of the wire and $t^\circ C$ is small rise in temperature.

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36. Standing waves are produced by superposition of two waves

$y_1 = 0.05\sin(3\pi t - 2x)$,

$y_2 = 0.05six(3\pi t + 2x)$

where x and y are measured in metre and t in second. Find the amplitude of the particle at x = 0.5m.

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37. A ship steams towards a hill in the sea and sounds its siren and the echo is heard after 6 s. The siren is sounded again 3 minutes later after the first sounding and the echo is heard after 4 s. If the velocity of the ship is 6.87 kmph, calculate the velocity of sound in air.

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38. A source of sonic oscillations with frequency and a receiver are located on the same normal to the wall. Both the source and the receiver are stationary and the wall recedes from source with velocity u. Find the beat frequency registered by the receiver. The velocity of sound is equal to v.

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39. An organ pipe 17 cm long open at one end radiates a tone of frequency 1.5 kHZ at temperature $16^\circ C$. What harmonic is this ? What

is the fundamental frequency of these oscillations velocity of sound at $NTP = 330m/s$.

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40. A string $25cm$ long and having a mass of $2.5gm$ is under tension. A pipe closed at one end is $40cm$ long. When the string is set vibrating in its first overtone and the air in the pipe in its fundamental frequency, 8 beats per second are heard. It is observed that decreasing the tension in the string decreases beat frequency. If the speed of sound in air is $320m/s$, find the tension in the string.

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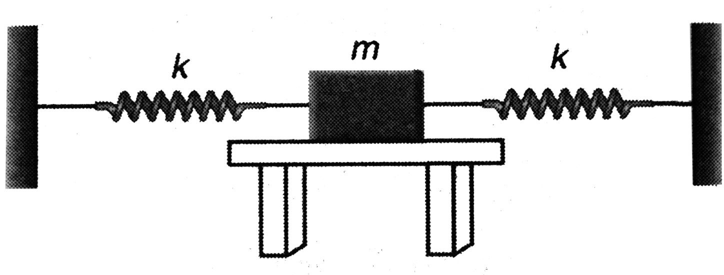
41. One end of each of two identical springs, each of force constant $0.5N/m$ are attached on the opposite sides the a wooden block of mass $0.01kg$. The other ends of the spring are connected to separate rigid supports such that the springs are unstrtched and are collinear

in a horizontal plane. To the wooden piece is fixed a pointer which touches a vertically moving plane paper. The wooden piece kept on a smooth horizontal table is now displaced by $0.02m$ along the line of springs and released. If the speed of paper is $0.1m/s$, find the equation of the path traced by the pointer on the paper and the distance between two consecutive maximum on this path.



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42. A note of frequency 300 Hz has an intensity of 1 microwatt per square metre. What is the amplitude of the air vibrations caused by this sound ? (Density of air $= 1.293kgm^{-3}$ and velocity of sound in air $= 332ms^{-1}$)

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43. A source of sound with natural frequency v_0 moves uniformly along a straight line separated from a stationary observer by a distance l . The velocity of the source is equal to η fraction of velocityof sound. Find the frequency of sound received by the observer at the moment when the source gets closest to him and also find the distance between the source and the observer at the moment, when the observer receives a frequency $v = v_0$

View Text Solution

44. A wire when stretched by the weight of a solid,' gives a fundamental)frequaicy v_1 when the solid is immersed in water it gives a frequency v, and when immersed in liquid it gives a frequency of v_2 Calculate the specific gravityofthe solidand that ofthe liquid.

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45. Two wires of different mass densities are soldered together end to end and are then stretched undera tension F (the tension is same in both the wires). The way e speed in the second wire is three times that in the first wire. When a harmonic wave is travelling in the first wire, it is reflected at thejunction of the wires, the reflected wave has half the am plitude of the incident wave

(a) If the amplitude of incident wave is A, what are the amplitudes of the reflected and transmitted waves ?

(b) Assuming no loss in wire, what fiaction of the incident power is reflected at thejunction and what fraction is transmitted ?

(c) Show that the displacement just to the left of the junction equals that just to the right ofthe junction.

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46. Calculate the velocity of sound in a mixture of oxygen, nitrogen and argon at 0° when their masses are in the ratio 2:7: 1. The molecular weights of gases are 32, 2S and 40 respectively.

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47. A non-uniform wire of length l and mass M has a variable linear mass density given by $\mu = kx$, where x is distance from one end of wire and k is a constant. Find the time taken by a pulse starting at one end to reach the other end when the tension in the wire is T.

