PHYSICS

BOOKS - CENGAGE PHYSICS (ENGLISH)

SUPERPOSITION AND STANDING WAVES

Exercise 7.1

1. Two sound waves with amplitude $4cm$ and $3cm$ interfere with a phase difference of

a. 0 b. $\pi/3$ c. $\pi/2$ d. π

Find the resultant amplitude in each case.

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2. Find the resultant amplitude and the phase difference between the resultant wave and the first wave , in the event the following waves interfere at a point , $y_1 = (3cm)\sin\omega t$, $y_2 = (4cm)\sin\left(\omega t + \frac{\pi}{2}\right)$, $y_3 = (5cm)\sin(\omega t + \pi)$

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3. When two waves interfere , does one alter the progress of the other ?

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4. When waves interfere , is there any loss of energy ?

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5. A travelling wave has speeds $50m/s$ and $200m/s$ in two different media A and B . Such a wave travelling through A , gets incident normally on a plane boundary , separating A and B. Find the ratio of amplitudes of the reflected anf transmitted waves.

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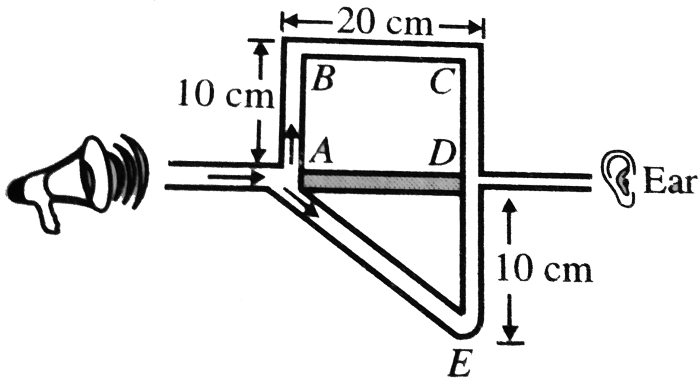
6. Figure 7.20 shows a tube structure in which signal is sent from one end and is received at the other end . The frequency of the sound source can be varied electronically between $2000 \rightarrow 5000Hz$. Find the frequencies at which maxima of intensity are detected . The speed of sound in air $340m / s$.



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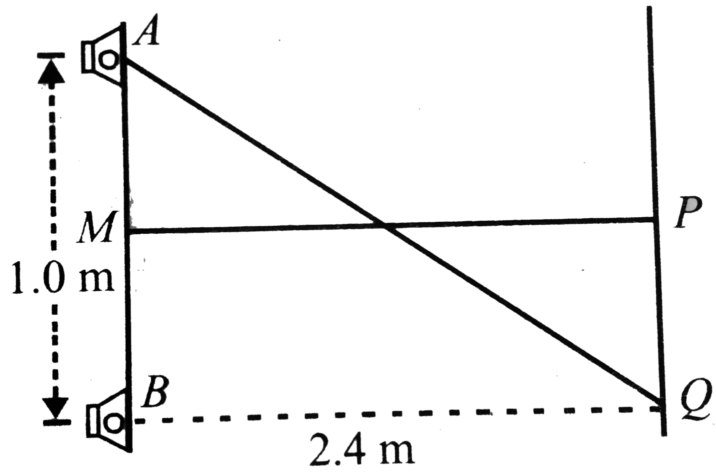
7. Two small loudspeakers A, B ($1m$ apart) are connected to the same oscillator so that both emit sound waves of frequency $1700Hz$ in phase . A sensitive detector , detects a maximum wave at P on the perpendicular bisector $MPofAB$ and another maximum wave when it first reaches a point Q directly opposite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



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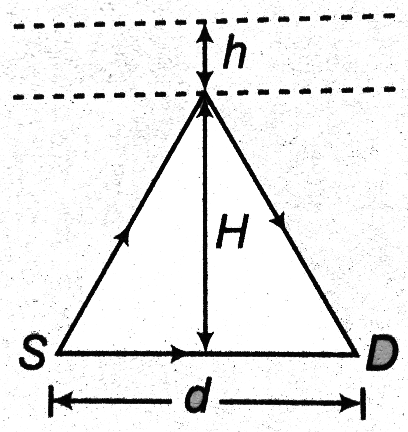
8. A source S and a detector D high frequency waves are a distance d apart on the ground. The direct wave from S is found to be in phase at D with the wave from S that is reflected from horizontal layer at an altitude H. The incident and reflected rayes make the same angle with the reflecting layer. When the layer rises a distance h, no signal is detected at D . Negle ct absorption in the atmosphere and find the relation between d,h,

H and the wavelength λ of the waves.



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9. Two waves have the same frequency . The first has intensity I_0. The second has intensity $4I_0$ and lags behind the first in phase by $\pi/2$. When they meet , find the resultant intensity , and the phase relationship of the resultant wave with the first wave .

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10. Determine the amplitudes of the resultant motion when two sinusoidal waves of same frequency , travelling in the same direction are combined . Their amplitudes are $3.0cm$ and $4.0cm$ and they differ in phase by $\pi/2radians$.

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11. In a large room , a person receives direct sound waves from a source $120m$ away . He also receives waves from the same source which reach him after being reflected from the $5-m$ high ceiling at a point halfway between them . For which wavelengths will these two sound waves interfere constructively ?

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12. Sound waves from a tuning fork placed at a point P reach another point Q , by two separate paths PRQ and PSQ . When PSQ is greater than $PRQby11.5cm$, there is silence at Q . When the difference is $23cm$, the sound becomes loudest at Q, and when $34.5cm$, there is silence , and so on . Explain this effect and calculate the frequency of the fork if the velocity of sound is taken to be $331.2m/s$.

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13. show that when reflection takes place from a boundary separating two media and the velocity in the second medium is infinitely large , the amplitude of the reflected wave is equal to the amplitude of the incident wave and there is a phase change of π in the displacement wave.

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14. Stationary waves are produced in a length of wire fixed between two points . Compare the amplitudes at an antinode for the fundamental and the first overtone . Assume that the total energy of the initial waves is , on an average , equally divided between the two modes.

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15. Two speakeer connected to the same source of fixed frequency are placed 2m apart in a box. A sensitive microphone placed at a distance of 4m from the midpoint alon the perpendicular bisector shown maximum response. The box is slowly rotated till the speaker are in line with the microphone, The distance between the midpoint of the speakers and the microphone remains unchanged. Exactly 5 maximum responses (inculuding the initial and last one) and observed in the microphone in doing this. The wavelength of the sound wave is (o.x) meter. Find the value of x.

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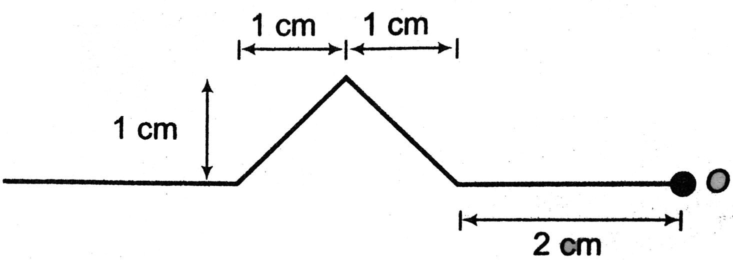
16. A wave pulse on a string has the dimensions shown in figure. The wave speed is $v = 1 cm/s$.



(a) If point O is a fixed end, draw the resultant wave on the string at t=3 s and t=4 s.

(b) Repeat part (a) for the case in which O is a free end.

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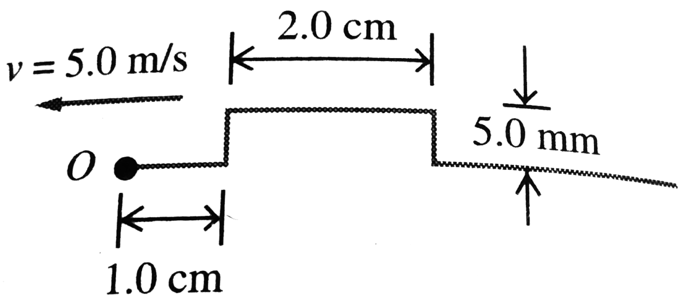
17. A wave pulse on a string has the dimensions shown in Fig.7.24 at $t = 0$. The wave speed is $5.0 m / s$. (a) If point O is fixed end , draw the total wave on the string at $t = 1.0 ms, 2.0 ms, 3.0 ms, 4.0 ms, 5.0 ms, 6.0 ms$ and $7.0 ms$.

(b) Repeat part (a) for the case in which point O is a free end .



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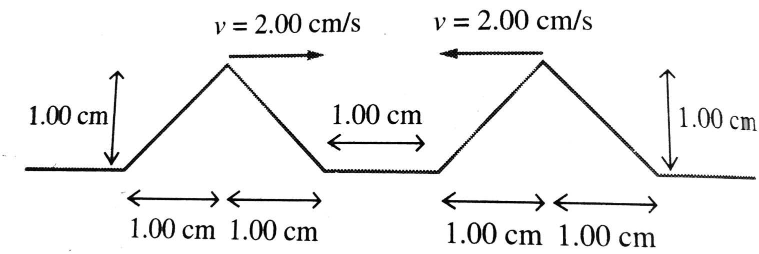
18. Two triangular wave pulses are travelling toward each other on a stretched string as shown in Fig . 7.25. Both pulses are identical to each other and travels at $2.00cm/s$. The leading edges of the pulses are $1.00cm$apart at $t=0$. Sketch the shape of the string at $t=0.250s, t=0.500s, t=0.750s, t=1.000s$ and $t=1.250s$.



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19. A sound wave may be considered either as a displacement wave or as a pressure wave . When reflection takes place from as a rigid wall , what phase change do you except in its displacement representation and in its pressure representation?

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Exercise 7.2

1. If two waves differ only in amplitude and are propagated in opposite directions through a medium, will they produce standing waves. Is energy transported?

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2. If two sound waves of frequiencies $500Hz$ and $550Hz$ superimose , will they produce beats ? Would you hear the beats ?

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3. All harmonics are overtones but all overtones are not harmonics . Explain .

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4. Resonance produces louder sound than that produced by the forced vibrations of a body . Why then is resonance purposely avoided in many instruments ?

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5. If f_1 and f_2 be the fundamental frequencies of the two segments into which a stretched string is divided by means of a bridge , then find the original fundamental frequency f of the complete string.

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6. Two tuning forks A and B produce $4beats / s$ when sounded together . A resonates to $32.4cm$ of stretched wire and B is in resonance with $32cm$ of the same wire . Determine the frequencies of the two tuning forks .

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7. A glass tube of length $1.5m$ is filled completely with water , the water can be drained out slowly at the bottom of the tube . Find the total number of resonance obtained , when a tuning fork of frequency $606Hz$ is put at the upper open end of the tub

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8. Calculate the velocity of sound in a gas in which two waves of wavelength 50 cm and 50.5cm, produce 6 beats per second.

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9. A string vibrates according to the equation

$y = 5\sin\frac{\pi x}{3}\cos 40\pi t$

where, x and y are in centimeters and t is in seconds.

(a) What is the speed of the component wave?

(b) What is the distance between the adjacent nodes?

(c) What is the velocity of the particle of the string at the position $x = 1.5$ cm when $t = \frac{9}{8}s$?

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10. In Qunick's acoustic interferometer , it is found that the sound intensity has a minimum value of $100 units$ at one position of the sliding tube , and cocontinuously climbs to a maximum of $900 units$ at a second position $1.65 cm$ from the first . Find

(a) the frequency of the sound emitted by the source and

(b) the relative amplitudes of the two waves arriving at the detector.

Velocity of sound in air $= 340 m / s$.

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11. Two tuning forks produce $5 beats$ when sounded together.A is in unison with $40 cm$ length of a sonometer wire under a constant tension and B is in unison with the same wire of length $40.5cm$ under the same tension. Calculate fundamental frequency of the forks.

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12. 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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13. A wire of density $9gm/cm^3$ is stretched between two clamps 1.00m apart while subjected to an extension of 0.05cm. The lowest frequency of transverse vibration in the wire is (Assume Yong's modulus $Y = 9 \times 10^{10} N/m^2$.

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14. An open organ pipe has a fundamental frequency of $300H_Z$. The first overtone of a closed organ pipe has the same frequency as the first overtone of this open pipe . How long is each pipe ? (Speed of sound in air = $330m/s$)

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15. A wire of uniform cross - section is suspended vertically from a fixed point , with a load attached at the lower end . Calculate the fractional change in frequency of the wire due to rise in temperature by $t^\circ C$. The coefficient of expansion of the wire is α.

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16. A certain fork is found to give $2beats/s$ when sounded in conjuction with a stretched string vibrating transversely under a tension of either $10.2 \text{ or } 9.9kgweight$. Calculate the frequency of fork.

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17. A wire is in uniform with a tuning fork when stretched by a weight of density $9000kg/m^3$ in a sonometer experiment . When the weight is immersed in water , the same wire produces $5beats/s$ with the same fork. Find the frequency of the fork.

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18. A tuning fork of frequency 256 Hz produces 4 beats per second when sounded with a stringed instrument. What is the

frequency produced by the instrument?

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19. Show that the period of the fundamental mode of a stretched strings is equal to double the time the component waves forming stationary waves in the string take in traversing the distance between the fixed ends.

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20. 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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21. An open organ pipe of length $11cm$ in its fundamental mode vibrates in resonance with the first overtone of a closed organ pipe of length $13.2cm$ filled with some gas . If the velocity of sound in air is $330m/s$, calculate the velocity of sound in the unknown gas .

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22. A string of length $25cm$ is stretched by a load of $10kg$. What is the highest overtone that a man of normal hearing capacity can detect ? The mass of the string is

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23. A tuning fork A is in resonance with an air column $32cm$ long and closed at one end . When the length of this column is increased by $1cm$,it is in resonance with another fork B. When A and B are sounded together , they produce $40\text{beats in}5s$. Find their frequencies .

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24. 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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25. 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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26. 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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27. 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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28. Two sonometer wires of the same material and cross - section are of lengths $50cm$ and $60cm$ and are stretched by tensions of $4.5kg$ and $5.12kg$, respectively . If the number of beats heard (when the two wires are vibrating) be $2per \sec ond$, find the mass per unit length of the wires . Take $g = 10m / s^2$.

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29. A string fixed at both ends is vibrating in the lowest possible mode of vibration for which a point at quarter of its length from one end is a point of maximum displacement. The frequency of vibration in this mode is 100 Hz. What will be the frequency emitted when it vibrates in the next mode such that this point of maximum displacement?

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30. A piano string $1.5m$ long is made of steel of density $7.7 \times 10^3 kg/m^3$ and $\gamma = 2 \times 10^{11} N/m^2$. It is maintained at a tension which produces an elastic strain of 1% in the string . What is the fundamental frequency of transverse vibration of the string ?

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31. Two sound waves travelling in the same direction are superposed. Their frequencies are 300 and $302 Hz$ and their amplitudes are 0.2 and $0.3mm$, respectively

a. What is the number of beats per second ?

b. What are the maximum and minimum values of resultant amplitude during the formation of beats ?

c. Calculate the ratio of maximum and minimum intensities of the resultant sound.

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32. Two tunning forks A and B when sounded together produce $3beats / s$. What are the possible frequencies of B, if the frequency of $Ais400$ cycle//s ? How can you verify which of the possible values is correct ?

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Subjective

1. Two wires of different linear mass densities are soldered together end to end and then stretched under a tension F. The wave speed in the first wire is thrice that in the second. If a harmonic wave travelling in the first wire is incident on the junction of the wires and if the amplitude of the incident wave is $A = \sqrt{13}cm$, find the amplitude of reflected wave.

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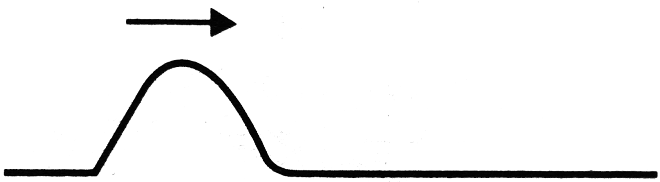
2. The pulse shown in Fig.7.73 has a speed of $5cm / s$. If the linear mass of the right string is 0.5 that of the left string , find the ratio of height of the transmitted pulse to that of incident pulse.



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3. 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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4. A $3m$ long organ pipe open at both ends is driven to third harmonic standing wave. If the amplitude of pressure oscillations is 1 per cent of mean atmospheric pressure $(p_o = 10^5 Nm^2)$. Find the amplitude of particle displacement and density oscillations. Speed of sound $v = 332m/s$ and density of air $\rho = 1.03kg/m^3$.

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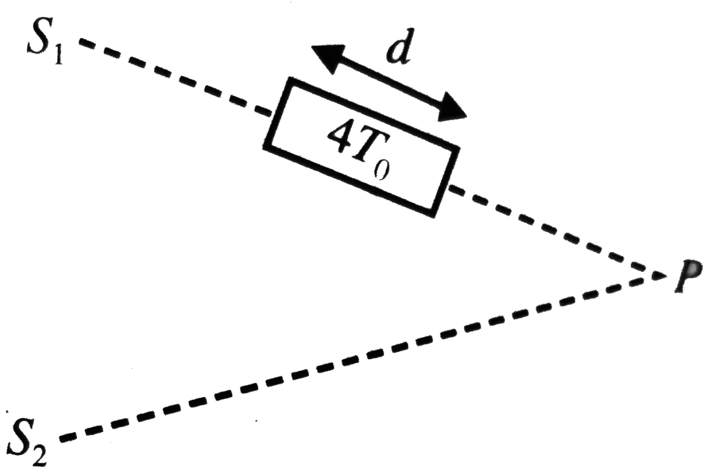
5. Sound from coherent sources S_1 and S_2 are sent in phase and detected at point P equidistant from both the sources . Speed of sound in normal air in V_0, but in some part in path S_1 , there is a zone of hot air having temperature $4 \times$, the normal temperature , and width d. What should be minimum frequency of sound , so that minima can be found at P?



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6. A bat emits ultrasonic sound of frequency $1000kHz$ in air . If the sound meets a water surface , it gets partially reflected back and partially refracted (transmitted) in water . What would be the difference of wavelength transmitted to wavelength reflected (speed of sound in air $= 330m/s$, Bulk modulus of water $= 2.25 \times 10^9$, $\rho_{water} = 1000kg/m^2$).

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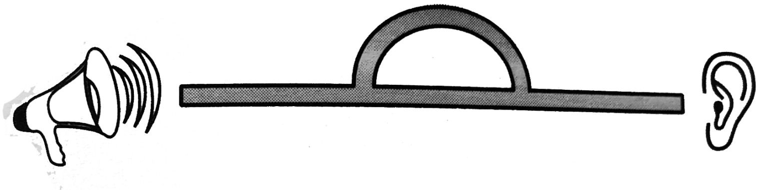
7. Figure 7.75 shows a tube structure in which a sound signal is bent from one end and is received at the other end . The semicircular part has a radius of $20.0cm$. The frequency of the sound source can be varied electronically between $1000 \text{ and } 4000Hz$. Find the frequencies at which maxima of intensity are detected. The speed of sound in air $= 340 m / s$.



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8. A source emitting sound of frequency 180 Hz is placed in front of a wall at a distance of 2 m from it. A detector is also placed in front of the wall 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 $= 360 m s^{-1}$.

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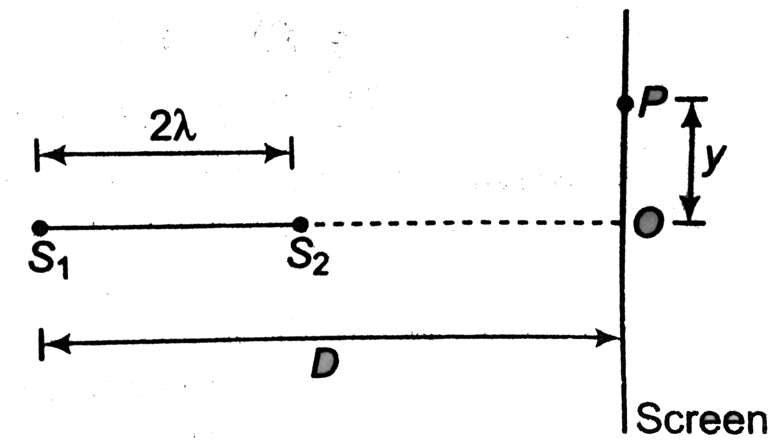
9. Two coherent narrow slits emitting sound of wavelength λ in the same phase are placed parallet to each other at a small separation of 2λ . The sound is delected by maving a delector on the screen at a distance $D(> > \lambda)$ from the slit S_1 as shows in figure. Find the distance y such that the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



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10. 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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11. 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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12. A set of 56tuning forks is arranged in a sequence of increasing frequencies . If each fork gives $4beats/s$ with the preceding one and the last fork is found to be an octave higher of the first , find the frequency of the first fork.

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13. Two tuning forks A and B sounded together give 8 beats per second. With an air resonance tube closed at one end, the two forks give resonances when the two air columns are $32cm$ and $33cm$ respectively. Calculate the frequenciec of forks.

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14. A certain fork is found to give $2beats/s$ when sounded in conjuction with a stretched string vibrating transversely under a tension of either 10.2 or $9.9kgweight$. Calculate the frequency of fork.

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15. The two parts of a sonometer wire divided by a movable knife edge , differ in length by $2mm$ and produce $1beat/s$, when sounded together . Find their frequencies if the whole length of wire is $1.00m$.

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16. Two tuning forks A and B give $18beats \text{in} 2s$. A resonates with one end closed air column of $15cm$ long and B with both ends open column of 30.5 long. Calculate their frequencies.

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17. Six antinodes are observed in the air column when a standing wave forms in a Kundt's tube . What is the length of the air column if steel bar of $1m$ length is clamped at the middle .

The velocity of sound in steel is $5250m/s$ and in air $343m/s$.

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18. 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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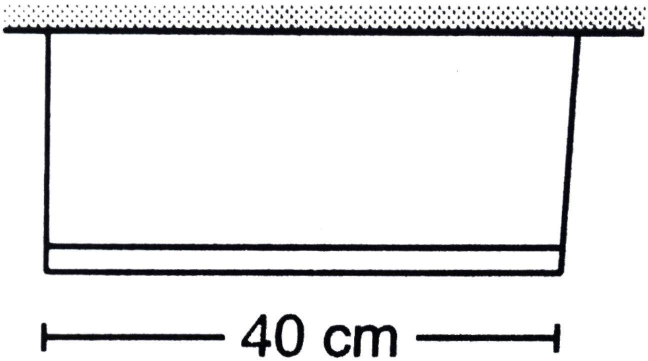
19. A uniform horizontal rod of length 40 cm and mass 1.2 kg is supported by two identical wires as shown in figure. Where should a mass of 4.8 kg be placed on the rod so that the same tuning fork may excite the wire on left into its fundamental vibrations and that on right into its first overtone ? Take $g = 10ms^{-2}$



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20. A sonometer wire under tension of $128N$ vibrates in resonance with a tuning fork . The vibrating portion of sonometer wire has length of $20cm$ and mass $1g$. The vibrating wire at constant speed of $0.75m/s$ and an observer standing near the sonometer hear $1beat/s$. Find the speed of sound in air.

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21. A rod of nickel of length l is clamped at its midpoint . The rod is stuck and vibrations are set up in the rod . Find the general expression for the frequency of the longitudinal vibrations of the rod . Young's modulus and density of the rod is Y and ρ , respectively.

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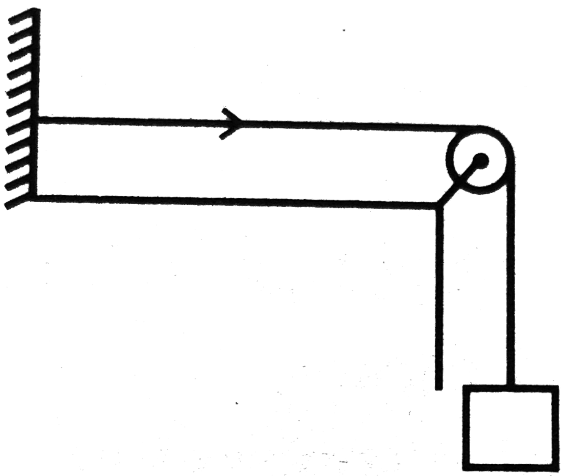
22. A string is stretched by a block going over a pulley . The string vibrates in its fifth harmonic in unison with a particular tuning fork . When a beaker containing a liquid of density ρ is brought under the block so that the block is completely dipped into the beaker , the string vibrates in its seventh harmonic in unison with the tuning fork . Find the density of the material of the block.



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23. An audio oscillator capable of producing notes of frequencies ranging from $500 Hz \text{to} 1500 Hz$ is placed constant tension T. The linear mass density of the wire is $0.75 g / m$. It is observed that by varying the frequency of the oscillator over the given permissible rang the sonometer wire sets into vibration at frequencies $840 Hz \text{ and } 1120 Hz$.

a. Find the tension in the string .

b. What are the frequencies of the first and fourth overtone produced by the vibrating string?

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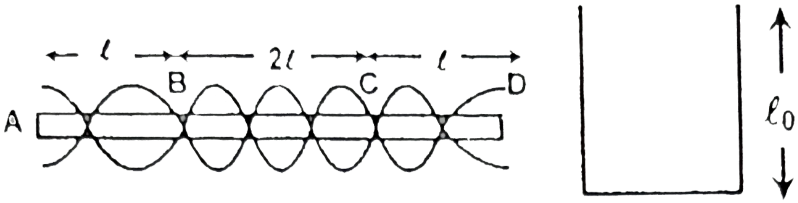
24. A closed orgain pipe of length l_0 is resonating in 5^{th} harmonic mode with rod clamped at two points l and $3l$ from one end. If the length of the rod is $4l$ and it is vibrating in first

overtone. Find the length of the rod. [Velocity of sound in air $= v_s$ Young's modulus for the rod Y and density ρ]



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Single Correct

1. The displacement of a particle is given by $x = 3\sin(5\pi t) + 4\cos(5\pi t)$. The amplitude of particle is

A. 3

B. 4

C. 5

D. 7

Answer: C

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2. 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

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3. On sounding fork A with another tuning fork B of frequency $384Hz, 6beats$ are produced per second .After loading the prongs of A with wax and then sounding it again with $B, 4beats$ are produced per second. What is the frequency of the tuning fork A.

A. $388Hz$

B. $80Hz$

C. $378Hz$

D. $390Hz$

Answer: D

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4. Two tuning forks A and B give $4 beats / s$ when sounded together . The frequency of $A is 320 Hz$. When some wax is added to B and it is sounded with A, $4 beats / s per \sec ond$ are again heard . The frequency of B is

A. $312 Hz$

B. $316 Hz$

C. $324 Hz$

D. $328 Hz$

Answer: C

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5. Forty - one forks are so arranged that each products $5 beat / s$ when sounded with its near fork . If the frequency of last fork is double the frequency of first and last fork , respectively are

A. $200, 400$

B. $205, 410$

C. $195, 390$

D. $100, 200$

Answer: A

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6. The equation of a stationary wave is $y = 0.8 \cos\left(\frac{\pi x}{20}\right) \sin 200\pi t$ where x is in cm and t is in s. The separation between consecutive nodes will be

A. $20cm$

B. $10cm$

C. $40cm$

D. $30cm$

Answer: A

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7. The following equations represent progressive transverse waves

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

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

$z_3 = A\cos(\omega t + ky)$

$z_4 = A\cos(2\omega t - 2ky)$

A stationary wave will be formed by superposing

A. z_1 and z_2

B. z_1 and z_4

C. z_2 and z_3

D. z_3 and z_4

Answer: A

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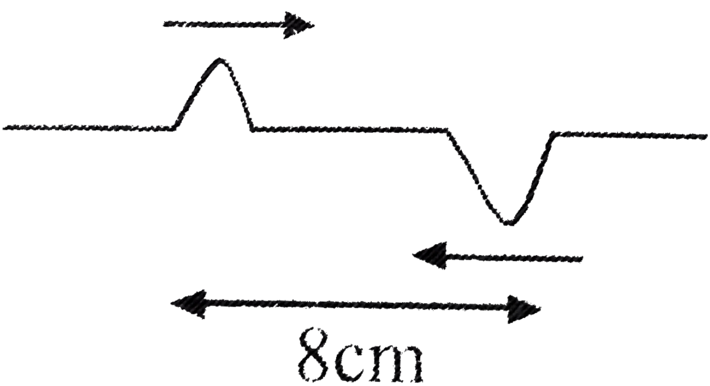
8. Two pulses in a stretched string whose centres are initially 8 cm apart are moving towards each other as shown in the figure. The speed of each pulse is 2 cm/s. After 2 second, the total energy of the pulses will be



A. zero

B. purely kinetic

C. purely potential

D. party kinetic and partly potential

Answer: B

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9. Two identical sounds s_1 and s_2 reach at a point P phase. The resultant loudness at a point P is not higher than the loudness of s_1. The value of n is

A. 2

B. 4

C. 5

D. 6

Answer: D

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10. The ratio of intensities between two cohernt sound sources is 4:1. The difference of loudness is decibel (bD) between maximum and minimum intensitiesm, when they interface in space is

A. $10\log(2)$

B. $20\log(3)$

C. $10\log(3)$

D. $20\log(2)$

Answer: B

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11. Mark the correct statement.

A. In case of stationary waves the maximum pressure change occurs at antinode.

B. velocity of longitudinal waves in a medium is its physical characteristics .

C. Due to propagation of longitudinal wave in air , the maximum pressure change is equal to $2\pi na / \rho v$.

D. None of the above

Answer: B

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12. Which of the following statements is correct for stationary waves

A. Nodes and antinodes are formed in case of stationary transverse wave only

B. In case of longitudinal stationary wave , compressions and rarefactions are obtained in place of nodes and antinodes respectively

C. Suppose two plane wave , one longitudinal and the other transverse having same frequency and amplitude are travelling in a medium in opposite directions with the same period , by superposition of these waves , stationary waves cannot be obtained

D. None of the above

Answer: C

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13. A sound wave of wavelength λ travels towards the right horizontally with a velocity V. It strikes and reflects from a vertical plane surface , travelling at a speed v towards the left . The number of positive crests striking in a time interval of $3s$ on the wall is

A. $3(V+v)/\lambda$

B. $3(V-v)/\lambda$

C. $(V+v)/3\lambda$

D. $(V-v)/3\lambda$

Answer: A

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14. A sonometer wire of length l vibrates in fundamental mode when excited by a tunning fork of frequency 416 Hz. If the length is double keeping other things same the string will

A. vibrate with a frequency of $416 Hz$

B. vibrate with a frequency of $208 Hz$

C. vibrate with a frequency of $832 Hz$

D. stop vibrating

Answer: A

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15. Two closed - end pipes , when sounded together produce $5 beats / s$. If their lengths are in the ratio $100 : 101$, then fundamental notes (in Hz) produced by them are

A. $245, 250$

B. $250, 255$

C. $495, 500$

D. $500, 505.$

Answer: D

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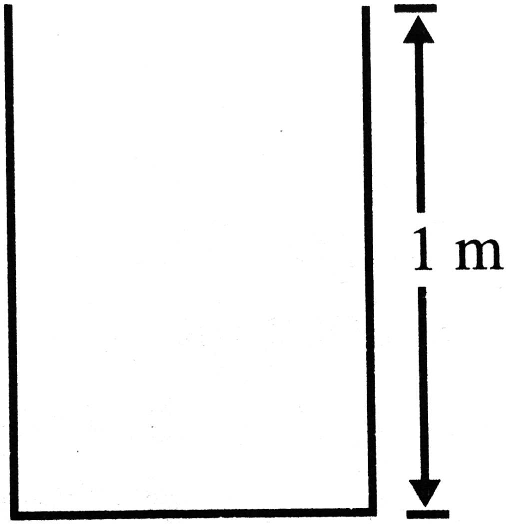
16. Velocity of sound in air is $320 m / s$. The resonant pipe shown in Fig. 7.81 cannot vibrate with a sound of frequency .



A. $80Hz$

B. $240Hz$

C. $320Hz$

D. $400Hz$

Answer: C

Watch Video Solution

17. Waves of frequency $1000Hz$ are produced in a Kundt's tube . The total distance between 6 successive nodes is $82.5cm$. The speed of sound in the gas filled in the tube is

A. $33cm/s$

B. $33m/s$

C. $330m/s$

D. $660m/s$

Answer: C

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18. In a Kundt's tube , the length of the iron rod is $1m$. The stationary waves frequency $2500Hz$ are produced in it. The velocity of sound in iron is

A. $1250 m/s$

B. $2500 m/s$

C. $5000 m/s$

D. $10,000 m/s$

Answer: C

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

A. $1/2$

B. 2

C. $1/4$

D. 4

Answer: A

Watch Video Solution

20. A closed organ pipe and an open organ pipe have their first overtones identical in frequency. Their lenghts are in the ratio

A. $1:2$

B. $2:3$

C. $3:4$

D. $4:5$

Answer: C

Watch Video Solution

21. Two organ pipe , both closed at one end , have lengths l and $l + \Delta l$. Neglect end corrections. If the velocity of sound in air is V, then the number of beats//s` is

A. $\frac{V}{4l}$

B. $\frac{V}{2l}$

C. $\frac{V}{4l^2}\Delta l$

D. $\frac{V}{2l^2}\Delta l$

Answer: C

Watch Video Solution

22. A closed tube has a frequency n. If its length is doubled and radius is halved its frequency will become

A. halved

B. doubled

C. trebled

D. quadrupled

Answer: A

Watch Video Solution

23. In a resonance tube experiment , the first resonance is obtained for $10cm$ of air column and the sound for $32cm$. The end correction for this apparatus is

A. $0.5cm$

B. $1.0cm$

C. $1.5cm$

D. $2cm$

Answer: B

Watch Video Solution

24. Two waves having intensity I and $9I$ produce interference . If the resultant intensity at a point is $7I$, what is the phase difference between the two waves ?

A. 0°

B. 60°

C. 90°

D. 120°

Answer: D

Watch Video Solution

25. A sonometer wire , $100cm$ in length has fundamental frequency of $330Hz$. The velocity of propagation of tranverse waves along the wire is

A. $330m/s$

B. $660m/s$

C. $115m/s$

D. $990m/s$

Answer: B

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26. In a resonance column experiment , the first resonance is obtained when the level of the water in the tube is at $20cm$ from the open end . Resonance will also be obtained when the water level is at a distance of

A. $40cm$ from the open end

B. $60cm$ from the open end

C. $80cm$ from the open end

D. $100cm$ from the open end

Answer: B

Watch Video Solution

27. A long glass tube is held vertically in water. A tuning fork is struck and held over the tube. Strong resonances are observed at two successive lengths 0.50 m and 0.84 m above the surface of water. If velocity of sound is $340ms^{-1}$, then the frequency of the tuning fork is

A. $128Hz$

B. $256Hz$

C. $384Hz$

D. $500Hz$

Answer: D

Watch Video Solution

28. A glass tube of $1.0m$ length is filled with water . The water can be drained out slowly at the bottom of the tube . If a vibrating tuning fork of frequency $500c/s$ is brought at the upper end of the tube and the velocity of sound is $330m/s$, then the total number of resonances obtained will be

A. 4

B. 3

C. 2

D. 1

Answer: B

Watch Video Solution

29. When the string of a sonometer of length L between the bridges vibrates in the first overtone , the amplitude of vibration is maximum at

A. $L/2$

B. $(L/4)$ and $(3L/4)$

C. $(L/6), (3L/6)$ and $(5L/6)$

D. $\frac{L}{8}, \frac{3L}{8}, \frac{5L}{8}, \frac{7L}{8}$

Answer: B

Watch Video Solution

30. A standing tuning fork of frequency f is used to find the velocity of sound in air by resonance column appartus. The difference two resonating lengths is $1.0m$. Then the velocity of sound in air is

A. fm/s

B. $2fm/s$

C. $f/2m/s$

D. $3fm/s$

Answer: B

Watch Video Solution

31. A sufficiently long closed organ pipe has a small hole at its bottom. Initially the pipe is empty. What poured into the pipe at a constant rate. The fundamental frequency of the air column in the pite

A. continuously increases

B. first increases and then becomes constant

C. continuously decreases

D. first decreases and then becomes constant

Answer: B

Watch Video Solution

32. An open pipe resonates with a tuning fork of frequency $500Hz$. It is observed that two successive notes are formed at distance $16 \text{ and } 46cm$ from the open end. The speed of sound in air in the pipe is

A. $230m/s$

B. $300m/s$

C. $320m/s$

D. $360m/s$

Answer: B

Watch Video Solution

33. If the length of a stretched string is shortened by 40% and the tension is increased by 44%, then the ratio of the final and initial fundamental frequencies is

A. $3:4$

B. $4:3$

C. $1:3$

D. $2:1$

Answer: D

Watch Video Solution

34. Two uniform strings A and B made of steel are made to vibrate under the same tension. If the first overtone of A is equal to the second overtone of B and if the radius of A is twice that of B, the ratio of the lengths of the strings is

A. $2:1$

B. $3:2$

C. $3:4$

D. $1:3$

Answer: D

Watch Video Solution

35. A somoneter wire resonates with a given tuning fork forming standing waves with five antindoes between the two bridges when a mass of 9 kg is suspended from the wire. Resonates with the same tuning fork forming three antindoes for the same postions of the bridges. the value of M is

A. $25kg$

B. $5kg$

C. $12.5kg$

D. $(1/25)kg$

Answer: A

Watch Video Solution

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

A. $20, \frac{20}{3}, \frac{20}{5}$, etc.

B. $10, 5, 2.5$, etc.

C. $10, 20, 30$, etc.

D. $15, 25, 35$, etc.

Answer: B

Watch Video Solution

37. Two waves are passing through a region in the same direction at the same time . If the equation of these waves are

$$y_1 = a\frac{\sin(2\pi)}{\lambda}(vt - x)$$

and $y_2 = b\frac{\sin(2\pi)}{\lambda}[(vt - x) + x_0]$

then the amplitude of the resulting wave for $x_0 = (\lambda/2)$ is

A. $|a - b|$

B. $a + b$

C. $\sqrt{a^2 + b^2}$

D. $\sqrt{a^2 + b^2 + 2ab\cos x}$

Answer: A

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38. The vibrations of a string of length 60 cm 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.

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

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

(c)What is the velocity of the particle at x=7.5cm and t=0.25s?

(d)Write down the equations of the component waves whose superposition gives the above wave.

A. $2\sqrt{3}cm$

B. $4cm$

C. zero

D. $4\sqrt{2}cm$

Answer: A

Watch Video Solution

39. Two instruments having stretched strings are being played in unison . When the tension in one of the instruments is increases by 1% , 3 beats are produced in $2s$. The initial frequency of vibration of each wire is

A. $600Hz$

B. $300Hz$

C. $200Hz$

D. $150Hz$

Answer: B

Watch Video Solution

40. The displacement ξ in centimetres of a particle is $\xi = 3\sin 314t + 4\cos 314t$. Amplitude and initial phase are

A. $5cm, \tan^{-1}\left(\frac{4}{3}\right)$

B. $3cm, \frac{\tan^{-1}(3)}{4}$

C. $4cm, \frac{\tan^{-1}(4)}{9}$

D. $4cm, 0$

Answer: A

Watch Video Solution

41. A stretched string of length $1m$ fixed at both ends , having a mass of $5 \times 10^{-4} kg$ is under a tension of $20N$. It is plucked at a point situated at $25cm$ from one end . The stretched string would vibrate with a frequency of

A. $400Hz$

B. $100Hz$

C. $200Hz$

D. $256Hz$

Answer: C

Watch Video Solution

42. A sonometer wire supports a 4 kg load and vibrates in fundamental mode with a tunig fork of frequency 416 Hz. The length of the wire between the bridges is now doubled. In order to maintain fundamental mode, the load should be changed to

A. $1kg$

B. $2kg$

C. $8kg$

D. $16kg$

Answer: D

Watch Video Solution

43. A piano wire having a diameter of $0.90mm$ is replaced by another wire of the same material but with a diameter of $0.93mm$.If the tension of the wire is kept the same , then the percentage change in the frequency of the fundamental tone is

A. $+3\%$

B. $+3.2\%$

C. -3.2%

D. -3%

Answer: C

Watch Video Solution

44. In the sonometer experiment , a tuning fork of frequency $256 Hz$ is in resonance with $0.4m$ length of the wire when the iron load attached to free end of wire is $2kg$. If the load is immersed in water , the length of the wire in resonance would be (specific gravity of iron $= 8$)

A. $0.37m$

B. $0.43m$

C. $0.31m$

D. $0.2m$

Answer: A

Watch Video Solution

45. An air column in a pipe, which is closed at one end, will be in resonance with a vibaring tuning fork of frequency 264 Hz, if the length of the column in cm is (Speed of sound = 330 m/s)

A. 31.25

B. 62.5

C. 93.75

D. 25

Answer: A

Watch Video Solution

46. If v_1, v_2 and v_3 are the fundamental frequencies of three segments of stretched string , then the fundamental frequency of the overall string is

A. $v_1 + v_2 + v_3$

B. $\left[\frac{1}{v_1} + \frac{1}{v_2} + \frac{1}{v_3}\right]^{-1}$

C. $v_1 v_2 v_3$

D. $[v_1 v_2 v_3]^{1/3}$

Answer: B

Watch Video Solution

47. An organ pipe P_1 closed at one end vibrating in its first harmonic and another pipe P_2 open at both ends vibrating in its third harmonic are in resonance with a given tuning fork. The ratio of the length of P_1 and p_2 is

(a) $8/3$ (b) $3/8$ (c) $1/6$ (d) $1/3$

A. $8/3$

B. $3/8$

C. $1/2$

D. $1/3$

Answer: B

Watch Video Solution

48. Two vibrating tuning forks produce progressive waves given by , $y_1 = 4\sin(500\pi t)$ and $y_2 = 2\sin(506\pi t)$. These tuning forks are held near the ear of person . The person will hear

A. $3beats/s$ with intensity ratio between maxima and minima equal to 2

B. $3beats/s$ with intensity ratio between maxima and minima equal to 9

C. $6beats/s$ with intensity ratio between maxima and minima equal to 2

D. $6beats/s$ with intensity ratio between maxima and minima equal to 9

Answer: B

Watch Video Solution

49. A metal rod $40cm$ long is dropped on to a wooden floor and rebounds into air . Compressional waves of many frequencies are thereby set up in the rod . If the speed of compressional waves in the rod in $5500m/s$, what is the lowest frequency of compressional waves to which the rod resonates as it rebounds?

A. $675Hz$

B. $6875Hz$

C. $16875Hz$

D. $0Hz$

Answer: B

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50. A wave of frequency 100 Hz is sent along a string towards a fixed end. When this wave travels back after reflection, a node is formed at a distance of 10 cm frome the fixed end of the string. The speed of incident (and reflected) wave are

A. $5m / s$

B. $10m / s$

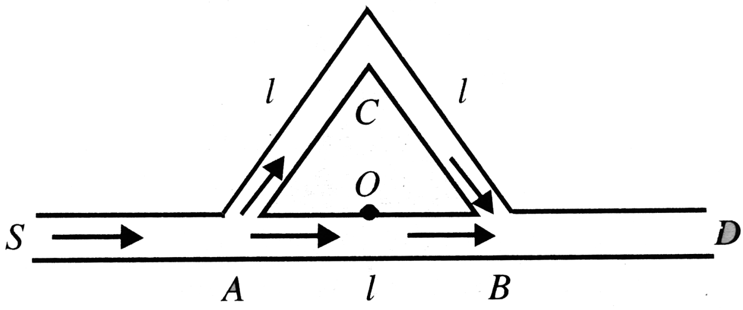
C. $20m / s$

D. $40m / s$

Answer: C

Watch Video Solution

51. A sound wave starting from source S, follows two paths AOB and ACB to reach the detector D. If ABC is an equilateral traingle , of side l and there is silence at point D, the maximum wavelength (λ) of sound wave must be



A. l

B. $2l$

C. $3l$

D. $4l$

Answer: B

Watch Video Solution

52. 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. $2 beats / s$ with intensity ratio $4/3$ between maxima and minima.