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48. Microwaves which travel with the speed of light are reflected from a distant aeroplane approaching the waye source radar. It is found that when the reflected waves are beat against• the wave sradiated

from the source, the beat frequency is 990 Hz. If the micro waves are 0.1 m in wavelength, what is the approaching speed of the aeroplane.

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49. A man walks towards a cliff while beating a drum at the rate of 5 beats per second till the echo of beating disappears completely. He walks at the rate of 8 kilometres per hour. Calculate the distance of the man from the cliff in the beginning if he walked for 5 mintes. (Velocity of sound in air $= 350ms^{-1}$)

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50. A tunnel leading straight through a hill greatly amplifies tones at 135 and 138 Hz. Find the shortest length of the tunnel if velocity of sound in air is 330 m/s.

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51. A smoked plate falls vertically under gravity. A tuning fork traces wave on it. It is found that the lengths of two conscutive grounps of 10 waves are 5.143 and 6.64 cm respectively. What is the frequecny of the fork ?

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52. A sonometer wire under tension of 64 N vibrating in its fundamental mode is in resonance with a vibrating tuning fork. The vibrating portion of the sonometer wire has a length of 10 cm and mass of 1 kg. The vibrating tuning fork is now moved away from the vibrating wire with a constant speed and an observer standing near the sonometer hears one beat per second. Calculate the speed with which the tuning fork is moved, if the speed of sound in air is 300 m/s.

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53. Sources Separated by 20 m vibrate according to equations $y_1 = 0.06 \sin \pi t$ metre and $y_2 = 0.02 \sin \pi t$ metre. They send out waves along a rod at speed 3 m/s. What is the equation of motion of a particle 12 m from the first source and 8 metre from the second ?

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54. A wire of density $9000 kg / m^3$ is stretched between two clamps $100 cm$ apart while subjected to an extension od $0.05 cm$. What is the lowest frequency of transverse vibrations in the wire , assuming Young's modulus of the material to be $9 \times 10^{10} N / m^2$?

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55. Ordinary cotton thread, 200cm of which weight 1g, is used in Melde's experiment It is attached at one to a vibrator of frequency 100 Hz and at the order to a pan weights 6g.What length of the srting

will vibrate in 4 loops in the longitudinal arrangement if 10g weight is put on the pan ?

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56. A heavy ball is suspended from the ceiling of a motor car through a light string. A transverse pulse travels at a speed of $60cms^{-1}$ on the string when the car is at rest and $62cms^{-1}$ when the car accelerates on a horizontal road. Find the acceleration of the car. Take $g = 10ms^{-2}$

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57. The difference between the apparent frequency of a source of sound as perceived by an observer during its approach and recession is 2% of the natural frequency of the source. Then the speed of the source will be

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58. Two wires are kept tight between the same pair of supports. The tensions in the wires are in the ratio 2 : 1, the radii are in the ratio 3 : 1 and the densities are in the ratio 1 : 2. Find the ratio of their fundamental frequencies.

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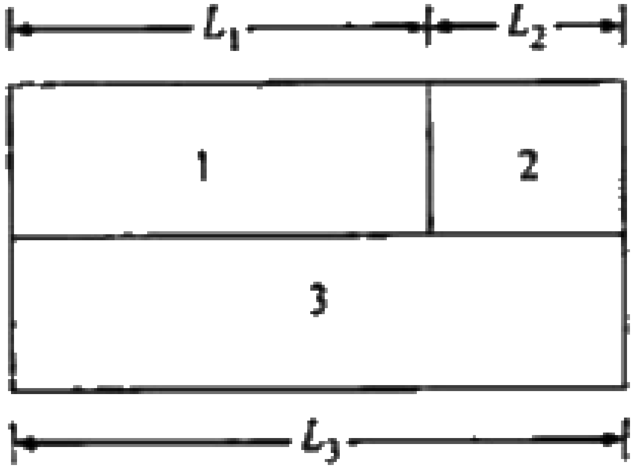
59. Three metal rods are located relative to each other shown in figure - 6.101, where $L_1 + L_2 = L_3$ Values of density and Young's modulus of the three materials are:

$(\rho_1) = 2.7 \times 10^3 kg/m^3$ $y_1 = 7 \times 10^{10} Pa$,

$(\rho_1) = 11.3 \times 10^3 kg/m^3$ $Y_2 = 1.6 \times 10^{10} pa$,

$(\rho_1) = 8.8 \times 10^3 kg/m^3$ $Y_3 = 11 \times 10^{10} pa$ If $L_3 = 1.5m$ What musht the ratio $L_1/L_{\_(2)}$ be if a sound wave is to travel the length of rods 1 and 2 in the same time as required to travel the length of



rod 3 ?