B. $2 beats / s$ with intensity ratio $49/1$ between maxima and minima.

C. $4 beats / s$ with intensity ratio $7/2$ between maxima and minima.

D. $4 beats / s$ with intensity ratio $4/3$ between maxima and minima.

Answer: B

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53. Ten tuning forks are arranged in increasing order of frequency is such a way that any two nearest tuning forks produce $4be * / \sec$. The highest freqeuncy is twice of the lowest. Possible highest and the lowest frequencies are

A. $40 \text{ and } 80$

B. $50 \text{ and } 100$

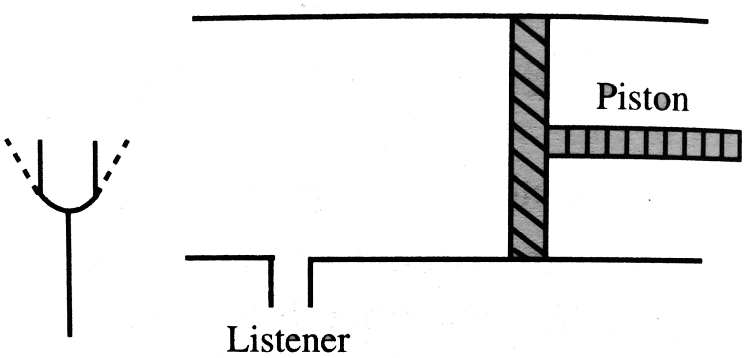
C. $22 \text{ and } 44$

D. $36 \text{ and } 72$

Answer: D

Watch Video Solution

54. A long cylindrical tube carries a highly polished piston and has a side opening . A tuning fork of frequency n is sounded at the open end of the tube . The intensity of the sounded heard by the listener changes if the piston is moved in or out. At a particular position of the piston he hears a maximum sound . When the piston is moved through a distance of $9cm$, the intensity of sound becomes minimum. If the speed of sound is $360m/s$, the value of n is



A. $129.6Hz$

B. $500Hz$

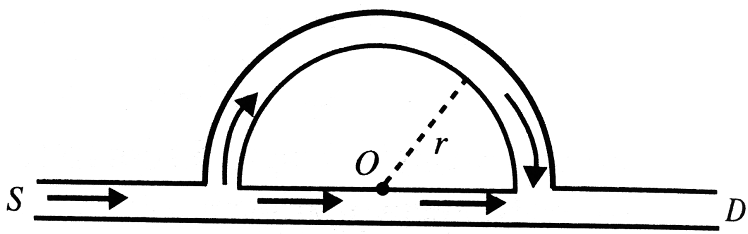
C. $1000Hz$

D. $2000Hz$

Answer: C

Watch Video Solution

55. A sound wave of wavelength $0.40m$ enters the tube at S. The smallest radius r of the circular segment to hear minimum at detector D must be



A. $1.75m$

B. $0.175m$

C. $0.93m$

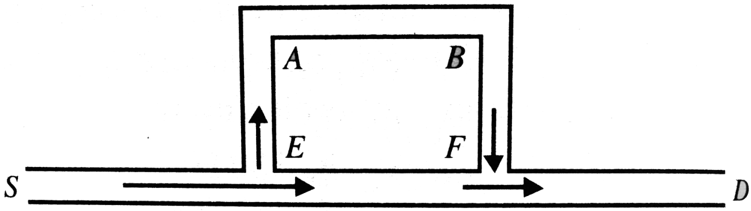
D. $9.3m$

Answer: B

Watch Video Solution

56. A sound wave starting from source S, follows two paths $SEFD$ and $SEABFD$. If $AB = 1, AE = BF = 0.6l$ and wavelength of wave is $\lambda = 6m$. If maximum sound is heard at D

, then maximum value of length l is



A. $11m$

B. $6m$

C. $2.5m$

D. $5m$

Answer: D

Watch Video Solution

57. An organ pipe A closed at one end vibrating in its fundamental frequency and another pipe B open at both ends is vibrating in its second overtone are in resonance with a given tuning fork . The ratiio of length of pipe A to that of B is

A. $1:2$

B. $3:8$

C. $2:3$

D. $1:6$

Answer: D

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58. The displacement y of a particle executing periodic motion is given by $y=4\cos^2\left(\frac{1}{2}t\right)\sin(1000t)$

This expression may be considereed to be a result of the superposition of

A. two

B. three

C. four

D. five

Answer: B

Watch Video Solution

59. Two identical straight wires are stretched so as to products $6beats/s$ when vibrating simultaneously. On changing the tension slightly in one of them, the beat frequency remains unchanged. Denoting by , T_1 the higher and T_2 the lower, initial tensions in the strings, then it could be said that that while making the above changes in tension

A. T_2 was decreased

B. T_1 was increased

C. both T_1 and T_2 were increased

D. either T_2 was increased or T_1 was decreased

Answer: D

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60. An open pipe of length $2m$ is dipped in water . To what depth x is to be immersed in water so that it may resonate with a tuning fork of frequency $170Hz$ when vibrating in its overtone . Speed of sound in air is $340m/s$

A. $0.5m$

B. $0.75m$

C. $1m$

D. $1.5m$

Answer: A

Watch Video Solution

61. A stone is hung in air from a wire which is stretched over a sonometer. The bridges of the sonometer are 40 cm apart when the wire is in unison with a tuning fork of frequency 256. when the stone is completely immersed in water , the length between the bridges is 22 cm for re- establishing unison. the specific gravity of the material of the stone is

A. $\frac{(40)^2}{(40)^2 + (22)^2}$

B. $\frac{(40)^2}{(40)^2 - (22)^2}$

C. $256 \times \frac{22}{40}$

D. $256 \times \frac{40}{22}$

Answer: B

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62. A stretched wire of stone length under a tension is vibrating with its fundamental frequency . Its length is decreased by 45% and tension is increased by 21% . Now fundamental frequency

A. increases by 50%

B. increases by 100%

C. decreases by 50%

D. decreases by 25%

Answer: B

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63. An open and a closed pipe have same length ratio of frequencies of their nth overtone is

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

B. $2\frac{n+1}{2n+1}$

C. $\frac{n}{2n+1}$

D. $\frac{n+1}{2n}$

Answer: B

Watch Video Solution

64. A string is stretched so that its length is increased by $\frac{1}{\eta}$ of its original length. The ratio of fundamental frequency of transverse vibration to that of fundamental frequency of longitudinal vibration will be

A. $1:n$

B. $n^2:1$

C. $\sqrt{n}:1$

D. $n:1$

Answer: C

Watch Video Solution

65. A closed organ pipe and an open organ pipe of some length produce $2beats$ when they are set up into vibration simultaneously in their fundamental mode . The length of the open organ pipe is now halved and of the closed organ pipe is doubled , the number of beats produced will be a) 7 b) 4 c) 8 d) 2

A. 8

B. 7

C. 4

D. 2

Answer: B

Watch Video Solution

66. the frequency of a sonometer wire is 10 Hz. When the weight producing th tensions are completely immersed in water the frequency becomes 80 Hz and on immersing the weight in a certain liquid the frequency becomes 60 Hz. The specific gravity of the liquid is

A. 1.42

B. 1.77

C. 1.82

D. 1.21

Answer: B

Watch Video Solution

67. An open organ pipe of length l is sounded together with another open organ pipe of length l + x in their fundamental tones. Speed of sound in air is v. the beat frequency heard will be $(x < < l)$

A. $\frac{vx}{4l^2}$

B. $\frac{vl^2}{2x}$

C. $\frac{vx}{2l^2}$

D. $\frac{vx^2}{2l}$

Answer: C

Watch Video Solution

68. n waves are produced on a string in $1s$. When the radius of the string is doubled and the tension is maintained the same , the number of waves produced in $1s$ for the same harmonic will be

A. $2n$

B. $\frac{n}{3}$

C. $\frac{n}{2}$

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

Answer: D

Watch Video Solution

69. The displacement y of a particle periodic motion is given by

$$y = 4\cos\left(\frac{1}{2}t\right)\sin(1000t)$$

This expression may be considered as a result of the superposition of

A. two

B. three

C. four

D. five

Answer: B

Watch Video Solution

70. The minimum intensity of audibility of sound is $10^{-12} W/m^2 s$ and density of air $= 1.293 kg/m^3$. If the frequency of sound in $1000 Hz$, then the corresponding amplitude the vibration of the air particles is

[Take velocity of sound $= 332 m/s$]

A. $1.1 \times 10^{-7} m$

B. $1.1 \times 10^{-9} m$

C. $1.1 \times 10^{-11} m$

D. $1.1 \times 10^{-14} m$

Answer: C

Watch Video Solution

71. The frequency of B is 3% greater than that of A . The frequency of $C is 2\%$ less than that of A . If B and C produce $8 beats / s$, then the frequency of A is

A. $136 Hz$

B. $168 Hz$

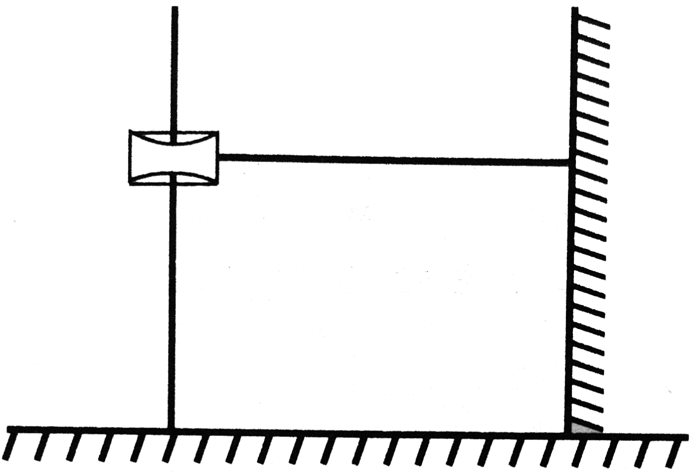
C. $164 Hz$

D. $160 Hz$

Answer: D

Watch Video Solution

72. One end of a $2.4 - m$string is held fixed and the other end is attached to a weightless ring that can slide along a frictionless rod as shown in Fig. 7.86. The three longest possible wavelength for standing waves in this string are respectively



A. $4.8m, 1.6m$ and $0.96m$

B. $9.6m, 3.2m$ and $1.92m$

C. $2.4m, 0.8m$ and $0.48m$

D. $1.2m, 0.4m$ and $0.24m$

Answer: B

Watch Video Solution

73. The strings of a violin are tuned to the tones G, D, A and E which are separated by a fifth from one another . That is $f(D) = 1.5(G), f(A) = 1.5f(D) = 400Hz$ and $f(E) = 1.5f(A)$. The distance between the two fixed points , the bridge at the scroll and over the body of the instrument is $0.25m$. The tension on the string $Eis90N$. The mass per unit length of string E is nearly

A. $1g/m$

B. $2g/m$

C. $3g/m$

D. $4g/m$

Answer: A

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74. Five sinusoidal waves have the same frequency 500 Hz but their amplitudes are in the ratio $2:\frac{1}{2}:\frac{1}{2}:1:1$ and their phase angles $0, \frac{\pi}{6}, \frac{\pi}{3}, \frac{\pi}{2}$ and π respectively. The phase angle of resultant wave obtained by the superspositon of these five waves is

A. 30°

B. 45°

C. 60°

D. 90°

Answer: B

Watch Video Solution

75. The breaking stress of steel is $7.85 \times 10^8 N/m^2$ and density of steel is $7.7 \times 10^3 kg/m^3$. The maximum frequency to which a string $1m$ long can be tuned is

A. $15.8Hz$

B. $158Hz$

C. $47.4Hz$

D. $474Hz$

Answer: B

Watch Video Solution

76. 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

Watch Video Solution

77. 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. f

B. $2f$

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

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

Answer: C

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78. 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. (a)$1m$

B. (b)$75cm$

C. (c)$60cm$

D. (d)$50cm$

Answer: A

Watch Video Solution

79. 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. $144m/s$

B. $216m/s$

C. $108m / s$

D. $72m / s$

Answer: A

Watch Video Solution

80. A string of length 'l' is fixed at both ends. It is vibrating in tis 3rd overtone with maximum amplitude 'a' the amplitude at a distance $\frac{l}{3}$ from one end is

A. a

B. 0

C. $\frac{\left(\sqrt{3}a\right)}{2}$

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

Answer: C

Watch Video Solution

81. 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. 25%

B. 50%

C. 67%

D. 75%

Answer: D

Watch Video Solution

82. A chord attached to a viberating tunning fork divides it into 6loops, when its tension is 36N. The tensin at which it will viberate in 4loops is

A. $24N$

B. $36N$

C. $64N$

D. $81N$

Answer: D

Watch Video Solution

83. A closed organ pipe has length L. The air in it is vibrating in third overtone with maximum amplitude a . The amplitude at distance $\frac{L}{7}$ from closed of the pipe is a) 0 b) a c) a/2 d) data insufficient

A. a

B. $a/2$

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

D. zero

Answer: A

Watch Video Solution

84. When a sound wave is reflected from a wall the phase difference between the reflected and incident pressure wave is:

A. 0

B. π

C. $\pi/2$

D. $\pi/4$

Answer: A

Watch Video Solution

85. A point source is emitting sound in all directions. The ratio of distance of two points from the point source where the difference in loudness levels is 3 dB is: $(\log_{10} 2 = 0.3)$.

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

B. $\frac{1}{\sqrt{2}}$

C. $\frac{1}{4}$

D. $\frac{2}{3}$

Answer: B

Watch Video Solution

86. The frequency of a man's voice is 300 Hz and its wavelength is 1 meter. If the wavelength of a child's voice is 1.5 m, then the frequency of the child's voice is"

A. $200Hz$

B. $150Hz$

C. $400Hz$

D. $350Hz$

Answer: A

Watch Video Solution

87. A sound wave of frequency $440Hz$ is passing through in air. An O_2 molecule $(mass = 5.3 \times 10^{-26} kg)$ is set in oscillation with an amplitude of $10^{-6}m$. Its speed at the centre of its oscillation is

A. $1.70 \times 10^{-5} m/s$

B. $17.0 \times 10^{-5} m/s$

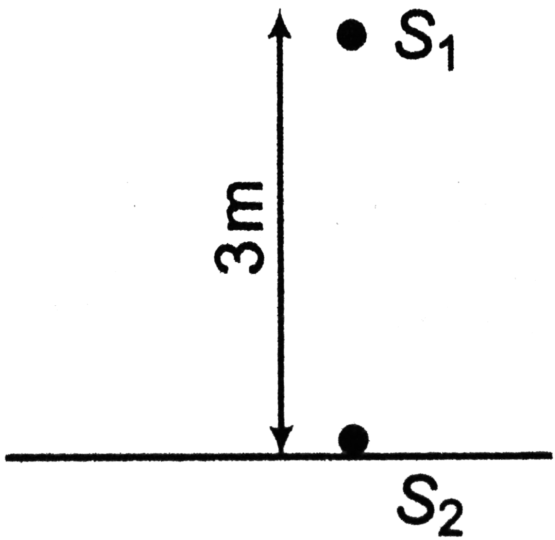
C. $2.76 \times 10^{-3} m/s$

D. $2.77 \times 10^{-5} m/s$

Answer: C

Watch Video Solution

88. S_1 and S_2 are two coherent sources of sound having no intial phase difference. The velocity of sound is $330m/s$. No maximum will be formed on the line passing through S_2 and prependicular to the line joining S_1 and S_2. If the frequency of both the sources is



A. $50 Hz$

B. $60 Hz$

C. $70 Hz$

D. $80 Hz$

Answer: A

Watch Video Solution

89. Under simuliar conditions of temperature and pressure, in which of the following gases the velocity of sound will be largest?

A. H_2

B. N_2

C. He

D. CO_2

Answer: A

Watch Video Solution

90. When beats are produced by two progressive waves of nearly the same frequency, which one of the following if correct?

A. The particle vibrates simple harmonically , with the frequency equal to the difference in the component frequencies

B. The amplitude of vibration at any point changes simple harmonically with a frequency equal to the difference in the frequencies of the two waves

C. The frequency of beats depends upon the position , where the observer is

D. The frequency of beats changes at the time progresses

Answer: B

Watch Video Solution

91. There is a set of four tuning forks , one with the lowest frequency vibrating at $550Hz$. By using any two tuning forks at a time , the following beat frequencies are heard : $1, 2, 3, 5, 7, 8$. The possible frequencies of the other three forks are

A. $552, 553, 560$

B. $557, 558, 560$

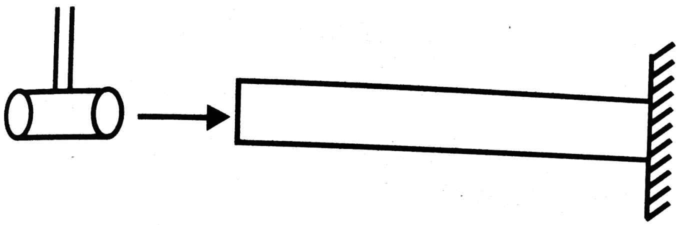
C. $552, 553, 558$

D. $551, 553, 558$

Answer: D

Watch Video Solution

92. A $100-m$ long rod of density $10.0 \times 10^4 kg/m^3$ and having Young's modulus $Y = 10^{11} Pa$, is clamped at one end . It is hammered at the other free end. The longitudinal pulse goes to right end , gets reflected and again returns to the left end . How much time the pulse take to go back to initial point.



A. $0.1s$

B. $0.2s$

C. $0.3s$

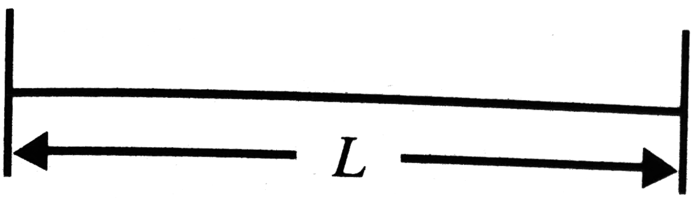
D. $2s$

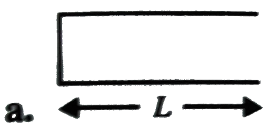
Answer: B

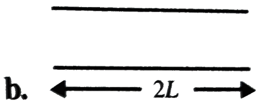
Watch Video Solution

Watch Video Solution

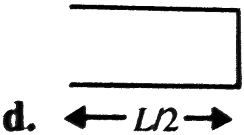
93. Figure 7.88 shows a stretched string of length L and pipes of length $L, 2L, L/2$ and $L/2$ in options (a) , (b), (c) and (d) respectively . The string 's tension is adjusted until the speed of waves on the string equals the speed of sound waves in the air . The fundamental mode of oscillation is the set up on the string . In which pipe will the sound produced by the string cause resonance ?



A. 

B. 

C. 

D. 

Answer: B

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94. Equations of a stationary and a travelling waves are as follows $y_1 = \sin kx \cos \omega t$ and $y_2 = a \sin(\omega t - kx)$. The phase difference between two points $x_1 = \pi / 3k$ and $x_2 = 3\pi / 2kis\phi_1$ in the standing wave (y_1) and is ϕ_2 in the travelling wave (y_2) then ratio ϕ_1 / ϕ_2 is

A. 1

B. $5/6$

C. $3/4$

D. $6/7$

Answer: D

Watch Video Solution

95. In the resonance tube experiment , the first resonance is heard when length of air column is l_1 and second resonance is heard when length of air column is l_2. What should be the minimum length of the tube so that third resonance can also be heard.

A. $2l_2 - l_1$

B. $2l_1$

C. $5l_1$

D. $7l_1$

Answer: A

Watch Video Solution

96. Microwaves from a transmitter are directed toward a plane reflector. A detector moves along the normal to the reflector. Between positions of 14 successive maxima, the detector travels distancee of 0.14 m . What is the frequency of transimitter?

A. $1.5 \times 10^{10} Hz$

B. $10^{10} Hz$

C. $3 \times 10^{10} Hz$

D. $6 \times 10^{10} Hz$

Answer: A

Watch Video Solution

97. 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.

A. i.$330m$

ii. $330m/s$

B. i. $300m$

ii. $720m/s$

C. i. $240m$

ii. $300m/s$

D. i. $270m$

ii. 270 m//s`

Answer: A::B::D

Watch Video Solution

98. Let the two waves $y_1 = A\sin(kx - \omega t)$ and $y_2 = A\sin(kx + \omega t)$ from a standing wave on a string . Now if an additional phase difference of ϕ is created between two waves , then

A. the standing wave will have a different frequency

B. the standing wave will have a different amplitude for a given point

C. the spacing between two consecutives nodes will change

D. None of the above

Answer: B

Watch Video Solution

99. A standing wave on a string is given by $y = (4cm)\cos[x\pi]\sin[50\pi t]$, where x is in metres and t is in seconds. The velocity of the string section at $x = 1/3matt = 1/5s$, is

A. zero

B. $\pi m / s$

C. $840\pi m / s$

D. noneof these

Answer: B

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100. If the velocity of sound in air is $320 m / s$, then the maximum and minimum length of a pipe closed at one end , that would produce a just audible sound would be

A. $2.6m$ and $3.6mm$

B. $4m$ and $4.2mm$

C. $3m \text{ and } 3mm$

D. $4m \text{ and } 4mm$

Answer: D

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101. Mark out the correct statement(s) regarding waves.

A. standing waves appear to be stationary but transfer of energy from one particle to another continues to take place.

B. A standing wave not only appears to be stationary but net transfer of energy from one particle to the other is also equal to zero.

C. A standing wave does not appear to be stationary and net transfer of energy from one particle to the other is also non - zero.

D. A standing wave does not appear to be stationary , but net transfer of energy from one particle to the other is zero.

Answer: B

Watch Video Solution

102. A harmonic wave is travelling on a stretched string . At any particular instant , the smallest distance between two particles having same displacement , equal to half of amplitude is $8cm$. Find the smallest separation between two particles which have same values of displacement (magnitude only) equal to half of amplitude.

A. (a)$8cm$

B. (b)$24cm$

C. (c)$12cm$

D. (d)$4cm$

Answer: D

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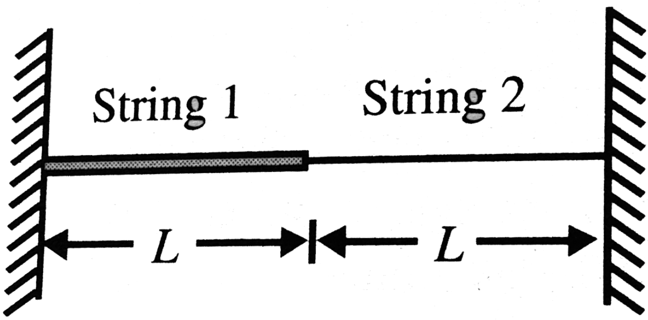
103. Two strings , one thick and other thin are connected as shown in Fig. 7.89.

Which of the following statement(s) is correct with regard to above arrangement?



A. (a)If a wave is travelling fom string 1 to string 2 , then the joint would be treated as free end.

B. (b)If a wave is travelling fom string 1 to string 2 , then the joint would be treated as a fixed end.

C. (c)If a wave is travelling fom string 2 to string 1 , then the joint would be treated as free end.

D. (d)Both (b) and (c) are correct.

Answer: A

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104. A string fixed at both ends whose fundamental frequency is $240Hz$ is vibrated with the help of a tuning fork having frequency $480Hz$, then

A. The string will vibrate with a frequency of $240Hz$

B. The string will vibrate in resonance with the tuning fork

C. The string will vibrate in resonance with a frequency of $480Hz$, but is not a resonance with the tuning fork

D. The string is in resonance with the tuning fork and hence vibrate with a frequency of $240Hz$

Answer: B

Watch Video Solution

105. If a string fixed at both ends having fundamental frequency of $240Hz$ is vibrated with the help of a tuning fork having frequency $280Hz$, then the

A. string will vibrate with a frequency of $240Hz$

B. string will be in resonance with the tuning fork

C. string will vibrate with the frequency of tuning fork , but resonance condition will not be achieved

D. string will vibrate with a frequency of $260Hz$.

Answer: C

Watch Video Solution

106. A string of length 0.4 m and mass 10^{-2} kg is tightly clamped at its ends. The tension in the string is 1. 6 N. identical wave pulses are produced at one end at equal intervals of time Δt. The value of Δt which allows construction tnterference betwenn successive pulses is

A. $0.1s$

B. $0.05s$

C. $0.2s$

D. constructive interference cannot take place

Answer: C

Watch Video Solution

107. A train of sound wsves is propagated along a wide pipe and it is reflected from an open end. If the amplitude of the waves is 0.002cm, the frequency 1000Hz and the wvelength 40cm, the amplitude of viberation at a point 10cm from open end inside the pipe will be(0.0.x)cm. Find teh value of x.