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60. Three sound waves of frequencies 320, 344 and 280 are produced simultaneously. Find the number of beats per second, assuming the human ear's resolution is 10 beats per second.

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61. A source of sound with frequency $256Hz$ is moving with a velocity V towards a wall and an observer is stationary between the source and the wall. When the observer is between the source and the wall he will hear beats.

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62. A siren emitting a sound of frequency $1000H_Z$ moves away from you towards a cliff at a speed of $10m/s$.

(a) What is the frequency of the sound you hear coming directly from the sirven ?

(b) What is the frequency of sounds you hear reflected off the cliffb ?

(c) What beat frequency would you hear ? Take the speed of sound in air as $330m/s$.

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63. S_1 and S_2 are two loudspeakers with the same frequency of 165 Hz and acoustic output 1.2×10^{-3} and 1.8×10^{-3} watts respectively/ They vibrate in the same phase. P is a point at a distance 4m from S_1 and 3m from S_2

How are the phase of the two waves arriving at P related?

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What is the intensity of sound at P if S_1 is turned off (S_2) on)

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67. A stretched sonometer wire gives 2 beats per second with a tuning frok when its length is 14.3 cm and also when its length is 14.5 cm.What is the frequency of the tuning frok ?

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68. The sounding rod of a dust tube apparatus is made of brass and is 160 cm long. The distance between adjacent nodes in the wave tube was 11.35 cm. Calculate the Young's modulus of the rod assuming that velocity of sound in air at room temperature is $350ms^{-1}$ and density o fbrass 900 kg m^(-3)`

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69. If at $t=0$, a travelling wave pulse on a string is described by the function.

$$y = \frac{6}{x^2 + 3}$$

What will be the waves function representing the pulse at time t, if the pulse is propagating along positive x-axis with speed $4m/s$?

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70. A receiver and a source of sonic oscillation of frequency n = 2000 Hz are located on the x - axis. The source swings harmonically along that axis with a circular frequency ω and an amplitude a = 50 cm. At what value of ω will the frequency band width registered by the stationary receiver be equal to `Deltan = 200 Hz? The velocity of sound is equal to v = 340 m/s

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71. Calculate the velocity of sound in air saturated with moisture at $25^\circ C$ and 745 mm pressure. The saturation pressure at $25^\circ C$ is $23.76mm$ of mercury and the velocity of sound at $0^\circ C$ in dry is

$332ms^{-1}$.

[Hint: See example 4.]

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72. Two long strings A and B, each having linear mass density $1.2 \times 10^{-2} kgm^{-1}$, are stretched by different tensions 4.8 N and 7.5 N respectively and are kept parallel to each other with their left ends at x = 0. Wave pulses are produced on the strings at the left ends at t = 0 on string A and at t = 20 ms on string B. When and where will the pulse on B overtake that on A ?

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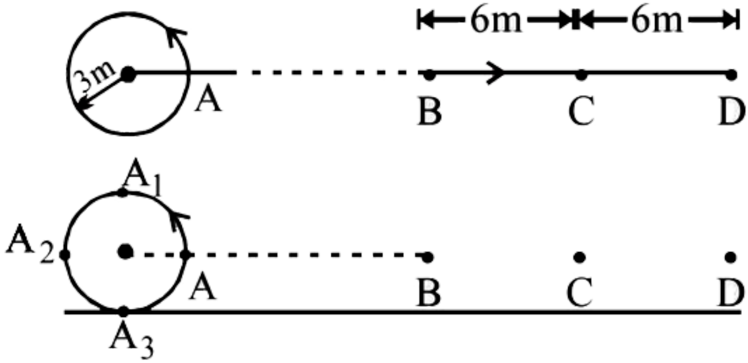
73. A source of sound is moving along a circular orbit of radius $3meter$ with an angular velocity of $10rad/s$. A sound detector located far away from the source is executing linear simple harmonic motion along the line BD with an amplitude $BC = CD = 6meters$.

The frequency of oscillation of the detector is $\frac{5}{\pi}$ per second. The source is at the point A when the detector is at the point B. If the source emits a continuous sound wave of frequency $340 Hz$, Find the maximum and the minimum frequencies recorded by the detector.



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74. A vibrator makes 150 cm of a arting vibrate in 6 loops in the longitudinal arrangement when it is stretched by 15 g. The entire length of the string is then weighed and is found to weigh 500mg.What is the frequency of the vibrator ? Wjat is the sidtance beween two nodes?