A. $0.002cm$

B. $0.003cm$

C. $0.001cm$

D. $0.000cm$

Answer: D

Watch Video Solution

108. An ideal organ pipe resonates at successive frequencies of $50Hz, 150Hz, 250Hz$, etc. (speed of sound $= 340m/s$) The pipe is

A. Open at both ends and of length $3.4m$

B. Open at both ends and of length $6.8m$

C. Closed at one end , open at the other , and of length $1.7m$

D. Closed at one end , open at the other , and of length $3.4m$

Answer: C

Watch Video Solution

109. A source of sound attached to the bob of a simple pendulum execute SHM . The difference between the apparent frequency of sound as received by an observer during its approach and recession at the mean frequency of the source . The velocity of the source at the mean position is (velocity of sound in the air is $340m/s$)

[Assume velocity of sound $< <$ velocity of sound in air]

A. (a)$1.4m/s$

B. (b)$3.4m/s$

C. (c)$1.7m/s$

D. (d)$2.1m/s$

Answer: B

Watch Video Solution

110. A standing wave arises on a string when two waves of equal amplitude , frequency and wavelength travelling in opposite superimose. If the frequency of oscillation of the standing waves

A. gets doubled

B. gets halved

C. remains unchanged

D. changes but not by a factor of 2 or $1/2$

Answer: A

Watch Video Solution

111. Two tunig forks of frequency $250Hz$ and $256Hz$ produce beats. If a maximum is observed just now, after how much time the next maximum is observed at the same place?

A. $\frac{1}{18}s$

B. $\frac{1}{6}s$

C. $\frac{1}{12}s$

D. $\frac{1}{24}s$

Answer: C

Watch Video Solution

112. Two separated sources emit sinusoidal travelling waves but have the same wavelength λ and are in phase at their respective sources . One travels a distance l_1 to get to the observeration point while the other travels a distance l_2 . The amplitude is minimum at the observation point , $l_1 - l_2$ is an

A. odd integral multiple of λ

B. even integral multiple of λ

C. odd integral multiple of $\lambda/2$

D. odd integral multiple of $\lambda/4$

Answer: C

Watch Video Solution

113. Standing waves can be produced.

A. two longitudinal travelling waves

B. two transverse travelling waves

C. two sinusoidal travelling waves travelling in opposite directions

D. all of the above

Answer: D

Watch Video Solution

114. Regarding an open organ pipe , which of the following is correct?

A. Both the ends are pressure antinodes

B. Both the ends are displacement nodes

C. Both the ends are pressure nodes

D. Both (a) and (b)

Answer: C

Watch Video Solution

115. Two canoes are 10 m apart on a lake. Each bobs up and down with a period of 4.0 s. when one canoe is at its highest point, the other canoe is at its lowest point. Both canoes are always within a single cycle of the waves determine the speed of the wave.

A. $2.5m / s$

B. $5m / s$

C. $40m / s$

D. $4m / s$

Answer: B

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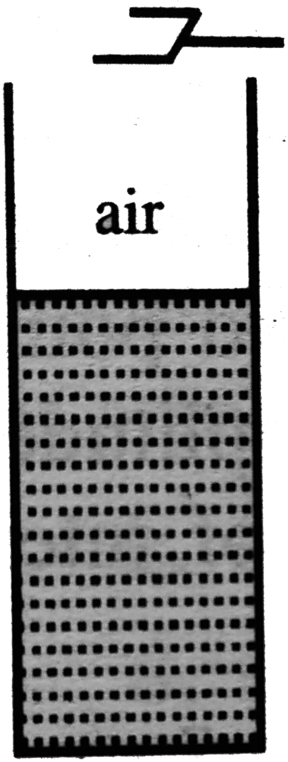
116. A resonance occurs with a tuning fork and an air column of size $12cm$. The next higher resonance occurs with an air column of $38cm$. What is the frequency of the tuning fork ? Assume that the speed of sound is $312m/s$.



A. $500Hz$

B. $550Hz$

C. $600Hz$

D. $650Hz$

Answer: C

Watch Video Solution

117. In a resonance tube experiment, the first two resonance are observed at length 10.5 cm and 29.5 cm. The third resonance is observed at the length ...(cm)

A. (a)47.5

B. (b)58.5

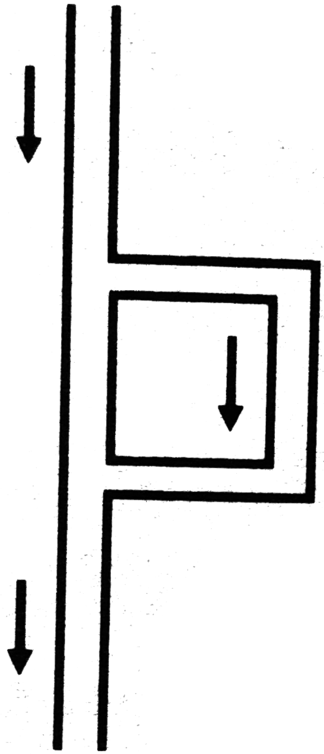
C. (c)48.5

D. (d)82.8

Answer: C

Watch Video Solution

118. A sound consists of four frequencies : $300Hz, 600Hz, 1200Hz$ and $2400Hz$. A sound 'filter' is made by passing this sound through a bifurcate pipe as shown . The sound wave has to travel a distance of $50cm$ more in the right branch - pipe than in the straight pipe. The speed of sound in air is $300m/s$. Then , which of the following frequencies will be almost completely muffled or 'silenced' at the outlet?



A. $300Hz$

B. $600Hz$

C. $1200Hz$

D. $2400 Hz$

Answer: A

Watch Video Solution

119. A sound increases its decibel reading from $20 \text{to} 40 dB$. This means that the intensity of the sound

A. is doubled

B. is 20times greater

C. is 100 times greater

D. is the old intensity 20

Answer: C

Watch Video Solution

120. To decrease the fundamental frequency of a stretched string fixed at both ends one might

A. increase its tension

B. increase its wave velocity

C. increase its length

D. decrease its linear mass density

Answer: C

Watch Video Solution

121. If the sound waves produced by the tuning fork can be expressed as $y = 0.2(cm)\sin(kx - \omega t)$, where $K = 2\pi / \lambda$ and $\omega = 2\pi f (f = 512 Hz)$, maximum value of amplitude in a beat will be

A. $0.4cm$

B. $0.6cm$

C. $0.8cm$

D. $0.2cm$

Answer: A

Watch Video Solution

122. A glass tube of length $1.5m$ is filled completely with water , the water can be drained out slowly at the bottom of the tube . Find the total number of resonance obtained , when a tuning fork of frequency $606Hz$ is put at the upper open end of the tube , $v_{sound} = 340m/s$.

A. 2

B. 3

C. 4

D. 5

Answer: D

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123. 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 wave is a progressive wave propagating along

$+x - a\xi s.$

C. the wave is a progressive wave propagating at right angle to the $+x - a\xi s$

D. all points lying on line $y = x + (4\pi / \alpha)$ are always at rest.

Answer: D

Watch Video Solution

124. A wave representing by the equation $y = A\cos(kx - \omega t)$ is suerposed with another wave to form a stationary wave such that point $x = 0$ is a node. The equation for the other wave is

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

B. $-a\cos(kx - \omega t)$

C. $-a\cos(kx + \omega t)$

D. $-a\sin(kx - \omega t)$

Answer: C

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125. A tunig fork whose frequency as given by mufacturer is $512Hz$ is being tested with an accurate oscillator it is found that the fork produces a beat of 2 Hz when oscillator reads 514 Hz but produces a beat of 6 Hz when oscillator reads 510 Hz. The actual frequency of fork is

A. 508

B. 512

C. 516

D. 518

Answer: C

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126. A sounding fork whose frequency is $256 Hz$ is held over an empty measuring cylinder. The sound is faint , but if just the right amount of water is poured into the cyclinder , it becomes loud. If the optimal amount of water produce an air column of length $0.31m$, then the speed of sound in air to a first approximation is

A. $317m/s$

B. $371m/s$

C. $340m/s$

D. $332m/s$

Answer: A

Watch Video Solution

127. A $40cm$ long brass rod is dropped one end first onto a hard floor but is caught before it topples over . With an $3kHz$ tone . The speed of sound in brass is

A. $600m/s$

B. $1200m/s$

C. $2400m/s$

D. $4800m/s$

Answer: C

Watch Video Solution

128. A metal bar clamped at its centre resonates in its fundamental mode to produce longitudinal waves of frequency

$4kHz$. Now the clamp is moved to one end . If f_1 and f_2 be the frequencies of first overtone and second overtone respectively then ,

A. (a)$3f_2 = 5f_1$

B. (b)$3f_1 = 5f_2$

C. (c)$f_2 = 2f_1$

D. (d)$2f_2 = f_1$

Answer: A

Watch Video Solution

129. A string under a tension of $100N$, emitting its fundamental mode , gives $5beats/s$ with a tuning fork. When the tension is increased to $121N$, again $5beats/s$ are heard. The frequency of the fork is

A. $105Hz$

B. $95Hz$

C. $210Hz$

D. $190Hz$

Answer: A

Watch Video Solution

130. If a man at the equator would weight (3/5)th of his weight, the angular speed of the earth is:

A. (a)$y = s_0 \cos(3.93t)\sin(1295x)$

B. (b)$y = s_0 \sin(7.86t)\cos(1295x)$

C. (c)$y = s_0 \cos(7.86t)\sin(1295x)$

D. (d)$y = s_0 \cos(1295t)\sin(3.93x)$

Answer: D

Watch Video Solution

131. A cylindrical tube, open at both ends, has a fundamental frequency, f, in air. The tube is dipped vertically in water so that half of it is in water. The fundamental frequency of the air-column is now

A. $v/2$

B. v

C. $3v/4$

D. $2v$

Answer: B

Watch Video Solution

132. A stiff wire is bent into a cylinder loop of diameter D. It is clamped by knife edges at two points opposite to each other . A transverse wave is sent around the loop by means resonance frequency (fundamental mode) of the loop in terms of wave speed v and diameter D is

A. $\frac{v}{D}$

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

C. $\frac{v}{\pi D}$

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

Answer: C

Watch Video Solution

133. The ratio between masses of two planets is 3 : 5 and the ratio between their radii is 5 : 3. The ratio between their acceleration due to gravity will be

A. (a)$2/3$

B. (b)$1/3$

C. (c)$1/4$

D. (d)$1/2$

Answer: D

Watch Video Solution

134. An air column closed at one end and opened at the other end , resonates with a tuning fork of frequency v when its length is $45cm$ and $99cm$ and at two other lengths in between these values. The wavelength of sound in air column is

A. (a)$180cm$

B. (b)$108cm$

C. (c)$54cm$

D. (d)$36cm$

Answer: D

Watch Video Solution

135. 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. 0.5%

B. 1%

C. 2%

D. 4%

Answer: C

Watch Video Solution

136. A long tube open at the top is fixed verticallly and water level inside the tube can be moved up or down . A vibrating tuning fork is held above the open end and the water level is pushed down gradually so as to get first and second resonance at $24.1cm$ and $74.1cm$, respectively below the open end . The diameter of the tube is

A. (a)$5cm$

B. (b)$4cm$

C. (c)$3cm$

D. (d)$2cm$

Answer: C

Watch Video Solution

137. Two open pipes A and B are sounded together such that beats are heard between the first overtone of A and second overtone of B. If the fundamental frequency of A and B is $256Hz$ and $170Hz$ respectively , then the beat frequency heard is

A. $4Hz$

B. $3Hz$

C. $2Hz$

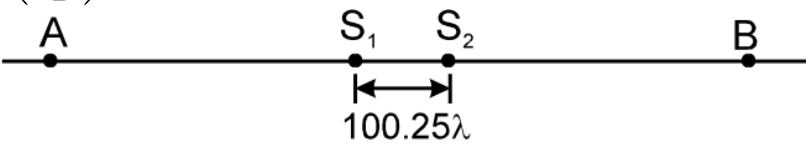
D. $1Hz$

Answer: C

Watch Video Solution

138. S_1 and S_2 are two coherent sources of radiations separated by distance 100.25λ, where λ is the wave length of radiation. S_1 leads S_2 in phase by $\pi/2$.A and B are two points on the line joining S_1 and S_2 as shown in figure.The ratio of amplitudes of component waves from source S_1 and S_2 at A and B are in ratio 1:2. The ratio of intensity at A to that of B

$\left(\frac{I_A}{I_B}\right)$ is



A. (a)∞

B. (b)$\frac{1}{9}$

C. (c)0

D. (d)9

Answer: B

Watch Video Solution

139. A travelling wave $y = A\sin(kx - \omega t + \theta)$ passes from a heavier string to a lighter string . The juction of the strings is at $x = 0$. The equation of the reflected wave is

A. $y' = 0.5A\sin(kx + \omega t + \theta)$

B. $y' = -0.5A\sin(kx + \omega t + \theta)$

C. $y' = -0.5A\sin(kx - \omega t - \theta)$

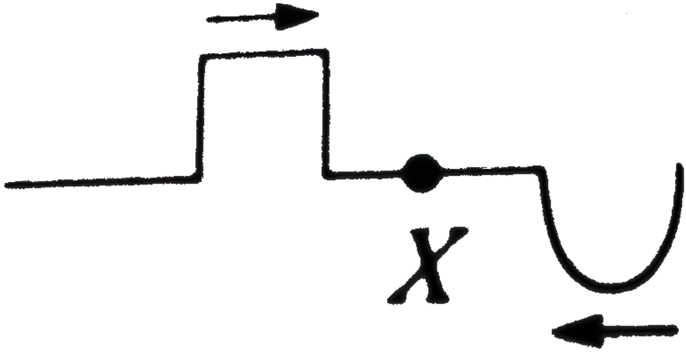
D. $y' = -0.5A\sin(kx + \omega t - \theta)$

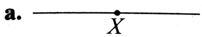
Answer: A

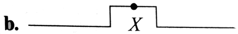
Watch Video Solution

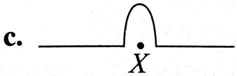
140. The diagram below shows two pulses traveling towards each other in a uniform medium with same speed . Pulses in the figure are at the same distance from X and has same height & width.

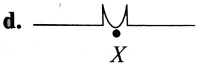
Which diagram best represents the medium when the pulses meet at point X?



A. 

B. 

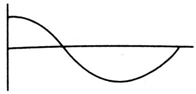
C. 

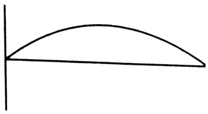
D. 

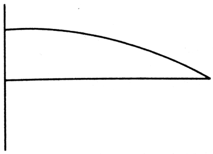
Answer: D

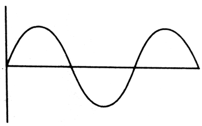
Watch Video Solution

141. Which of the figures, shows the pressure difference from regular atmospheric pressure for an organ pipe of length L closed at one end, corresponds to the $1st$ overtime for the pipe ?

A. a. 

B. b. 

C. c. 

D. d. 

Answer: A

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142. An ideal organ pipe resonates at successive frequencies of $50Hz, 150Hz, 250Hz, etc. (speedofsound$ = 340 m//s\`) The pipe is

A. Open at both ends and of length $3.4m$

B. Open at both ends and of length $6.8m$

C. Closed at one end , open at the other , and of length $1.7m$

D. Closed at one end , open at the other , and of length $3.4m$

Answer: C

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

A. more

B. less

C. same (zero)

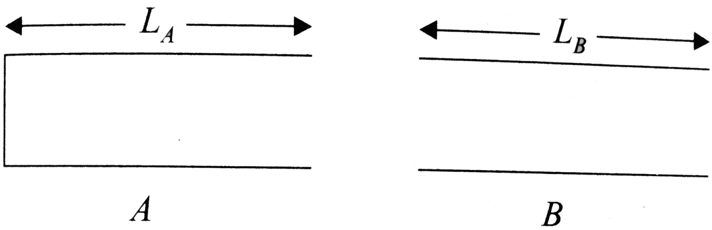
D. same(non - zero)

Answer: C

Watch Video Solution

144. Two pipes are submerged in sea water , arranged as shown in figure . Pipe (A) with length $L_A = 1.5m$ and one open end , contains a small source that sets up the standing wave with the second lowest resonant frequency of that pipe . Sound from pipe A sets up resonance in pipe B , which has both ends open . The resonance is at the second lowest resonant frequency of pipe B.

The length of the pipe B is :



A. $1m$

B. $1.5m$

C. $2m$

D. $3m$

Answer: C

Watch Video Solution

Multiple

1. velocity of sound in air is 320 m/s. A pipe closed at one end has a length of 1 m. Neglecting end corrections, the air column in the pipe can resonates for sound of frequency

A. $80Hz$

B. $240Hz$

C. $320Hz$

D. $400Hz$

Answer: A::B::D

Watch Video Solution

2. Two identical straight wires are stretched so as to products $6beats/s$ when vibrating simultaneously. On changing the tension slightly in one of them, the beat frequency remains unchanged. Denoting by , T_1 the higher and T_2 the lower, initial tensions in the strings, then it could be said that that while making the above changes in tension

A. T_2 was decreased

B. T_2 was increased

C. T_1 was increased

D. T_1 was decreased

Answer: B::D

Watch Video Solution

3. A loudspeaker that produces signals from 50 to $500Hz$ is placed at the open end of a closed tube of length $1.1m$. The lowest and the highest frequency that excites resonance in the tube are f_1 and f_h respectively . The velocity of sound is $330m/s$. Then

A. (a) $f_1 = 50Hz$

B. (b) $f_h = 500Hz$

C. (c) $f_1 = 75Hz$

D. (d) $f_h = 450Hz$

Answer: C::D

Watch Video Solution

4. Three simple harmonic waves , identical in frequency n and amplitude A moving in the same direction are superimposed in air in such a way , that the first , second and the third wave have the phase angles $\phi, \phi + (\pi/2)$ and $(\phi + \pi)$, respectively at a given point P in the superposition

Then as the waves progress , the superposition will result in

A. a periodic , non - simple harmonic wave of amplitude $3A$

B. a stationary simple harmonic wave of amplitude $3A$

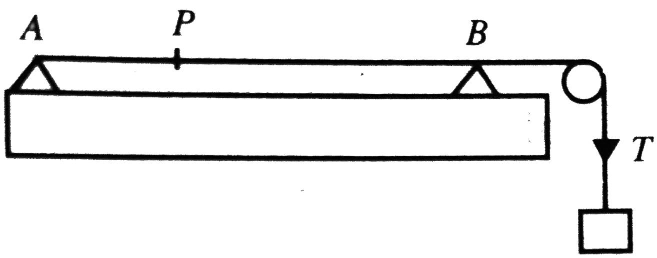
C. a simple harmonic progressive wave of amplitude A

D. the velocity of the superposed resultant wave will be the same as the velocity of each wave

Answer: C::D

Watch Video Solution

5. A sonometer strings AB of length $1m$ is stretched by a load and the tension T is adjusted so that the string resonates to a frequency of $1kHz$. Any point P of the wire may be held fixed by use of a movable bridge that can slide along the base of sonometer.



A. If point P is fixed so that $AP : PB : 1 : 4$, then the smallest frequency for which the sonometer wire resonates is $5 kHz$

.

B. If P be taken at midpoint of AB and fixed , then when the wire vibrates in the third harmonic of its fundamental , the number of nodes in the wire (including A and B) will be totally seven.

C. If the fixed point P divides AB in the ratio $1:2$, then the tension needed to make the string vibrate at $1kHz$ will be $3T$. (neglecting the terminal effects)

D. The fundamental frequency of the sonometer wire when P divides AB in the ratio $a:b$ will be the same as the fundamental frequency when P divides AB in the ratio $b:a$.

Answer: A::B::D

Watch Video Solution

6. A wire of density $9 \times 10^3 kg/m^3$ is stretched between two clamps $1m$ apart and is stretched to an extension of $4.9 \times 10^{-4} m$. Young's modulus of material is $9 \times 10^{10} N/m^2$.

A. The lowest frequency of standing wave is $35Hz$

B. The frequency of $1st$ overtone is $70Hz$

C. The frequency of $1st$ overtone is $105Hz$

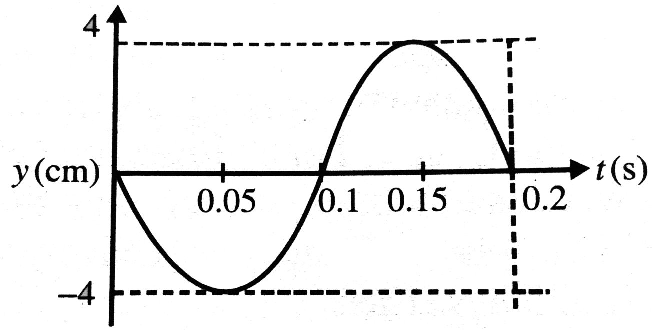
D. The stress in the wire is $4.41 \times 10^7 N/m^2$

Answer: A::B::D

Watch Video Solution

7. For a certain transverse standing wave on a long string, an antinode is formed at $x = 0$ and next to it, a node is formed at $x = 0.10m$, the displacement $y(t)$ of the string particle at $x = 0$

is shown in Fig.7.97.



A. Transverse displacement of the particle at $x = 0.05m$ and

$t = 0.05sis - 2\sqrt{2}cm$

B. Transverse displacement of the particle at $x = 0.04m$ and

$t = 0.025sis - 2\sqrt{2}cm$

C. Speed of the travelling waves that interface to produce

this standing wave is $2m/s$

D. The transverse velocity of the string particle at

$x = 1/15m$ and $t = 0.1sis20\pi cm/s$

Answer: A::C::D

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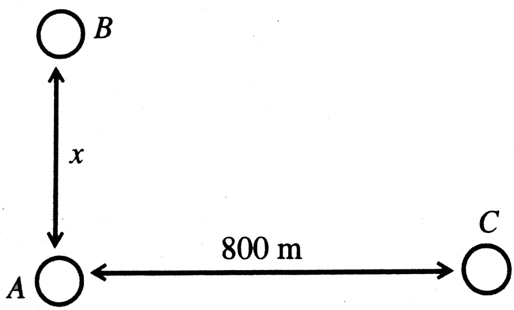
8. Two speakers are placed as shown in Fig.7.98.

Mark out the correct statement(s)



A. If a person is moving along AB , he will hear the sound as loud , faint , loud and so on

B. If a person moves along CD, he will hear loud , faint , loud and so on

C. If a person moves along AB , he will hear uniform intense sound

D. If a person moves along CD , he will hear uniform intense sound

Answer: B::C

Watch Video Solution

9. Two coherent waves represented by $y_1 = A\sin\left(\frac{2\pi}{\lambda}x_1 - \omega t + \frac{\pi}{4}\right)$ and $y_2 = A\sin\left(\frac{2\pi}{\lambda}x_2 - \omega t + \frac{\pi}{6}\right)$ are superposed. The two waves will produce

A. constructive interference at $(x_1 - x_2) = 2\lambda$

B. constructive interference at $(x_1 - x_2) = 23/24\lambda$

C. destructive interference at $(x_1 - x_2) = 1.5\lambda$

D. denstructive interference at $(x_1 - x_2) = 11/24\lambda$

Answer: B::D

Watch Video Solution

10. Two waves travel down the same string . These waves have the same velocity , frequency f and wavelength but having different phase constants ϕ_1 and $\phi_2(< \phi_1)$ and amplitudes A_1 and $A_2(< A_1)$. Mark the correct statement(s) for the resultant wave which is produced due to superposition of these two waves.

A. The amplitude of the resultant waves is $A = A_1 + A_2$

B. The amplitude of the resultant waves is $A_1 - A_2 \rightarrow A_1 + A_2$

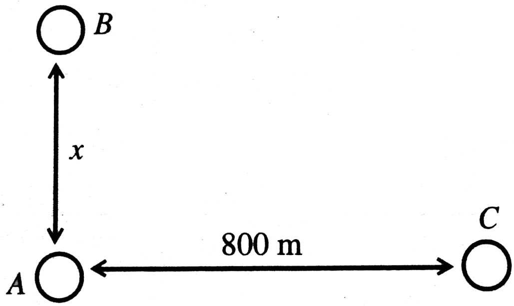
C. The frequency of the resultant waves is f

D. The frequency of the resultant waves is $f/2$

Answer: B::C

Watch Video Solution

11. A radio transmitter at position A operates at a wavelength of $20m$. A second , identical transmitter is located at a distance x from the first transmitter , at position B. The transmitters are phase locked together such that the second transmitter is lagging $\pi/2$ out of phase with the first . For which of the following values of $BC - CA$ will the intensity at C be maximum .



A. $BC - CA = 60m$

B. $BC - CA = 65m$

C. $BC - CA = 55m$

D. $BC - CA = 75m$

Answer: C::D

Watch Video Solution

12. Following are equations of four waves :

(i) $y_1 = a \sin \omega\left(t - \frac{x}{v}\right)$

(ii) $y_2 = a \cos \omega\left(t + \frac{x}{v}\right)$

(iii) $z_1 = a \sin \omega\left(t - \frac{x}{v}\right)$

(iv) $z_1 = a \cos \omega\left(t + \frac{x}{v}\right)$

Which of the following statements are correct ?

A. On superposition of waves (i) and (iii) , a travelling wave having amplitude $a\sqrt{2}$ will be formed

B. Superposition of waves (ii) and (iii) is not possible

C. On superposition of waves (i) and (ii) , a travelling wave having amplitude $a\sqrt{2}$ will be formed

D. On superposition of (iii) and (iv) , a transverse stationary wave will be formed

Answer: A::D

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13. Two waves of equal frequency f and velocity v travel in opposite directions along the same path. The waves have amplitudes A and $3A$. Then:

A. the amplitude of the resulting wave varies with position between maxima of amplitude $4A$ and minima of zero amplitude.

B. the distance between a maxima and adjacent minima of amplitudes is $v/2f$

C. maximum amplitude is $4A$ and minimum amplitude is $2A$

D. The position of a maxima or minima of amplitude does not change with time

Answer: C::D

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14. 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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15. Mark the correct statements.

A. If all the particle of a string are oscillating in same phase , the string is resonating in its fundamental tone

B. To observe interference , two sources of same frequency must be placed some distance apart from each other

C. To observe beats , two sources of same amplitude must be placed some distance apart from each other

D. None of the above

Answer: A::B

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16. Choose the correct statements from the following :

A. Any function of the form $y(x, t) = f(vt + x)$ represents a travelling wave.

B. The velocity , wavelength and frequency of a wave do not undergo any change when it is reflected from the surface .

C. When an ultrasonic wave travels from air into water , it bends towards the normal to air - water interface.

D. The velocity of sound is generally greater in solids than in gases at NTP.

Answer: A::B::D

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17. Which of the following statements are correct ?

A. The decrease in the speed of sound at high altitudes is due to a fall in pressure .

B. The standing wave on a string under a tension , fixed at its ends , does not have well - defined nodes .

C. The phenomenon of beats is not observable in the case of visible light waves.

D. The apparent frequency is f_1 when a source of sound approached a stationary observer with a speed u and is f_2 when the observer approaches the same stationary source with the same speed . Then $f_2 < f_1, \quad \text{if} \quad u < v$, where v is the speed of sound.

Answer: B::C::D

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18. Which of the following functions represent a stationary wave ? Here a, b and c are constants:

A. $y = a\cos(bx)\sin(ct)$

B. $y = a\sin(bx)\cos(ct)$

C. $y = a\sin(bx + ct)$

D. $y = a\sin(bx + ct) + a\sin(bx - ct)$

Answer: A::B::D

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19. The stationary waves set up on a string have the equation :

$y = (2mm)\sin\left[\left(6.28m^{-1}\right)x\right]\cos\omega t$

The stationary wave is created by two identical waves , of amplitude A each , moving in opposite directions along the string . Then :

A. $A = 2mm$

B. $A = 1mm$

C. the smallest length of the string is $50cm$

D. the smallest length of the string is $2m$

Answer: B::C

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20. A plane wave $y = a\sin(bx + ct)$ is incident on a surface. Equation of the reflected wave is $y' = a'\sin(ct - bx)$. Which of the following statements is not correct ?

A. The wave is incident normally on the surface

B. Reflecting surface is $y - z$plane

C. Medium , in which incident wave is travelling , is denser than the other medium

D. a' cannot be greater than a

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

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21. A string is fixed at both end transverse oscillations with amplitude a_0 are excited. Which of the following statements are correct ?

A. (a) Energy of oscillations in the string is directly proportional to tension in the string

B. (b) Energy of oscillations in nth overtone will be equal to n^2 times of that in first overtone

C. (c) Average kinetic energy of string (over an oscillation period) is half of the oscillation energy

D. (d) None of the above

Answer: A::C

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22. 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 resulting intensity with $\frac{I_{\min}}{I_{\max}} = \frac{a_1 - a_2}{(a_1 + a_2)^2}$ is obtained.

C. both the waves must have been travelling in the same direction and must be coherent.

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

Answer: B::C

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23. 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 wave varies periodically with time with maximum intensity $4a^2$ and minimum intensity zero.

D. A maxima appears at a time $1/[2(f_1 - f_2)]$ later (or earlier) than a minima appears .

Answer: C::D

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24. 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 waves are obtained with antinodes at the rigid support.

B. Stationary waves are obtained with nodes at the rigid support.

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

D. Stationary waves are obtained with intensity varying periodically with time.

Answer: B::C

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25. 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 $x = 2.3cmis4.63cm.$

B. The maximum displacement of the motion at $t = 2.3sis4.63cm.$

C. Nodes are formed at x values given by $0, \pi/3, 2\pi/3, 4\pi/3, \ldots.$

D. Antinodes are formed at x values given by

$\pi/6, \pi/2, 5\pi/6, 7\pi/6, \ldots$

Answer: A::C::D

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26. If the tension in a stretched string fixed at both ends is increased by 21% , the fundamental frequency is found to be changed by 15 Hz. Then, the

A. original frequency is $150Hz$

B. velocity of propagation of the transverse wave along the string changes by $5\ \%$

C. velocity of propagation of the transverse wave along the string changes by $10\ \%$.

D. fundamental wave length on the string does not change.

Answer: A::C::D

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Assertion - Reasoning

1. Statement I : When a guitar string is plucked , the frequency of the plucked string will not be the same as the wave it produces in air .

Statement II : The speeds of the waves depend on the medium in whhich they are propagating.

A. Statement I is true , Statement II is true , Statement II is a correct explanation for Statement I.

B. Statement I is true , Statement II is true , Statement II is NOT a correct explanation for Statement I.

C. Statement I is true , Statement II is false.

D. Statement I : is false , Statement II is true.

Answer: D

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2. Statement I : Maximum changes of pressure and density occur at the nodal points of the medium in a stationary transverse wave produced in the medium

Statement II : There will be compressions and rarefractions in a stationary longitudinal wave at the nodal points.

A. Statement I is true , Statement II is true , Statement II is a correct explanation for Statement I.

B. Statement I is true , Statement II is true , Statement II is NOT a correct explanation for Statement I.

C. Statement I is true , Statement II is false.

D. Statement I : is false , Statement II is true.

Answer: D

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3. Statement I : The principle of superpositions states that amplitudes , velocities , and , accelerations of the particles of the medium due to the simultaneous operation of two or more progressive simple harmonic waves are the vector sum of the separate amplitude , velocity and acceleration of those particles under the effect of each such wave acting alone in the medium

Statement II : Amplitudes , velocities and accelerations are linear functions of the displacement of the particle and its time derivates.

A. Statement I is true , Statement II is true , Statement II is a correct explanation for Statement I.

B. Statement I is true , Statement II is true , Statement II is NOT a correct explanation for Statement I.

C. Statement I is true , Statement II is false.

D. Statement I : is false , Statement II is true.

Answer: C

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4. In a standing wave, node is a point of

A. Statement I is true , Statement II is true , Statement II is a correct explanation for Statement I.

B. Statement I is true , Statement II is true , Statement II is NOT a correct explanation for Statement I.

C. Statement I is true , Statement II is false.

D. Statement I : is false , Statement II is true.

Answer: D

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5. Statement I : In a standing wave on a string , the spacing between nodes is Δx. If the tension in string is increased wave same as before , then the separation between nearest nodes will be increased.

Statement II : Spacing between nodes (consecutive) in the standing wave is equal to half of the wavelength of component waves.

A. Statement I is true , Statement II is true , Statement II is a correct explanation for Statement I.

B. Statement I is true , Statement II is true , Statement II is NOT a correct explanation for Statement I.

C. Statement I is true , Statement II is false.

D. Statement I : is false , Statement II is true.

Answer: B

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6. Statement I : In standing waves on a string , the medium particles , i.e., different striung elements remain at rest .

Statement II : In standing waves all the medium particles attain maximum velocity twice in one cycle.

A. Statement I is true , Statement II is true , Statement II is a correct explanation for Statement I.

B. Statement I is true , Statement II is true , Statement II is NOT a correct explanation for Statement I.

C. Statement I is true , Statement II is false.

D. Statement I : is false , Statement II is true.

Answer: D

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Comprehension

1. A closed air column $32cm$ long is in resonance with a tuning fork . Another open air column of length $66cm$ is in resonance with another tuning fork . If the two forks produce $8beats/s$ when sounded together , find

the speed of sound in the air

A. $33792cm/s$

B. $35790cm/s$

C. $31890cm/s$

D. $40980cm/s$

Answer: A

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2. A tuning fork A is in resonance with an air column $32cm$ long and closed at one end . When the length of this column is increased by $1cm$,it is in resonance with another fork B. When A and B are sounded together , they produce $40\text{beats in}5s$. Find their frequencies .

A. $230Hz, 290Hz$

B. $250Hz, 300Hz$

C. $264Hz, 256Hz$

D. $150Hz, 300Hz$

Answer: C

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3. 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.

A. $5.29cm$

B. $3.33cm$

C. $4.78cm$

D. $4.29cm$

Answer: B

Watch Video Solution

4. 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.

A. $163.27Hz$

B. $205.37Hz$

C. $153.93Hz$

D. $198.88Hz$

Answer: A

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5. A pipe of length 85 cm is closed from one end.Find the number of possible natural oscillations of air columm in the pipe whose frequencies lie bnelow 1250 Hz.The velocity of sound in air is 340 m / s.

A. 2

B. 4

C. 8

D. 6

Answer: D

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6. The number of possible natural oscillartions of air column in a pipe closed at one end of length 85 cm whose ferquences lie below 1250 Hz are (velocity of sound = 340 ms^(-1))`

A. 3

B. 7

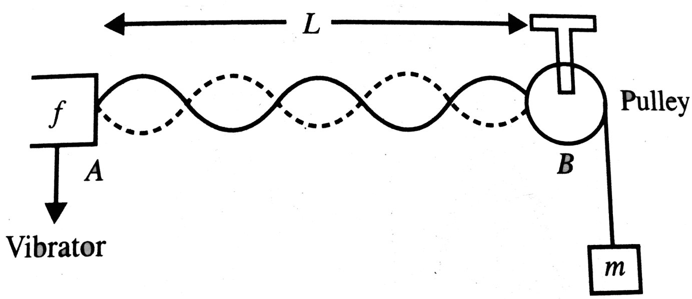
C. 6

D. 9

Answer: C

Watch Video Solution

7. In the arrangement shown in Fig. 7.100 , mass can be hung from a string with a linear mass density of $2 \times 10^{-3} kg/m$ that passes over a light pulley . The string is connected to a vibrator of frequency $700 Hz$ and the length of the string between the vibrator and the pulley is $1m$.



If the mass suspended is $16kg$, then the number of loops formed in the string is

A. $16kg$

B. $25kg$

C. $32kg$

D. $400kg$

Answer: D

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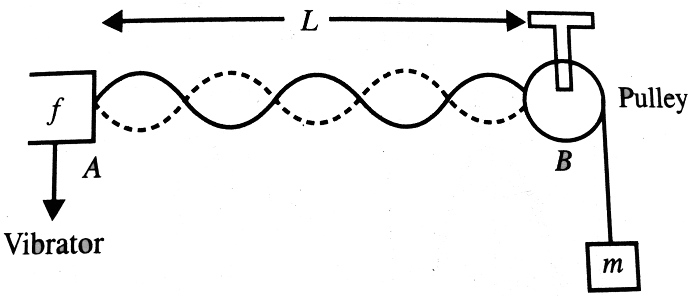
8. In the arrangement shown in Fig. 7.100 , mass can be hung from a string with a linear mass density of $2 \times 10^{-3} kg/m$ that passes over a light pulley . The string is connected to a vibrator of frequency $700Hz$ and the length of the string between the vibrator and the pulley is $1m$.



If the mass suspended is $16kg$, then the number of loops formed in the string is

A. 1

B. 3

C. 5

D. 8

Answer: C

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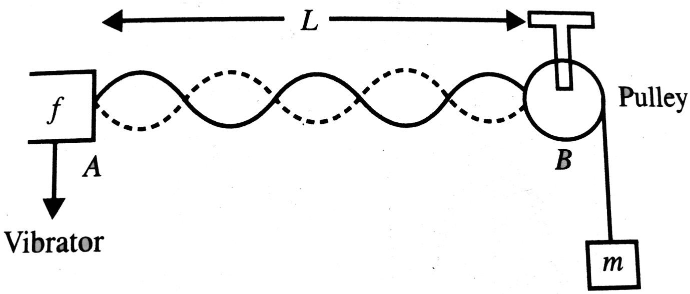
9. In the arrangement shown in Fig. 7.100 , mass can be hung from a string with a linear mass density of $2 \times 10^{-3} kg/m$ that passes over a light pulley . The string is connected to a vibrator of frequency $700 Hz$ and the length of the string between the vibrator and the pulley is $1 m$.



The string is set into vibrations and represented by the equation $y = 6 \sin\left(\frac{\pi x}{10}\right) cm \cos\left(14 \times 10^3 \pi t\right)$ where x ane y are in cm , and t in s, the maximum displacement at $x = 5 m$ from the vibrator is

A. $6 cm$

B. $3cm$

C. $5cm$

D. $2cm$

Answer: A

Watch Video Solution

10. Both neon $[M_{Ne} = 20 \times 10^{-3} kg]$ and helium $[M_{He} = 4 \times 10^{-3} kg]$ are monoatomic gases and can be assumed to be ideal gases. The fundamental frequency of a tube (open at both ends) of neon is $300 Hz$ at $270K(R = (25/3)J/Kmol)$

The length of the tube is

A. $\frac{5}{12}m$

B. $\frac{\sqrt{3}}{12}m$

C. $\frac{5\sqrt{3}}{12}m$

D. $(5\sqrt{3})m$

Answer: C

Watch Video Solution

11. Both neon $\left[M_{Ne}=20\times10^{-3}kg\right]$ and helium $\left[M_{He}=4\times10^{-3}kg\right]$ are monoatomic gases and can be assumed to be ideal gases. The fundamental frequency of a tube (open at both ends) of neon is $300Hzat270K(R=(25/3)J/Kmol)$

The fundamental frequency of the tube if the tube is filled with helium , all other factors remaining the same is

A. $300Hz$

B. $\sqrt{2} \times 300Hz$

C. $\sqrt{3} \times 300Hz$

D. $\sqrt{5} \times 300Hz$

Answer: D

Watch Video Solution

12. A long tube contains air pressure of $1atm$ and a temperature of $59^{\circ} C$. The tube is open at one end and closed at the other by a movable piston . A tuning fork near the open end is vibrating with a frequency of $500Hz$. Resonance is produced when the piston is at distances $16cm, 49.2cm$ and $82.4cm$ from open end. Molar mass of air is $28.8g / mol$.

The speed of sound in air at $59^{\circ} C$ is

A. $332m / s$

B. $342m/s$

C. $352m/s$

D. $362m/s$

Answer: A

Watch Video Solution

13. A long tube contains air pressure of $1atm$ and a temperature of $59^\circ C$. The tube is open at one end and closed at the other by a movable piston . A tuning fork near the open end is vibrating with a frequency of $500Hz$. Resonance is produced when the piston is at distances $16cm, 49.2cm$ and $82.4cm$ from open end. Molar mass of air is $28.8g/mol$.

Ratio of heat capacities at constant pressure and constant volume for air at $59^\circ C$ is

A. 1.4

B. 1.152

C. 1.60

D. 2

Answer: B

Watch Video Solution

14. A long tube contains air pressure of $1atm$ and a temperature of $59^{\circ} C$. The tube is open at one end and closed at the other by a movable piston . A tuning fork near the open end is vibrating with a frequency of $500Hz$. Resonance is produced when the piston is at distances $16cm, 49.2cm$ and $82.4cm$ from open end. Molar mass of air is $28.8g/mol$.

Radius of tube is

A. (a)$1.1cm$

B. (b)$1cm$

C. (c)$1.2cm$

D. (d)$2cm$

Answer: B

Watch Video Solution

15. A turning fork vibrating at $500Hz$ falls from rest accelerates at $10m/s^2$.

Velocity of the tuning fork when waves with a frequency of $475Hz$ reach the release point is (Take the speed of sound in air to be $340m/s$).

A. $1.79m/s$

B. $17.9m/s$

C. $35.8m/s$

D. $3.58m/s$

Answer: B

Watch Video Solution

16. A turning fork vibrating at $500Hz$ falls from rest accelerates at $10m/s^2$.

Time taken by the waves with a frequency of $475Hz$ to reach the release point is nearly

A. $1.79s$

B. $1.84s$

C. $17.9s$

D. $18.4s$

Answer: B

Watch Video Solution

17. A turning fork vibrating at $500Hz$ falls from rest accelerates at $10m/s^2$.

How far below the point of release is the tuning fork when wave with a frequency of $475Hz$ reach the release point ?

A. $16.9m$

B. $16m$

C. $1.69m$

D. $1.6m$

Answer: A

Watch Video Solution

18. A long tube contains air at a pressure of $1 atm$ and a temperature of $107^{\circ} C$. The tube is open at one end and closed at the other by a movable piston. A tuning fork near the open end is vibrating with a frequency of $500 Hz$. Resonance is produced when the piston is at distance $19, 58.5$ and $98 cm$ from the open end.

The speed of sound at $10^{\circ} C$ is

A. $330 m / s$

B. $340 m / s$

C. $395 m / s$

D. $495 m / s$

Answer: C

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19. A long tube contains air at a pressure of $1atm$ and a temperature of $107^{\circ}C$. The tube is open at one end and closed at the other by a movable piston. A tuning fork near the open end is vibrating with a frequency of $500Hz$. Resonance is produced when the piston is at distance $19, 58.5$ and $98cm$ from the open end.

The molar mass of air is $28.8g/mol$. The ratio of molar heat capacities at constant pressure and constant volume for air at this temperature is nearly

A. 1.66

B. 1.4

C. 1.33

D. 1.5

Answer: B

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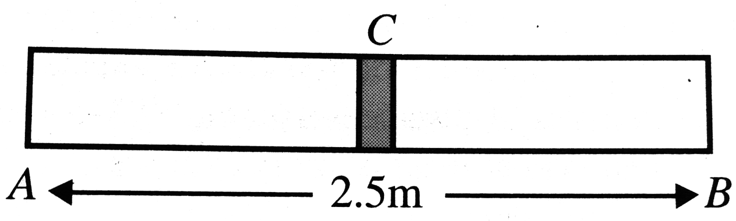
20. A steel rod $2.5m$ long is rigidly clamped at its centre C and longitudinal waves are set up on both sides of C by rubbing along the rod . Young's modulus for steel $= 2 \times 10^{11} N/m^2$, density of steel $= 8000 kg/m^3$



If the clamp of the rod be shifted to its end A and totally four antinodes are observed in the rod when longitudinal waves are set up in it , the frequency of vibration of the rod in this mode is

A. $1000 Hz$

B. $3000Hz$

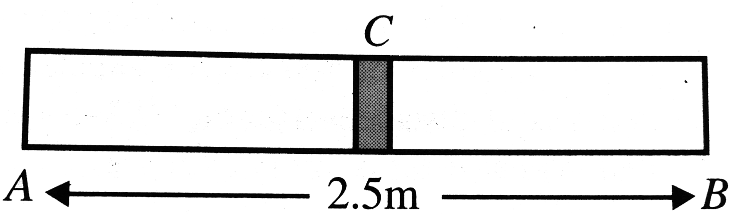
C. $7000Hz$

D. $1500Hz$

Answer: B

Watch Video Solution

21. A steel rod $2.5m$ long is rigidly clamped at its centre C and longitudinal waves are set up on both sides of C by rubbing along the rod . Young's modulus for steel $= 2 \times 10^{11} N/m^2$, density of steel $= 8000kg/m^3$



If the clamp of the rod be shifted to its end A and totally four antinodes are observed in the rod when longitudinal waves are set up in it , the frequency of vibration of the rod in this mode is

A. $1.25 \times 10^{-2} m/s$

B. $1.25 \times 10^{-3} m/s$

C. $1 m/s$

D. $0.12 m/s$

Answer: A

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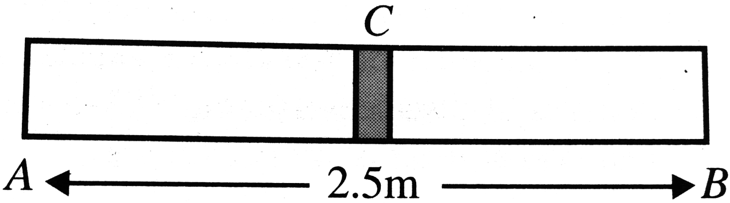
22. A steel rod $2.5m$ long is rigidly clamped at its centre C and longitudinal waves are set up on both sides of C by rubbing along the rod . Young's modulus for steel $= 2 \times 10^{11} N/m^2$, density of steel $= 8000 kg/m^3$



If the clamp of the rod be shifted to its end A and totally four antinodes are observed in the rod when longitudinal waves are set up in it , the frequency of vibration of the rod in this mode is

A. $500Hz$

B. $2500Hz$

C. $3500Hz$

D. $1500HZ$

Answer: C

Watch Video Solution

23. A longitudinal standing wave $y = a \cos kx \cos \omega t$ is maintained in a homogeneious medium of density ρ. Here ω is the angular speed and k , the wave number and a is the amplitude of the standing wave . This standing wave exists all over a given region of space.