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75. Find the radius vector defining the position of a point source of spherical waves if that source is known to be located on the straight line between the points with radius vector r_1 and r_2 at which the oscillation amplitudes of particles of the medium are equal to a_1 and a_2. The damping of the wave is negligible, the medium is homogeneous.

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76. A sonometer wire of length $1.5m$ is made of steel. The tension in it produces an elastic strain of 1%. What is the fundamental frequency of steel if density and elasticity of steel are $7.7 \times 10^3 kg/m^3$ and $2.2 \times 10^{11} N/m^2$ respectively?

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77. Fifty-six tuning forks are arranged in order of increasing frequencies so that each fork gives 4 beats per second with the next one. The last fork gives the octave of the first. Find the frequency of the first.

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78. Two plane sonic waves of same frequency are travelling in a homogeneous medium. Loudness recorded by a moving detector in the medium varies from $L_1 = 30db \text{ to} L_2 = 43.9794$ dB . Calculate intensity of the two waves.

Give $\log_1 2 = 0.30103$

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79. A column of air and a tuning fork produce 4 beats per second when sounded together. The tuning fork gives the lower note. The

temperature of air is $15^\circ C$. When the temperature falls to $10^\circ C$, the two produce 3 beats per second. Find the frequency of the fork.

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80. A source of sonic oscillations with frequency $v_0 = 100 Hz$ moves at right angles to the wall with a velocity $u = 0.17 m/s$. Two stationary receivers R_1 and R_2 are located on a straight line, coinciding with the trajectory of the source , in the following succession :$R_1 -$ source $- R_2 -$ wall. Which receiver registers the beatings and what is the beat frequency ? The velocity of sound is equal to $v = 340 m/s$.

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81. A $200 Hz$ wave with amplitude $1 mm$ travels on a long string of linear mass density $6 g/m$ keep under a tension of $60 N$.

(a) Find the average power transmitted across a given point on the string.

(b) Find the total energy associated with the wave in a $2.0m$ long portion of the string.

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83. The temperature of air varies with height linearly from T_1 at the earth's surface to T_2 at a height h. Calculate the time t needed for a

sound wave produced at a heights to reach the earth's surface. The velocity ofsound near the earth's surface is C.

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84. The shape of a wave propagating in the positive x or negative x-direction is given $y = \frac{1}{\sqrt{1 + x^2}}$ at t=0 and $y = \frac{1}{\sqrt{2 - 2x + x^2}}$ at t=1s where x and y are in meters the shape the wave disturbance does not change during propagation find the velocity of the wave

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86. The following equations represent transverse waves :

$z_1 = A\cos(kx - \omega t)$,

$z_2 = A\cos(kx + \omega t)$, $z_3 = A\cos(ky - \omega t)$

Identify the combination (s) of the waves which will produce (i) standing wave(s), (ii) a wave travelling in the direction making an angle of 45° with the positive x and positive y axes. In each case, find the positions at which the resultant is always zero.

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87. A wire of length l is kept just taut horizontally between two walls.A mass m hanging from its mid point depresses it by δ.Calculte the time in which a pulse set up at one end will reach the other end . The mass of the wire per unit length of it is μ

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88. Wavelength of two notes in ai rare $80/195$ m and $80/193$ m. Each note produces five beats per second with a third note of a fixed frequency. Calculate the velocity of sound in air.

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89. A fork and a monochord string 100 cm long give 4 beats per second.The string is made shorter without any change of tension untill it is in unsion the frok.If its length is now 99 cm, what is the frequency if the frok ?

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90. 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 $1.0mm^2$, find its Young modulus.

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91. A stationary observer receives sonic oscillations from two tuning forks one of which approaches and the other recedes with the same velocity. As this takes place, the observer hears the beats of frequency $f = 2.0 H_Z$. Find the velocity of each tuning fork if their oscillation frequency is $f_o = 680 H_Z$ and the velocity of sound in air is $v = 340 m / s$.

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92. A sonometer wire under tension of 64 N vibrating in its fundamental mode is in resonance with a vibrating tuning fork. The vibrating portion of the sonometer wire has a length of 10 cm and mass of 1 kg. The vibrating tuning fork is now moved away from the vibrating wire with a constant speed and an observer standing near the sonometer hears one beat per second. Calculate the speed with

which the tuning fork is moved, if the speed of sound in air is 300 m/s.