The space density of the potential energy $PE = E_p(x, t)$ at a point (x, t) in this space is

A. $E_p = \frac{\rho a^2 \omega^2}{2}$

B. $E_p = \frac{\rho a^2 \omega^2}{2} \cos^2 kx \sin^2 \omega t$

C. $E_p = \frac{\rho a^2 \omega^2}{2} \sin^2 kx \cos^2 \omega t$

D. $E_p = \frac{\rho a^2 \omega^2}{2} \sin^2 kx \sin^2 \omega t$

Answer: C

Watch Video Solution

24. A longitudinal standing wave $y = a\cos kx \cos\omega t$ is maintained in a homogeneious medium of density ρ. Here ω is the angular speed and k , the wave number and a is the amplitude of the standing wave . This standing wave exists all over a given region of space.

The space density of the kinetic energy . $KE = E_k(x, t)$ at the point (x, t) is given by

A. $E_k = \frac{\rho a^2 \omega^2}{2} \cos^2 kx \cos^2 \omega t$

B. $E_k = \frac{\rho a^2 \omega^2}{2} \sin^2 kx \cos^2 \omega t$

C. $E_k = \frac{\rho a^2 \omega^2}{2}$

D. $E_k = \frac{\rho a^2 \omega^2}{2} \cos^2 kx \sin^2 \omega t$

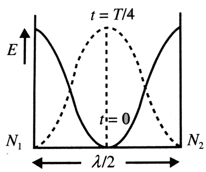
Answer: D

Watch Video Solution

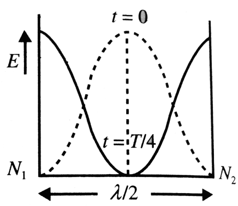
25. A longitudinal standing wave $y = a\cos kx \cos \omega t$ is maintained in a homogeneious medium of density ρ. Here ω is the angular speed and k , the wave number and a is the amplitude of the standing wave . This standing wave exists all over a given region of space.

If a graph $E(=E_p + E_k)$ versus t , i.e., total space energy density verus time were drawn at the instants of time $t = 0$ and $t = T/4$, between two successive nodes separated by distance $\lambda/2$ which of the following graphs correctly shows the total energy (E) distribution at the two instants.

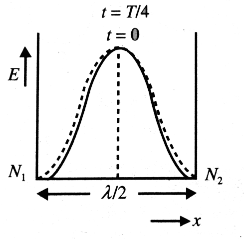
A. **a.**



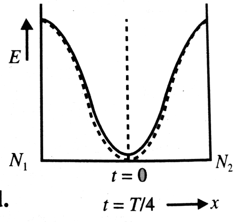
B. **b.**



C. c.



D. d.



Answer: A

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26. In a standing wave experiment , a $1.2 - kg$ horizontal rope is fixed in place at its two ends $(x = 0 \text{ and } x = 2.0m)$ and made to oscillate up and down in the fundamental mode , at frequency of $5.0Hz$. At $t = 0$, the point at $x = 1.0m$ has zero displacement and is moving upward in the positive direction of

$y - a\xi s$ with a transverse velocity $3.14m / s$.

Tension in the rope is

A. $60N$

B. $100N$

C. $120N$

D. $240N$

Answer: D

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27. In a standing wave experiment , a $1.2 - kg$ horizontal rope is fixed in place at its two ends $(x = 0 \text{ and } x = 2.0m)$ and made to oscillate up and down in the fundamental mode , at frequency of $5.0Hz$. At $t = 0$, the point at $x = 1.0m$ has zero displacement and is moving upward in the positive direction of

$y - a\xi s$ with a transverse velocity $3.14m / s$.

Speed of the participating travelling wave on the rope is

A. $6m / s$

B. $15m / s$

C. $20m / s$

D. $24m / s$

Answer: C

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28. In a standing wave experiment , a $1.2 - kg$ horizontal rope is fixed in place at its two ends $(x = 0 \text{ and } x = 2.0m)$ and made to oscillate up and down in the fundamental mode , at frequency of $5.0Hz$. At $t = 0$, the point at $x = 1.0m$ has zero displacement and is moving upward in the positive direction of

$y - a\xi s$ with a transverse velocity $3.14m/s$.

What is the correct expression of the standing wave equation ?

A. $(0.1)\sin(\pi/2)x\sin(10\pi)t$

B. $(0.1)\sin(\pi)x\sin(10\pi)t$

C. $(0.05)\sin(\pi/2)x\cos(10\pi)t$

D. $(0.04)\sin(\pi/2)x\sin(10\pi)t$

Answer: A

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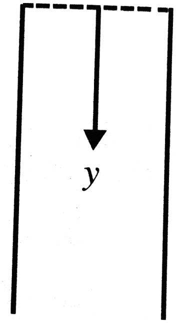
29. In an organ pipe (may be closed or open) of $99cm$ length standing wave is set up , whose equation is given by longitudinal displacement.



$\xi = (0.1mm)\frac{\cos(2\pi)}{0.8}(y + 1cm)\cos(400)t$where y is measured from the top of the tube in $metres$ and $t \text{in} \sec onds$. Here $1cm$ is the end correction.

The upper end and the lower end of the tube are respectively .

A. open - closed

B. closed - open

C. open - open

D. closed - closed

Answer: A

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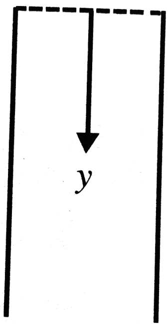
30. In an organ pipe (may be closed or open of $99cm$ length standing wave is setup , whose equation is given by longitudinal displacement $\xi = (0.1mm)\frac{\cos(2\pi)}{0.8}(y + 1cm)\cos 2\pi(400)t$ where y is measured from the top of the tube in metres and t in second. Here $1cm$ is th end correction.



The air column is vibrating in

A. first overtone

B. second overtone

C. third overtone

D. fundamental mode

Answer: B

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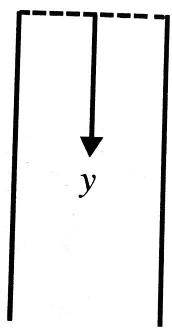
31. In an organ pipe (may be closed or open) of $99cm$ length standing wave is set up , whose equation is given by longitudinal displacement.



$\xi = (0.1mm)\frac{\cos(2\pi)}{0.8}(y + 1cm)\cos(400)t$where y is measured from the top of the tube in $metres$ and $t in \sec onds$. Here $1cm$ is the end correction.

Equation of the standing wave in terms of excess pressure is (take bulk modulus $= 5 \times 10^5 N/m^2$))

A. $P_{ex} = (125\pi N/m^2) \frac{\sin(2\pi)}{0.8}(y + 1cm)\cos(400t)$

B. $P_{ex} = (125\pi N/m^2) \frac{\cos(2\pi)}{0.8}(y + 1cm)\sin(400t)$

C. $P_{ex} = (225\pi N/m^2) \frac{\sin(2\pi)}{0.8}(y + 1cm)\cos(200t)$

D. $P_{ex} = (225\pi N/m^2) \frac{\cos(2\pi)}{0.8}(y + 1cm)\sin(200t)$

Answer: A

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32. Estimate the fraction of molecular volume to the actual volume occupied by oxygen gas at NTP. Take the diameter of an oxygen molecule to be 3Å.

A. $\frac{10\pi}{36 \times 22.4}$

B. $\frac{10\pi}{18 \times 22.4}$

C. $\frac{10\pi}{72 \times 22.4}$

D. $\frac{10\pi}{60 \times 22.4}$

Answer: A

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33. Two plane harmonic sound waves are expressed by the equations.

$y_1(x, t) - A\cos(0.5\pi x - 100\pi t), y_2(x, t) = A\cos(0.46\pi x - 92\pi t)$

(All parameters are in MKS) :

How many times does an observer hear maximum intensity in one second :-

A. 4

B. 6

C. 8

D. 10

Answer: A

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34. Two waves $y_1 = A\cos(0.5\pi x - 100\pi t)$ and $y_2 = A\cos(0.46\pi x - 92\pi t)$ are travelling in a pipe placed along the x - axis.

Find wave velocity of louder sound

A. $100m/s$

B. $192m/s$

C. $200m / s$

D. $96m / s$

Answer: C

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35. Two waves $y_1 = A\cos(0.5\pi x - 100\pi t)$ and $y_2 = A\cos(0.46\pi x - 92\pi t)$ are travelling in a pipe placed along the x - axis.

Find wave velocity of louder sound

A. 100

B. 46

C. 192

D. 96

Answer: A

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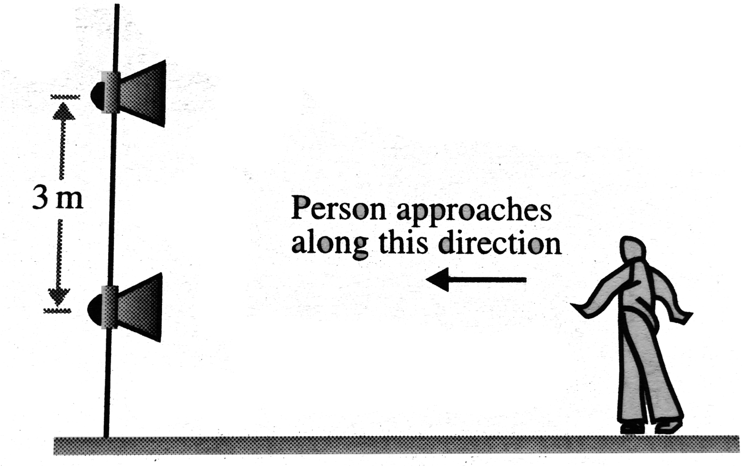
36. An oscillator of frequency $680Hz$ drives two speakers . The speakers are fixed on a vertical pole at a distance $3m$ from each other as shown in Fig. 7.103. A person whose height is almost the same as that of the lower speaker walks towards the lower speaker in a direction perpendicular to the pole. Assuming that there is no reflection of sound from the ground and speed of sound is $v = 340m/s$, answer the following questions.



As the person walks towards the pole , his distance from the pole when he first hears a minimum in sound intensity is nearly

A. $14.6m$

B. $17.9m$

C. $10.1m$

D. $22.4m$

Answer: B

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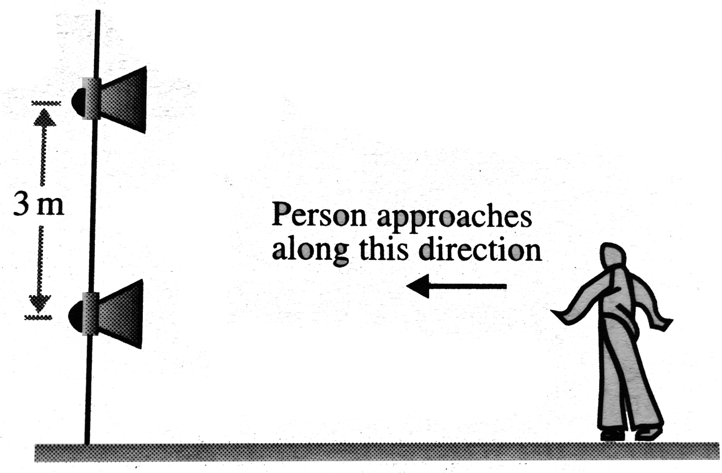
37. An oscillator of frequency $680 Hz$ drives two speakers . The speakers are fixed on a vertical pole at a distance $3m$ from each other as shown in Fig. 7.103. A person whose height is almost the same as that of the lower speaker walks towards the lower speaker in a direction perpendicular to the pole. Assuming that there is no reflection of sound from the ground and speed of sound is $v = 340 m / s$, answer the following questions.



How far is the person from the pole when he hears a minimum in sound intensity a second time ?

A. $5.6m$

B. $7.8m$

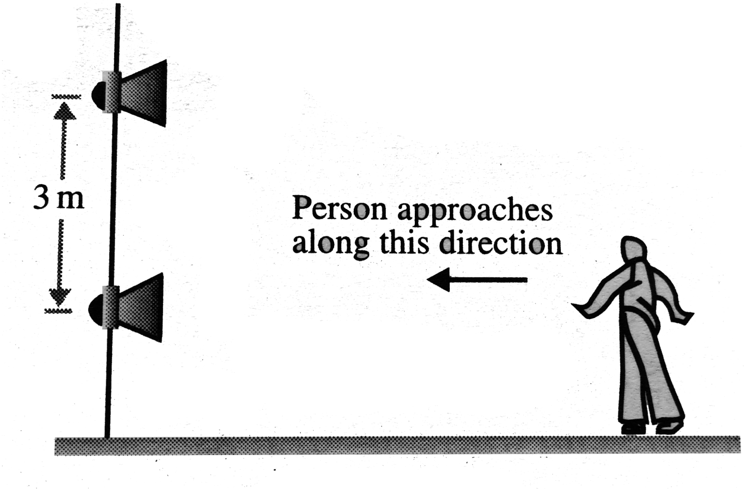
C. $12.4m$

D. $17.6m$

Answer: A

Watch Video Solution

38. An oscillator of frequency $680Hz$ drives two speakers . The speakers are fixed on a vertical pole at a distance $3m$ from each other as shown in Fig. 7.103. A person whose height is almost the same as that of the lower speaker walks towards the lower speaker in a direction perpendicular to the pole. Assuming that there is no reflection of sound from the ground and speed of sound is $v = 340m/s$, answer the following questions.



As the person walks toward the pole , the total number of times that the person hears a minimum in sound intensity will be

A. 2

B. 8

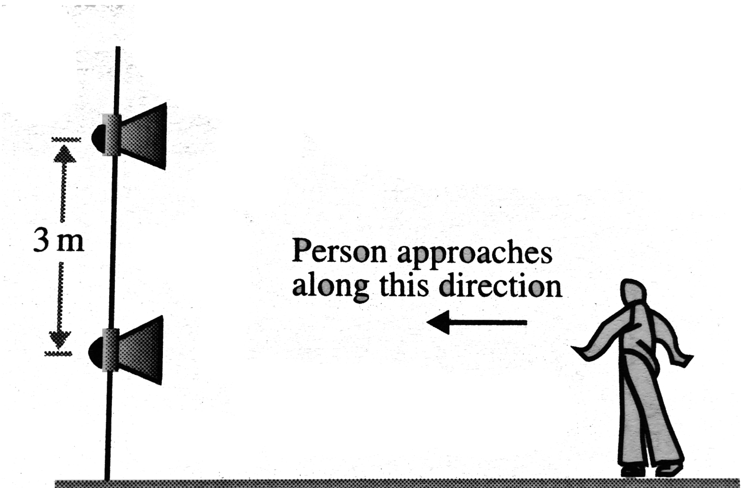
C. 4

D. 6

Answer: D

Watch Video Solution

39. An oscillator of frequency $680Hz$ drives two speakers . The speakers are fixed on a vertical pole at a distance $3m$ from each other as shown in Fig. 7.103. A person whose height is almost the same as that of the lower speaker walks towards the lower speaker in a direction perpendicular to the pole. Assuming that there is no reflection of sound from the ground and speed of sound is $v = 340m/s$, answer the following questions.



At some instant , when the person is at a distance $4m$ from the pole , the wave function (at the person's location) that describes the waves coming from the lower speaker $y = A\cos(kx - \omega t)$, where A is the amplitude , $\omega = 2\pi v$ with $v = 680Hz$ (given) and $k = 2\pi / \lambda$

Wave function (at the person's location) that describes waves coming from the upper speaker can be expressed as :

A. $y = A\cos(kx - \omega t + \pi)$

B. $y = A\cos(kx - \omega t + \pi / 2)$

C. $y = A\cos(kx - \omega t + 2\pi)$

D. $y = A\cos\left(kx - \omega t + \frac{3\pi}{2}\right)$

Answer: C

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40. Consider a standing wave formed on a string . It results due to the superposition of two waves travelling in opposite directions . The waves are travelling along the length of the string in the x - direction and displacements of elements on the string are along the y - direction . Individual equations of the two waves can be expressed as

$Y_1 = 6(cm)\sin[5(rad/cm)x - 4(rad/s)t]$

$Y_2 = 6(cm)\sin[5(rad/cm)x + 4(rad/s)t]$ Here x and y are in cm.

Answer the following questions.

Amplitude of simple harmonic motion of a point on the string that is located at $x = 1.8cm$ will be

A. $\pm 6cm$

B. $\pm 8cm$

C. $\pm 12cm$

D. $\pm 3cm$

Answer: C

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41. Consider a standing wave formed on a string . It results due to the superposition of two waves travelling in opposite directions . The waves are travelling along the length of the string in the x - direction and displacements of elements on the string are along the y - direction . Individual equations of the two waves can be expressed as

$Y_1 = 6(cm)\sin[5(rad/cm)x - 4(rad/s)t]$

$Y_2 = 6(cm)\sin[5(rad/cm)x + 4(rad/s)t]$ Here x and y are in cm.

Answer the following questions.

If one end of the string is at $x = 0$, positions of the nodes can be described as

A. $x = n\pi/5cm, wheren = 0, 1, 2, \ldots$

B. $x = n2\pi/5cm, wheren = 0, 1, 2, \ldots$

C. $x = n\pi / 5cm, where n = 0, 1, 3, 5, \ldots$

D. $x = n\pi / 10cm, where n = 0, 1, 3, 5, \ldots$

Answer: A

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42. Consider a standing wave formed on a string . It results due to the superposition of two waves travelling in opposite directions . The waves are travelling along the length of the string in the x - direction and displacements of elements on the string are along the y - direction . Individual equations of the two waves can be expressed as

$Y_1 = 6(cm)\sin[5(rad / cm)x - 4(rad / s)t]$

$Y_2 = 6(cm)\sin[5(rad / cm)x + 4(rad / s)t]$ Here x and y are in cm.

Answer the following questions.

Amplitude of simple harmonic motion of a point on the string that is located at $x = 1.8cm$ will be

A. $3.3cm$

B. $6.7cm$

C. $4.9cm$

D. $2.6cm$

Answer: C

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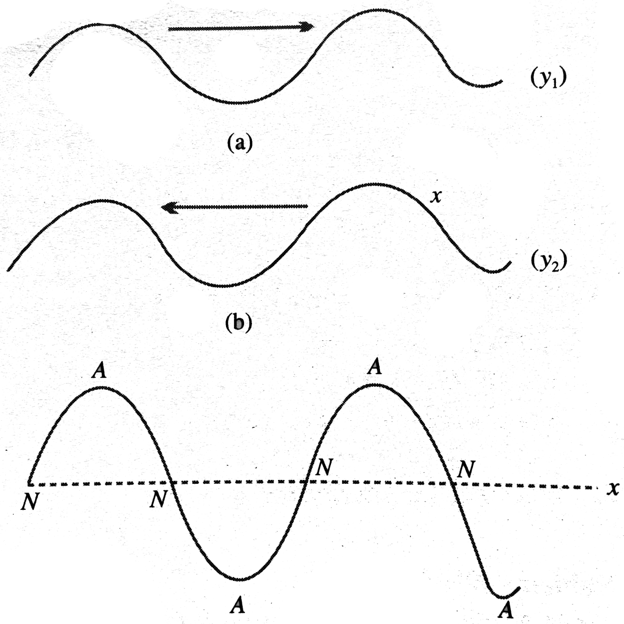
43. Consider a standing wave formed on a string . It results due to the superposition of two waves travelling in opposite directions . The waves are travelling along the length of the string in the x - direction and displacements of elements on the string are along the y - direction . Individual equations of the two waves can be expressed as

$Y_1 = 6(cm)\sin[5(rad/cm)x - 4(rad/s)t]$

$Y_2 = 6(cm)\sin[5(rad/cm)x + 4(rad/s)t]$ Here x and y are in cm.

Answer the following questions.

Figure 7.104(c) shows the standing wave pattern at $t = 0$ due to superposition of waves given by y_1 and y_2 in Figs.7.104(a) and (b) . In Fig. 7.104 (c) , N is a node and A and antinode . At this instant say $t = 0$, instantaneous velocity of points on the string named as A



A. is different for different points

B. is zero for all points

C. changes with position of the point

D. is constant but not equal to zero for all points

Answer: B

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44. A vertical pipe open at both ends is partially submerged in water . A tuning fork is unknown frequency is placed near the top of the pipe and made to vibrate . The pipe can be moved up and down and thus length of air column the pipe can be adjusted. For definite lengths of air column in the pipe, standing waves will be set up as a result of superposition of sound waves traveling in opposite directions. Smallest value of length of air column , for which sound intensity is maximum is $10cm$ [take speed of sound , $v = 344m/s$].

Answer the following questions.

The air column here is closed at one end because the surface of water acts as a wall. Which of the following is correct ?

A. a. At the closed end of air column , there is a displacement node and also a pressure node

B. b. At the closed end of the air column , there is a displacement node and also a pressure antinode

C. c. At the closed end of the air column , there is a displacement antinode and a pressure node

D. d. At the closed end of the air column , there is a displacement antinode and also a pressure antinode

Answer: B

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45. A vertical pipe open at both ends is partially submerged in water . A tuning fork is unknown frequency is placed near the top of the pipe and made to vibrate . The pipe can be moved up and down and thus length of air column the pipe can be adjusted. For definite lengths of air column in the pipe, standing waves will be set up as a result of superposition of sound waves travelling in opposite directions. Smallest value of length of air column , for which sound intensity is maximum is $10cm$[take speed of sound , $v = 344m/s$].

Answer the following questions.

Frequency of the tuning fork is

A. $1072Hz$

B. $940Hz$

C. $860Hz$

D. $533Hz$

Answer: C

Watch Video Solution

46. A vertical pipe open at both ends is partially submerged in water . A tuning fork is unknown frequency is placed near the top of the pipe and made to vibrate . The pipe can be moved up and down and thus length of air column the pipe can be adjusted. For definite lengths of air column in the pipe, standing waves will be set up as a result of superposition of sound waves travelling in opposite directions. Smallest value of length of air column , for which sound intensity is maximum is $10cm$[take speed of sound , $v = 344m / s$].

Answer the following questions.

Length of air column for third resonance will be

A. $30cm$

B. $45cm$

C. $20cm$

D. $50cm$

Answer: A

Watch Video Solution

47. A vertical pipe open at both ends is partially submerged in water . A tuning fork is unknown frequency is placed near the top of the pipe and made to vibrate . The pipe can be moved up and down and thus length of air column the pipe can be adjusted. For definite lengths of air column in the pipe, standing waves will be set up as a result of superposition of sound waves travelling in opposite directions. Smallest value of length of air column , for which sound intensity is maximum is $10cm$[take speed of sound , $v = 344m / s$].

Answer the following questions.

Length of air column for third resonance will be

A. $30cm$

B. $45cm$

C. $20cm$

D. $50cm$

Answer: D

Watch Video Solution

48. A vertical pipe open at both ends is partially submerged in water . A tuning fork is unknown frequency is placed near the top of the pipe and made to vibrate . The pipe can be moved up and down and thus length of air column the pipe can be adjusted. For definite lengths of air column in the pipe, standing waves will be set up as a result of superposition of sound waves travelling in opposite directions. Smallest value of length of air column , for which sound intensity is maximum is $10cm$[take speed of sound , $v = 344m / s$].

Answer the following questions.

Frequency of the tuning fork is

A. $3400Hz$

B. $2500Hz$

C. $4300Hz$

D. $1720Hz$s

Answer: C

Watch Video Solution

49. Estimation of frequency of a wave forming a standing wave represented by $y = A \sin kx \cos t$ can be done if the speed and wavelength are known using $speed = \text{Frequency} \times \text{wavelength}$. Speed of motion depends on the medium properties namely tension in string and mass per unit length of string . A string may vibrate with different frequencies . The corresponding wavelength should be related to the length of the string by a whole number for a string fixed at both ends . Answer the following questions:

Speed of a wave in a string forming a stationary wave does not depend on

A. Tension

B. Mass of wire for a given length

C. Length of the wire for a given mass

D. Harmonics of string

Answer: D

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50. Estimation of frequency of a wave forming a standing wave represented by $y = A \sin kx \cos t$ can be done if the speed and wavelength are known using $speed = \text{Frequency} \times \text{wavelength}$. Speed of motion depends on the medium properties namely tension in string and mass per unit length of string . A string may vibrate with different frequencies . The corresponding wavelength should be related to the length of the string by a whole number for a string fixed at both ends . Answer the following questions:

If $y = 10 \sin 5x \cos 2tm$ represents a stationary wave then , the possible one of the travelling waves causing this is

A. $y = 10 \sin(5x - 2t)$

B. $y = 5 \sin(2t - 5x)$

C. $y = 10 \sin 2t$

D. $y = 5 \cos 5x$

Answer: B

Watch Video Solution

51. Estimation of frequency of a wave forming a standing wave represented by $y = A\sin kx \cos t$ can be done if the speed and wavelength are known using $speed = \text{Frequency} \times \text{wavelength}$. Speed of motion depends on the medium properties namely tension in string and mass per unit length of string . A string may vibrate with different frequencies . The corresponding wavelength should be related to the length of the string by a whole number for a string fixed at both ends . Answer the following questions:

A string fixed at both ends having a third overtone frequency of $200Hz$ while carrying a wave at a speed of $30ms^{-1}$ has a length of

A. $30m$

B. $22.5cm$

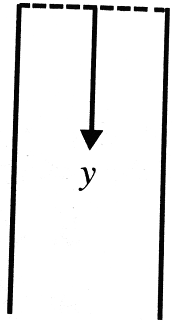
C. $30cm$

D. $10.25cm$

Answer: C

Watch Video Solution

52. In an organ pipe (may be closed or open) of $99cm$ length standing wave is set up , whose equation is given by longitudinal displacement.



$\xi = (0.1mm)\frac{\cos(2\pi)}{0.8}(y + 1cm)\cos(400)t$where y is measured from the top of the tube in $metres$ and $t \text{in} \sec onds$. Here $1cm$ is the end correction.

The air column is vibrating in

A. open - closed

B. closed - open

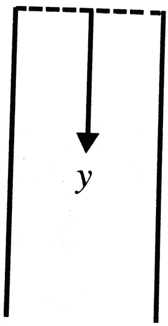
C. open - open

D. closed - closed

Answer: A

Watch Video Solution

53. In an organ pipe (may be closed or open of $99cm$ length standing wave is setup , whose equation is given by longitudinal displacement $\xi = (0.1mm)\frac{\cos(2\pi)}{0.8}(y + 1cm)\cos 2\pi(400)t$ where y is measured from the top of the tube in metres and t in second. Here $1cm$ is th end correction.



The air column is vibrating in

A. First overtone

B. Second overtone

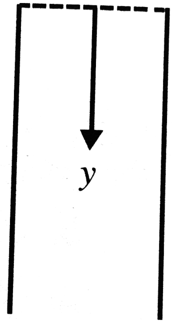
C. Third overtone

D. fundamental mode

Answer: B

Watch Video Solution

54. In an organ pipe (may be closed or open of $99cm$ length standing wave is setup , whose equation is given by longitudinal displacement $\xi = (0.1mm)\frac{\cos(2\pi)}{0.8}(y + 1cm)\cos 2\pi(400)t$ where y is measured from the top of the tube in metres and t in second. Here $1cm$ is th end correction.



Equation of the standing wave in terms of excess pressure is -

(Bulk modulus of air $B = 5 \times 10^5 N/m^2$)

A. $P_{ex} = \left(125pN/m^2\right)\frac{\sin(2\pi)}{0.8}(y + 1cm)\cos 2\pi(400t)$

B. $P_{ex} = \left(125pN/m^2\right)\frac{\cos(2\pi)}{0.8}(y + 1cm)\sin 2\pi(400t)$

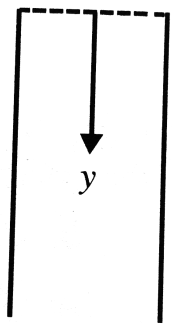
C. $P_{ex} = \left(225pN/m^2\right)\frac{\sin(2\pi)}{0.8}(y + 1cm)\cos 2\pi(200t)$

D. $P_{ex} = \left(225pN/m^2\right)\frac{\cos(2\pi)}{0.8}(y + 1cm)\sin 2\pi(200t)$

Answer: A

View Text Solution

55. In an organ pipe (may be closed or open of $99cm$ length standing wave is setup , whose equation is given by longitudinal displacement $\xi = (0.1mm)\frac{\cos(2\pi)}{0.8}(y + 1cm)\cos 2\pi(400)t$ where y is measured from the top of the tube in metres and t in second. Here $1cm$ is th end correction.



Assume end correction approximately equals to $(0.3) \times$ (diameter of tube) , estimate the moles of air pressure inside the tube (Assume tube is at NTP , and at NTP, $22.4litre$ contain $1mo \leq$)

A. $\frac{10\pi}{36 \times 22.4}$

B. $\frac{10\pi}{18 \times 22.4}$

C. $\frac{10\pi}{72 \times 22.4}$

D. $\frac{10\pi}{60 \times 22.4}$

Answer: A

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Integer

1. For a certain organ pipe three successive resonance frequencies are observed at 425Hz, 595 Hz and 765Hz respectively. If the speed of sound air is 340m/s, then the length of the pipe is

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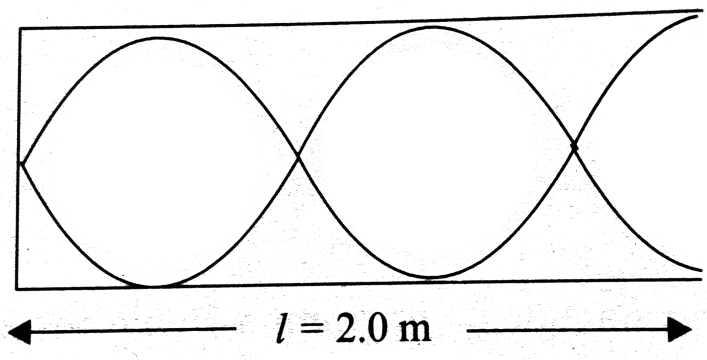
2. The standing wave pattern shown in the tube has a wave speed of $5.0 ms^{-1}$. What is the frequency of the standing wave [in Hz approx.] ?



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3. A tuning fork of frequency $200 Hz$ is in unison with a sonometer wire . How many beats are heard in $30 s$ if the tension is increased by 1% (in terms of $\times 10$]

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4. Two identical sinusoidal waves travel in opposite direction in a wire $15m$ long and produce a standing wave in the wire . If the speed of the wave is $12ms^{-1}$ and there are 6 nodes in the standing wave . Find the frequency .

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5. A glass tube of $1.0m$ length is filled with water . The water can be drained out slowly at the bottom of the tube . A vibrating tuning fork of frequency $500Hz$ is brought at the upper end of the tube and the velocity of sound is $330m/s$. Find the number of resonances that can be obtained.

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6. A tube , opened from both ends is vibrated in its second overtone . At how many points inside the tube maximum pressure variation is observed ?

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7. nth harmonic of a closed organ is equal to mth harmonic of an pipe . First overtone frequency of the closed organ pipe is also equal to first overtone frequaency of an organ pipe . Find the value of n, if $m = 6$.

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8. A closed organ pipe and an open organ pipe of some length produce $2 beats$ when they are set up into vibration simultaneously in their fundamental mode . The length of the open organ pipe is now halved and of the closed organ pipe is doubled , the number of beats produced will be a) 7 b) 4 c) 8 d) 2

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9. The length , radius , tension and density of string A are twice the same parameters of string B. Find the ratio of fundamental frequency of B to the fundamental frequency of A.

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Single Correct Answer Type

1. Two sources of sound A and B produces the wave of $350Hz$. They vibrate in the same phase. The particel P is vibrating under the influence of these two waves, if the amplitudes at the point P produced by the two waves is $0.3mm$ and $0.4mm$ then the resultant amplitude of the point P will be when $AP - BP = 25cm$ and the velocity of sound is $350m/\sec$.

A. 0.7 mm

B. 0.1 mm

C. 0.2 mm

D. 0.5 mm

Answer: D

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2. 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. (a)2a

B. (b)$a\sqrt{3}$

C. (c)$a\sqrt{2}$

D. (d)a

Answer: D

Watch Video Solution

3. The minimum intensity of sound is zero at a point due to two sources of nearly equal frequencie4s when

A. (a)two sources are vibration in the opposite phase

B. (b)the amplitude of two sources are equal

C. (c)at the point of observation, the amplitudes of two S.H.M. produced by two sources are equal and both the S.H.M. are along the same straight line

D. (d)both the sources are in the same phase

Answer: C

Watch Video Solution

4. Out of given four waves (1),(2),(3) and (4)

$y = a\sin(kx + \omega t)$.(1)

$y = a\sin(\omega t - kx)$ ..(2)

$y = a\cos(kx + \omega t)$ ..(3)

$y = a\cos(\omega t - kx)$.(4)

emitted by four different source S_1,S_2,S_3 and S_4 respectively, interference phenomena would be observed in space under appropriate conditions when

A. (a)source S_1 emits wave (1) and S_4 emits wave (2)

B. (b)source S_3 emits wave (3) and S_4 emits wave (4)

C. (c)source S_2 emits wave (2) and S_4 emits wave (4)

D. (d)S_4 smits waves (4) and S_3 emits waves (3)

Answer: C

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5. Equation of motion in the same direction is given by $y_1 = A\sin(\omega t - kx), y_2 = A\sin(\omega t - kx - \theta)$. The amplitude of the medium particle will be

A. $2A\cos.\ \frac{\theta}{2}$

B. $2A\cos\theta$

C. $\sqrt{2}A\cos.\ \frac{\theta}{2}$

D. $1.2f,\ 1.2\lambda$

Answer: A

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6. The amplitude of a wave represented by displacement equation $y=\frac{1}{\sqrt{a}}\sin\omega t\pm\frac{1}{\sqrt{b}}\cos\omega t$ will be

A. $\frac{a+b}{ab}$

B. $\frac{\sqrt{a}+\sqrt{b}}{ab}$

C. $\frac{\sqrt{a}\pm\sqrt{b}}{ab}$

D. $\sqrt{\frac{a+b}{ab}}$

Answer: D

Watch Video Solution

7. Two waves having equation

$$x_1 = a\sin(\omega t + \phi_1)$$

$$x_2 = a\sin(\omega t + \phi_2)$$

If in the resultant wave the frequency and amplitude remains equals to amplitude of superimposing waves. Then phase diff. between them : -

A. $\frac{\pi}{6}$

B. $\frac{2\pi}{3}$

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

D. $\frac{\pi}{3}$

Answer: B

Watch Video Solution

8. 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 string is at $x = 0$ The equation of the reflected is :

A. $y' = 0.5A\sin(kx + \omega t + \theta)$

B. $y' = -0.5A\sin(kx + \omega t + \theta)$

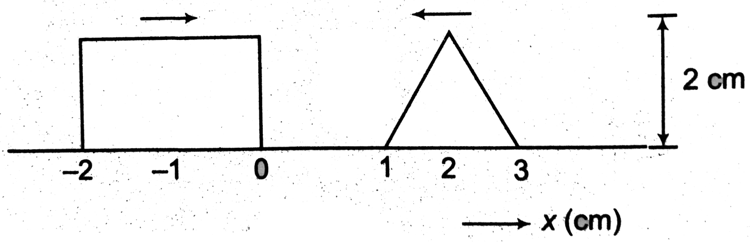
C. $y' = -0.5A\sin(\omega t = kx - \theta)$

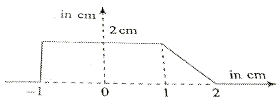
D. $y' = -0.5A\sin(kx + \omega t - \theta)$

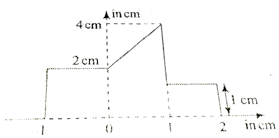
Answer: D

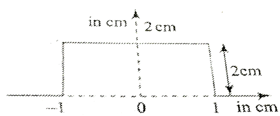
Watch Video Solution

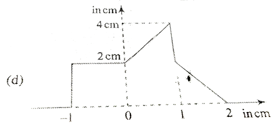
9. Figure shows a rectangular pulse and triangular pulse approaching towards each other. The pulse speed is 0.5 cm/s. Sketch the resultant pulse at t=2 s.



A. 

B. 

C. 

D. 

Answer: D

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

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

B. 10 ,5 ,2.5, etc.

C. 10 , 20, 30, etc.

D. 15, 20, 35, etc.

Answer: A

Watch Video Solution

11. Two speakeer connected to the same source of fixed frequency are placed 2m apart in a box. A sensitive microphone placed at a distance of 4m from the midpoint alon the perpendicular bisector shown maximum response. The box is slowly rotated till the speaker are in line with the microphone, The distance between the midpoint of the speakers and the microphone remains unchanged. Exactly 5 maximum responses (inculuding the initial and last one) and observed in the microphone in doing this. The wavelength of the sound wave is (o.x) meter. Find the value of x.

A. 0.2 m

B. 0.4 m

C. 0.6 m

D. 0.8 m

Answer: B

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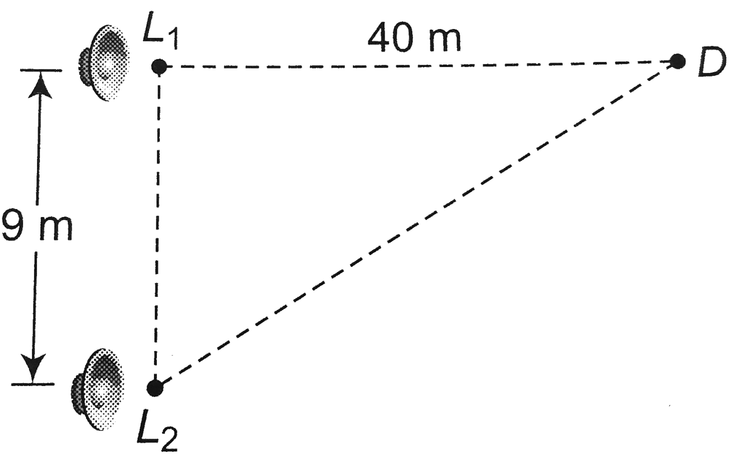


12.

Two loudspeakers L_1 and L_2 driven by a common oscillator and amplifier, are arranged as shown. The frequency of the oscillator is gradually increased from zero and the detector at D records a series of maxima and minima. If the speed of sound is $330ms^{-1}$ then the frequency at which the first maximum is observed is

A. 165 Hz

B. 330 Hz

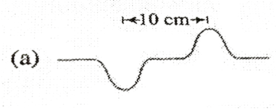
C. 496 Hz

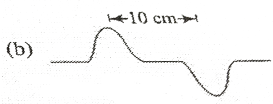
D. 660 Hz

Answer: B

Watch Video Solution

13. Two pulses travel in mutually opposite directions in a string with a speed of $2.5cm/s$ as shown in the figure. Initially the pulses are $10cm$ apart. What will be the state of the string after two seconds?

A. 

B. 

C. 

D. 

Answer: C

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14. An unknown frequency x produces 8 beats per seconds with a freuquency of 250 Hz and 12 beats with $270Hz$. Source then x is

A. 258 Hz

B. 242 Hz

C. 262 Hz

D. 282 Hz

Answer: A

Watch Video Solution

15. Two tuning forks when sounded together produced $4 beats / \sec$. The frequency of one fork is 256. The number of beats heard increases when the fork of frequency 256 is loaded with wax. The frequency of the other fork is

A. 504

B. 520

C. 260

D. 252

Answer: C

Watch Video Solution

16. If two tuning fork A and B are sounded together they produce 4 beats per second. A is then slightly loaded with wax, they produce 2 beats when sounded again. The frequency of A is 256. The frequency of B will be

A. 250

B. 252

C. 260

D. 262

Answer: B

Watch Video Solution

17. The frequencies of two sound sources are 256 Hz and 260 Hz, At $t=0$ the intesinty of sound is maximum. Then the phase difference at the time $t=1/16$ sec will be

A. Zero

B. π

C. $\pi/2$

D. $\pi/4$

Answer: C

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18. When a tuning fork of frequency 341 is sounded with another tuning fork, six beats per second are heard. When the second tuning fork is loaded with wax and sounded with the first fork, the number of beats is two per second. The natural frequency of the second tuning fork is

A. 334

B. 339

C. 343

D. 347

Answer: D

Watch Video Solution

19. Tuning fork F_1 has a frequency of 256 Hz and it is observed to produce $6beats/\sec ond$ with another tuning fork F_2. When F_2 is loaded with wax, it still produces $6beats/\sec$ with F_1. The frequency of F_2 before loading was

A. 253 Hz

B. 262 Hz

C. 250 Hz

D. 259 Hz

Answer: B

Watch Video Solution

20. Beats are produced by two waves

$y_1 = a \sin 2000\pi t$

and $y_2 = a \sin 2008\pi t$

The number of beats heard per second is

A. Zero

B. One

C. Four

D. Eight

Answer: C

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21. A tunig fork A of frequency as given by the anufacturer is $512 Hz$is being tested using an accurate oscillator . It is found that they produce $2 beats / s$ when the oscillator reads $514 Hz$ and $6 beats / s$ when it reads $510 Hz$. The actual frequency of the fork in Hz is

A. 508 Hz

B. 512 Hz

C. 516 Hz

D. 518 Hz

Answer: C

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22. Ten tuning forks are arranged in increasing order of frequency in such a way that any two nearest forks produce $4beats / s$. The highest frequency is twice that of the lowest . Possible lowest and highest frequencies are

A. 80 and 40

B. 100 and 50

C. 44 and 22

D. 72 and 36

Answer: D

Watch Video Solution

23. Two identical flutes produce fundamental notes of frequency 300 Hz at $27^\circ C$. If the temperature of the air in one of the flutes is increased to $31^\circ C$, the number of beats heard per second will be

A. 1

B. 2

C. 3

D. 4

Answer: B

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24. The frequency of tuning forks A and B are respectively 3% more and 2% less than the frequency of tuning fork C. When A and B are simultaneously excited, 5 beats per second are produced. Then the frequency of the tuning fork A (in Hz)` Is

A. 98

B. 100

C. 103

D. 105

Answer: C

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25. Two tuning forks have frequencies 380 and 384 Hz respectively. When they are sounded together they produce 4 beats. After hearing the maximum sound how long will it take to hear the minimum sound

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

B. $\frac{1}{4}\sec$

C. $\frac{1}{8}\sec$

D. $\frac{1}{16}\sec$

Answer: C

Watch Video Solution

26. When a tuning fork A of unknown frequency is sounded with another tuning fork B of frequency 256Hz, then 3 beats per second are observed. After that A is loaded with wax and sounded, the again 3 beats per second are observed. The frequency of the tuning fork A is

A. 250 Hz

B. 253 Hz

C. 259 Hz

D. 262 Hz

Answer: C

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27. In a stationary wave all the particles

A. on either side of a node vibrate in the same phase

B. in the region between two nodes vibrate in the same phase

C. in the region between two antinodes vibrate in the same phase

D. of the medium vibrate in the same phase

Answer: B

Watch Video Solution

28. When a stationary wave is formed, then its frequency is

A. same as that of the individual waves

B. twice that of the individual waves

C. half that of the individual waves

D. none of the above

Answer: A

Watch Video Solution

29. At a certain instant, a stationary transverse wave is found to have maximum kinetic energy. The appearance of string at that instant is

A. simusoidal shape with amplitude $A/3$

B. sinusoidal shape with amplitude $A/2$

C. sinusoidal shape with amplitude A

D. straight line

Answer: D

Watch Video Solution

30. Which two of the given transverse waves will give stationary wave when get superimposed?

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

$z_2 = a\cos(kx + \omega t) \qquad (B)$

$z_3 = a\cos(ky - \omega t) \qquad (C)$

A. A and B

B. A and C

C. B and C

D. Any two

Answer: A

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31. For the stationary wave $y = 4\sin\left(\frac{\pi x}{15}\right)\cos(96\pi t)$, the distance between a node and the next antinode is

A. 7.5

B. 15

C. 22.5

D. 30

Answer: A

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32. A wave representing by the equation $y = A\cos(kx - \omega t)$ is suerposed with another wave to form a stationary wave such that point $x = 0$ is a node. The equation for the other wave is

A. $y = a\sin(kx + \omega t)$

B. $y = -a\cos(kx + \omega t)$

C. $y = -a\cos(kx - \omega t)$

D. $y = -a\sin(kx - \omega t)$

Answer: B

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

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

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

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

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

Answer: B

Watch Video Solution

34. Two sinusoidal waves with same wavelengths and amplitudes travel in opposite directions along a string with a speed $10ms^{-1}$. If the minimum time interval between two instant when the string is flat is $0.5s$, the wavelength of the waves is

A. 25 m

B. 20 m

C. 15 m

D. 10 m

Answer: D

Watch Video Solution

35. 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

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36. 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

Watch Video Solution

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

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

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

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

Watch Video Solution

38. A tuning fork vibrating with a sonometer having 20 cm wire produces 5 beats per second. The beat frequency does not change if the length of the wire is changed to 21 cm. The frequency of the tuning fork (in Hertz) must be

A. 200

B. 210

C. 205

D. 215

Answer: C

Watch Video Solution

39. In order to double the frequney of the fundamental note emitted by a stratched string the length is reduced to $\frac{3}{4}$ th of the original length and the tension is changed. The factor by which the tension is to be changed is

A. $\frac{3}{8}$

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

C. $\frac{8}{9}$

D. $\frac{9}{4}$

Answer: D

Watch Video Solution

40. A string of 7m length has a mass of $0.035kg$. If tension in the string is $60. N$, then speed of a wave on the string is

A. $77m/s$

B. $102m/s$

C. $110m/s$

D. $165m/s$

Answer: C

Watch Video Solution

41. A second harmonic has to be generated in a string of length L stretched between two rigid supports. The point where the string has to be plucked and touched are

A. pluked at $\frac{l}{4}$ and touch at $\frac{l}{2}$

B. Pluked at $\frac{l}{4}$ and touch at $\frac{3l}{4}$

C. Pluked at $\frac{l}{2}$ and touched at $\frac{l}{4}$

D. Pluked at $\frac{l}{2}$ and touched at $\frac{3l}{4}$

Answer: A

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42. Two wires are fixed on a sonometer. Their tensions are in the ratio 8:1, their lengths are in the ratio 36:35, the diameters are in the ratio 4:1 and densities are in the ratio 1:2. Find the value of lower frequency if higher frequency is 360 Hz.