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93. the linear density of a wire under tension t varies linearly from μ_1 to μ_{20}.Calculate the time that a pulse would need to pass one to the other.The length of the wire is l

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94. In a sonometer wire, the tension is maintained by suspending a 50.7 kg mass from the free end of the wire. The suspended mass has a volume of 0.0075 m 3. The fundamental frequency of the wire is 260 Hz . If the suspended mass is completely submerged in water, the fundamental frequency will become (take $g = 10ms^{-2}$) [

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95. Calculate the velocity of sound in air on a day when temperature is $30^\circ C$, pressure $0.74m$ of mercury and relative humidity 60%. Velocity of sound at NTP $= 330ms^{-1}$. Saturated vapour pressure at $30^\circ C = 0.032m$ of mercury.

$$\left[\text{Hint: Relative Humidity } = \frac{\text{Vapour pressure at } 30^\circ C}{\text{Saturated vapour pressure at } 30^\circ C} \quad C_m = C_d\sqrt{\frac{P}{P - 0.385f}}\right]$$

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96. If a loop of chain is spunat high speed, it will roll like a hoop without collapsing. Consider a chain oflinear mass density p that μ is rollingwithoutslipping at a high speed v_0

(a) Show that the tension in the chain is $F = \mu v_0^2$

(b) If the chain rolls over a small hump, a transverse wave pulse will be generated in the chain. At whatspeedwill it travel alongthe chain ?

(c)How far around the loop (in degrees) will a transverse pulse travelin the time the hoop rolls through one complete revolution ?

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97. In a pipe closed at both ends the maximum amplitude of vibration is 5 mm and the amplitude of vibration at a distance 5 cm from one end is 4.33 mm. The length of the pipe is 120cm. To what mode of vibration does it correspond ? What is the frequency of the note emitted by the pipe ? Velocity of sound in the gas enclosed in the pipe 336 m/s.

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98. A 2.00 m-long rope, having a mass of 80 g, is fixed at one end and is tied to a light string at the other end. The tension in the string is 256 N. (a) Find the frequencies of the fundamental and the first two overtones. (b) Find the wavelength in the fundamental and the first two overtones.

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100. A 2 m string is fixed at one end and is vibrating in its third harmonic with amplitude 3 cm and frequency 100Hz

(a) Write an expression for the kinetic energy of a segment of a segment of the string of length dx at a point x at some time l. At what time is its kinetic energy maximum? What is the shape of the string at this time?

Find the maximum kinedic energy of the string by intergrating your expression for part (a) over the total length of the string.

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101. Show that ifthe rate of change oftemperature with height dT/dh called lapse rate is a constant, a sound wave travelling horizontally is refracted along an arc of radius of curvature

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102. A transverse wave of amplitude 0.50 mm and frequency 100 Hz is produced on a wire stretched to a tension of 100 N. If the wave speed is $100ms^{-1}$, what average power is the source transmitting to the wire ?

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103. An aluminium wire of length 0.6 m and cross-sectional area $10^{-6}m^2$ is connected to a steel wire of the same crosssectional area and length 0.866 m. The compound wire is loaded with 10 kg. Find the

lowest frequency of excitation for which the joint in the wire is a node. Also find the number ofnodes, excluding the two at the ends of the wire. The density of aluminium is $2600kg/m^3$ andthatofsteel is $7800kg/m^3$

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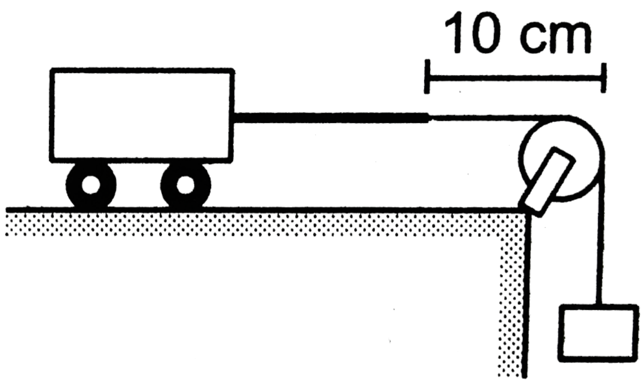

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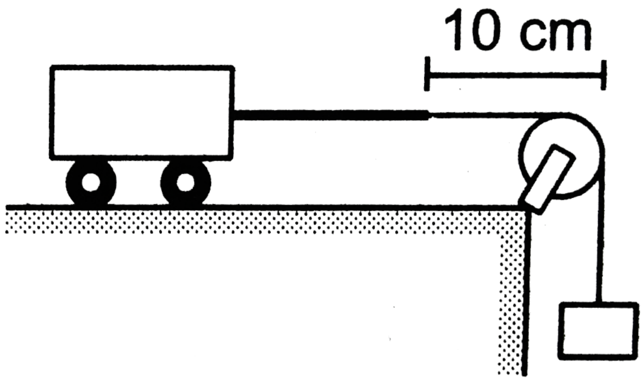

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