A. 5

B. 8

C. 6

D. 10

Answer: D

Watch Video Solution

43. A string is rigidly tied at two ends and its equation of vibration is given by $y = \cos 2\pi x$. Then minimum length of string is

A. 1m

B. $\frac{1}{2}M$

C. 5M

D. $2\pi M$

Answer: B

Watch Video Solution

44. Fundamental frequency of sonometer wire is n. If the length, tension and diameter of wire are tripled the new fundamental frequency is

A. $\frac{n}{\sqrt{3}}$

B. $\frac{n}{3}$

C. $n\sqrt{3}$

D. $\frac{n}{3\sqrt{3}}$

Answer: D

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45. A string of length 2 m is fixed at both ends. If this string vibrates in its fourth normal mode with a frequency of 500 Hz, then the waves would travel on its with a velocity of

A. $125m/s$

B. $250m/s$

C. $500m/s$

D. $1000m/s$

Answer: C

Watch Video Solution

46. The length of two open organ pipes are l and $(l + \delta l)$ respectively. Neglecting end correction, the frequency of beats between them will b approximately.

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

B. $\frac{v}{4l}$

C. $\frac{v \Delta l}{2l^2}$

D. $\frac{v \Delta l}{l}$

Answer: C

Watch Video Solution

47. Two closed organ pipes, when sounded simultaneously gave 4 beats per sec. If longer pipe has a length of 1 m. Then length of shorter pipe will be (v=300 m//s`

A. $185.5cm$

B. $94.9cm$

C. $90cm$

D. $80cm$

Answer: B

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48. A closed organ pipe and an open organ pipe are tuned to the same fundamental frequency. The ratio of their lengths is

A. $1:2$

B. $2:1$

C. $2:3$

D. $4:3$

Answer: A

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49. On producing the waves of frequency 1000 Hz in a kundt's tube the total distance between 6 successive nodes n 85 cm. Speed of sound in the gas filled in the tude is

A. $330m/s$

B. $340m/s$

C. $350m/s$

D. $300m/s$

Answer: B

Watch Video Solution

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

A. 17closed

B. 85closed

C. 17oppen

D. 85open

Answer: B

Watch Video Solution

51. Two closed organ pipes of length 100 cm and 101 cm 16 beats is 20 sec. When each pipe is sounded in its fundamental mode calculate the velocity of sound `

A. 303ms^{-1}

B. $332ms^{-1}$

C. $323.2ms^{-1}$

D. $300ms^{-1}$

Answer: C

Watch Video Solution

52. In a resonance pipe the first and second resonance are obtained at depths 22.7 cm and 70.2 respectively. What will be the end correction?

A. $1.05cm$

B. $115.5cm$

C. $92.5cm$

D. $113.5cm$

Answer: A

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53. 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.

A. $15cm$

B. $25cm$

C. $30cm$

D. $45cm$

Answer: D

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54. 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

55. The fundamental frequency of a closed pipe is 220 Hz. If $\frac{1}{4}$ of the pipe is filled with water, the frequency of the first overtone of the pipe now is

A. $220Hz$

B. $440Hz.$

C. $880Hz.$

D. $1760Hz.$

Answer: C

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56. A glass tube $1.5m$ long and open at both ends, is immersed vertically in a water tank completely. A tuning fork of 660 Hz is vibrated and kept at the upper end of the tube and the tube is gradually raised out of water the total number of resonances heard before the tube comes out of water taking velocity of sound air $330m/s$ is

A. 12

B. 6

C. 8

D. 4

Answer: B

Watch Video Solution

Multiple Correct Answers Type

1. 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. at $x = \frac{3}{2} m$ the resultant displacement will be zero at all times.

B. at t = 1 s which resultant displacement will be zero everywhere.

C. Both waves travel along the same direction.

D. Both waves travel in the opposite directions.

Answer: A::B::D

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2. In a standing wave on a string.

A. In one time period all the particles are simultaneously at rest twice.

B. All the particles must be at their positive extremes simultaneously once in one time period

C. All the particles may be at their positive extremes simultaneously once in a time period.

D. All the particles are never at rest simultaneously.

Answer: A::C

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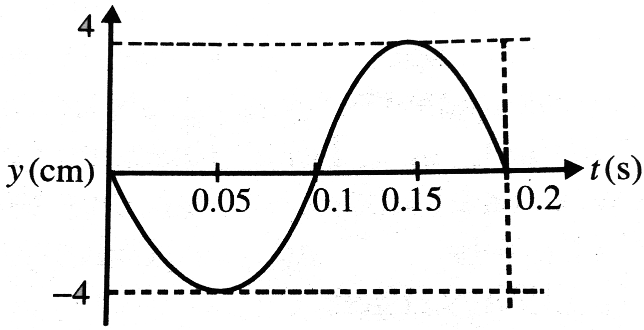
3. For a certain transverse standing wave on a long string , an antinode is formed at $x = 0$ and next to it , a node is formed at $x = 0.10m$, the displacement $y(t)$of the string particle at $x = 0$ is shown in Fig.7.97.



A. Transverse displacement of the particle at x = 0.05 m and t = 0.05 s is $-2\sqrt{2}cm$

B. Transverse displacement of the particle at x = 0.04 m and t = 0.025 s is $-2\sqrt{2}cm$

C. Speed of the travelling waves that interfere to produce this standing wave is $2m/s$

D. The transverse velocity of the string particle at $x = \frac{1}{15}m$ and t = 0.1 s is $20cm/s$

Answer: A::C::D

Watch Video Solution

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

A. replacing the air in tube by hydrogen gas

B. increasing the length of the tube

C. decreasing the length of the tube

D. opening the closed end of the tube.

Answer: A::C::D

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5. An air column in pipe, which is closed at one end, will be in resonance with a vibrating tuning fork of frequency $264Hz$ if the length of the column in cm is :

A. 31.25

B. 62.50

C. 93.75

D. 125

Answer: A::D

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Fill in the Blanks Type

1. There is a destructive interference between the two waves of wavelength λ coming from two different paths at a point. To get maximum sound or constructive interference at that point, the path of one wave is to be increased by

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2. When two sound waves with a phase difference of $\pi/2$, and each having amplitude A and frequency ω , are superimposed on each other, then the maximum amplitude and frequency of resultant wave is

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3. If the phase difference between the two wave is 2π during superposition, then the resultant amplitude is

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4. The superposition takes place between two waves of frequency f and amplitude a . The total intensity is directly proportional to

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5. Two waves of the same frequency and same amplitude 'a' are reaching a point simultaneously. What should be the phase difference between the waves so that the amplitude of the resultant wave be :

(i) 2a (ii) $\sqrt{2}a$ (iii) a (iv) zero.

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6. Two sound waves (expressed in CGS units) given by $y_1 = 0.3\frac{\sin(2\pi)}{\lambda}(vt - x)$ and $y_2 = 0.4\frac{\sin(2\pi)}{\lambda}(vt - x + \theta)$ interfere. The resultant amplitude at a place where phase difference is $\pi / 2$ will be

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7. If two waves having amplitudes 2 A and A and same frequency and velocity, propagate in the same direction in the same phase, the resulting amplitude will be

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8. The intensity ratio of two waves is $1:16$. The ratio of their amplitudes is

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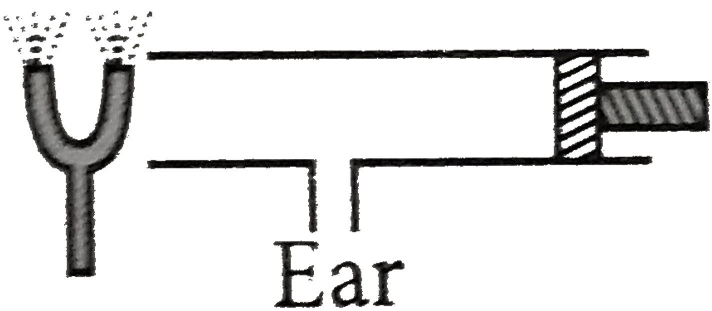
9. A vibrating tuning fork of frequency v is placed near the open end of a long cylindrical tube. The tube has a side opening and is also fitted with a movable reflecting piston. As the piston is moved through 8.75 cm, the intensity of sound changes from a maximum to minimum. If the speed of sound is 350 m s^{-1}, then u is



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10. If the ratio of amplitude of two waves is $4:3$, then the ratio of maximum and minimum intensity is

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11. A string vibrates according to the equation

$$y = 5\sin\frac{\pi x}{3}\cos 40\pi t$$

where, x and y are in centimeters and t is in seconds.

(a) What is the speed of the component wave?

(b) What is the distance between the adjacent nodes?

(c) What is the velocity of the particle of the string at the position $x = 1.5$ cm when $t = \frac{9}{8}s$?

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12. A standing wave having 3 node and 2 antinode is formed between two atoms having a distance 1.21 A between the wavelength of the standing wave is

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13. In stationary waves, distance between a node and its nearest antinode is 20 cm . The phase difference between two particles having a separation of 60 cm will be

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14. A standing wave is represeneted by $y = a \sin(100t)\cos(0.01)x$, t in second and x is in metre. Velocity of wave is

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15. A wave of frequency 100 Hz is sent along a string towards a fixed end. When this wave travels back after reflection, a node is formed at a distance of 10 cm frome the fixed end of the string. The speed of incident (and reflected) wave are

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16. A 1 cm long string vibrates with fundamental frequency of 256 Hz . If the length is reduced to $\frac{1}{4}$ cm keeping the tension unaltered, the new fundamental frequency will be

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17. Standing waves are produced in a 10 m long stretched string. If the string vibrates in 5 segments and the wave velcoity is 20 m/s the frequency

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18. The velocity of waves in a string fixed at both ends is 2 m / s . The string forms standing waves with nodes 5.0 cm apart. The frequency of vibration of the string in Hz is

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19. A stretched string of length $1m$ fixed at both ends , having a mass of $5 \times 10^{-4} kg$ is under a tension of $20N$. It is plucked at a point situated at $25cm$ from one end . The stretched string would vibrate with a frequency of

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20. 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

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21. The linear density of a vibrating string is $10^{-4}kg/m$. A transverse wave is propagating on the string, which is described by the equation $y = 0.02\sin(x + 30t)$, where x and y are in metres and time t in seconds. Then tension in the string is

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22. Four wires of identical lengths, diameters and materials are stretched on a sonometer box. The ratio of their tension $1:4:9:16$. The ratio of their fundamental frequencies is

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23. The fundamental frequency of a sonometre wire is n . If its radius is doubled and its tension becomes half, the material of the wire remains same, the new fundamental frequency will be

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24. Two uniform strings A and B made of steel are made to vibrate under the same tension. If the first overtone of A is equal to the second overtone of B and if the radius of A is twice that of B, the ratio of the lengths of the strings is

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25. If you set up the seventh harmonic on a string fixed at both ends, how many nodes and antinodes are set up in it

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26. A tube closed at one end and containing air produced, when excited the fundamental note of frequency $512H_Z$. If the tube is opened at both ends, the fundamental frequency that can be exited is (in H_Z)

(a) 1024 (b) 512 (c) 256 (d) 128

Watch Video Solution

27. A closed organ pipe and an open organ pipe have their first overtones identical in frequency. Their lenghts are in the ratio

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28. If the velocity of sound in air is 336 m/s. The maximum length of a closed pipe that would produce a just audible sound will be

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29. An air column in a pipe, which is closed at one end , will be in resonance with a vibrating tuning fork of frequency 264 Hz. If the length of the column in cm is :

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30. A cylindrical tube, open at both ends, has a fundamental frequency v. The tue is dipped vertically in water so that half of its length is inside the water. The new fundamental frequency is

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31. Two closed pipe produce 10 beats per second when emitting their fundamental nodes. If their length are in ratio of 25 : 26. Then their fundamental frequency in Hz , are

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32. An open pipe resonates with a tuning fork of frequency $500Hz$. It is observed that two successive notes are formed at distance $16 \text{ and } 46cm$ from the open end. The speed of sound in air in the pipe is

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33. In a resonance tube the first resonance with a tuning fork occurs at 16 cm and second at 49 cm . If the velocity of sound is 330 m/s , the frequency of tuning fork is

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34. In the $5th$ overtone of an open organ pipe, these are (N-stands for nodes and A- for antinodes)

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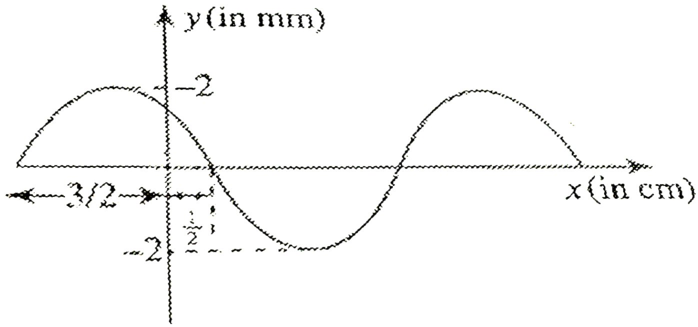
Subjective Type

1. A standing wave pattern of maximum amplitude 2 mm is obtained in a string whose shape at t = 0 is represented in the graph.



If the speed of the travelling wave in the string is 5 cm/s, then find the component waves.

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2. A 40 cm long wire having a mass 3.1 gm and area of cross section $1mm^2$ is stretched between the support 40.05 cm apart. In its fundamental mode , it vibrates with a frequency

$1000 / 64Hz$. Find the young's modulus of the wire in the form $X \times 108N - m^2$ and fill value of X.

Watch Video Solution

Comprehension Type

1. A string of length L, fixed at its both ends is vibrating in its 1^{st} overtone mode. Consider two elements of the string of the same small length at positions $l_1 = 0.2L \text{and} l_2 = 0.45L$ from one end. If $K_1 \text{and} K_2$ are their respective maximum kinetic energies,then

A. $K_1 = K_2$

B. $K_1 > K_2$

C. $K_1 < K_2$

D. it is not possible to decide the relation

Answer: B

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2. A string of length L, fixed at its both ends is vibrating in its 1^{st} overtone mode. Consider two elements of the string of the same small length at positions $l_1 = 0.2L \text{and} l_2 = 0.45L$ from one end. If $K_1 \text{and} K_2$ are their respective maximum kinetic energies,then

A. $k_1 = K_2$

B. $K_1 > K_2$

C. $K_1 < K_2$

D. it is not possible to decide the relation

Answer: A

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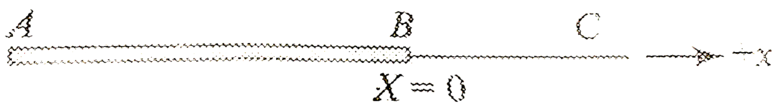
3. In the figure shown a sinusoidal wave is generated at the end A the wave travels along positive x-axis and during its motion it encounter another string BD at the junction $'B' at x = 0$. The density of string AB and BC are ρ and 9ρ respectively and their radii of cross sections are $2r$ and r. The wave function amplitude and wavelength of incident wave are respectively $y_p A_i$ and λ_r Similarly for reflected and transmitted wave these peremeters are y_r, A_r, λ_r and y_i, A_i, λ_i



Which of the following statement regarding phase difference $\Delta\phi$ between waves at $x = 0$ is true?

A. $\Delta\phi = 0$, between y_i and y_r

B. $\Delta\phi = 0$ between y_r and y_t

C. $\Delta\phi = \pi$, between y_i and y_t

D. $\Delta\phi = \pi$, between y_r and y_t

Answer: D

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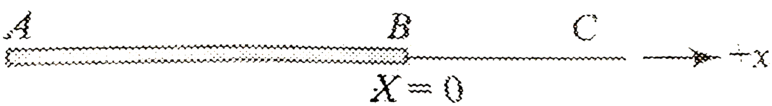
4. In the figure shown a sinusoidal wave is generated at the end A the wave travels along positive x-axis and during its motion it encounter another string BD at the junction $'B' at x = 0$. The density of string AB and BC are ρ and 9ρ respectively and their radii of cross sections are $2r$ and r. The wave function amplitude and wavelength of incident wave are respectively $y_i A_i$ and λ_i Similarly for reflected and transmitted wave these peremeters are y_r, A_r, λ_r and y_t, A_t, λ_t



The ratio of wavelengths λ_r to λ_i $(i.e.\ \lambda_r : \lambda_t)$ will be

A. $1:1$

B. $3:2$

C. $2:3$

D. None of these

Answer: B

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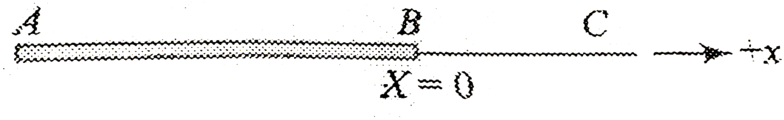
5. In the figure shown a sinusoidal wave is generated at the end A the wave travels along positive x-axis and during its motion it encounter another string BD at the junction $'B' at x = 0$. The density of string AB and BC are ρ and 9ρ respectively and their radii of cross sections are $2r$ and r. The wave function amplitude and wavelength of incident wave are respectively $\mathrm{y}_p A_i$ and λ_r Similarly for reflected and transmitted wave these peremeters are $\mathrm{y}_r, A_r, \lambda_r \text{and} y_i, A_i, \lambda_i$



The ratio of amplitudes $A_r \text{to} A_r \text{is} (i.e. A_r : A_t)$ will be

A. $1:1$

B. $1:4$

C. $4:1$

D. none of these

Answer: B

Watch Video Solution

Illustration

1. Two pulses travelling on the same string are described by

$$y_1 = \frac{5}{(3x - 4t)^2 + 2} \text{ and } y_2 = \frac{-5}{(3x + 4t - 6)^2 + 2}$$

(a). In which direction does each pulse travel ?

(b). At what instant do the two cancel everywhere ?

(c). At what point do the two pulses always cancel ?

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2. Two waves passing through a region are represented by

$y = (1.0m)\sin\left[\left(\pi cm^{-1}\right)x - \left(50\pi s^{-1}\right)t\right]$

and $y = (1.5cm)\sin\left[\left(\pi / 2cm^{-1}\right)x - \left(100\pi s^{-1}\right)t\right]$.

Find the displacement of the particle at $x = 4.5cm$ at time $t = 5.0ms$.

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3. Two travelling sinusoidal waves described by the wave functions

$y_1 = (5.00m)\sin[\pi(4.00x - 1200t)]$

and $y_2 = (5.00m)\sin[\pi(4.00x - 1200t - 0.250)]$

Where x, y_1 and y_2 are in metres and t is in seconds. (a) what is the amplitude of the resultant wave ? (b) What is the frequency of resultant wave ?

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4. Two sounds sources of same frequency produce sound intensities I_0 and $4I_0$ at a point P when used separately . Now , they are used together so that the sound waves from the reach P with a phase difference ϕ. Determine the resultant intensity at P for

(i) $\phi = 0$ (ii) $\phi = 2\pi/3$ (iii) $\phi = \pi$

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5. Two identical sources of sound S_1 and S_2 produce intensity I_0 at a point P equidistant from each source .

(i) Determine the intensity of each at the point P.

(ii) If the power of S_1 is reduced to 64% and phase difference between the two sources is varied continuously , then determine the maximum and minimum intensities at the point P.

(iii) If the power of S_1 is reduced by 64% , then determine the maximum and minimum intensities at the point P.

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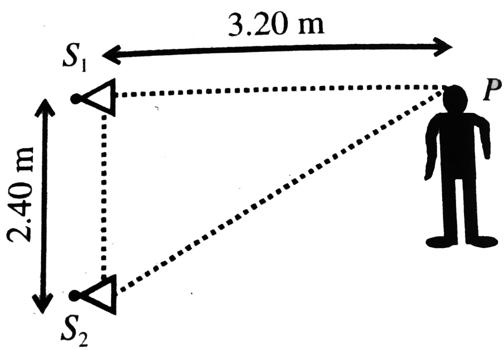
6. Two stereo speaks S_1 and S_2 are separated by a distance of $2.40m$. A person (P) is at a distance of $2.40m$. A person (P) is at a distance of $3.20m$ directly in front of one of the speakers as shown in Fig. 7.8. Find the frequencies in the audible range $(20 - 20,000Hz)$ for which the listener will hear a minimum sound intensity . Speed of sound in air = 320 m//s`.



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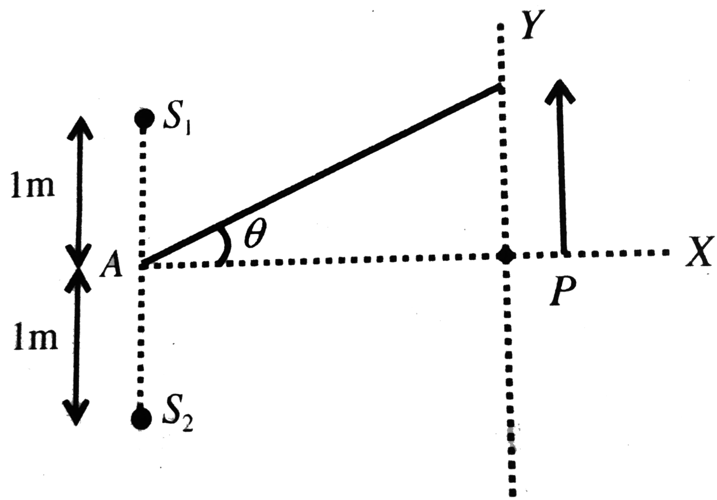
7. Two speakers S_1 and S_2 derived by the same amplifier and placed at $y = 1.0m$ and $y = -1.0m$ (Fig . 7.9) The speakers vibrate in phase at $600Hz$. A man stands at a point on the x - axis at a very large distance from the origin and starts moving parallel to the Y - axis . The speed of sound in air is $330m/s$.

(a). At what angle will the intensity of sound drop to a minimum for the first time ?

(b) At what angle will the sound intensity be maximum for the first time ?

(c) If he continues to walk along the line , how many more maxima can he hear ?



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8. In a Quinck's experiment , the sound intensity being detected at an appropriate point , changes from minimum for the second time , when the slidable tube is drawn apart by $9.0cm$. If the speed of sound in air be $336m/s$, then what is the frequency of this sounding source ?

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9. In an experiment related to interference , Quinck's tube was employed to determine the speed of sound in air. A tunning fork of frequency $1328Hz$ was used as the sounding source . Initially , the apparatus , yielded a maximum sound intensity . Later , when the slidable tube was drawn by a distance of $12.5cm$, the intensity was found to be maximum for the first time . Determine the speed of sound in air .

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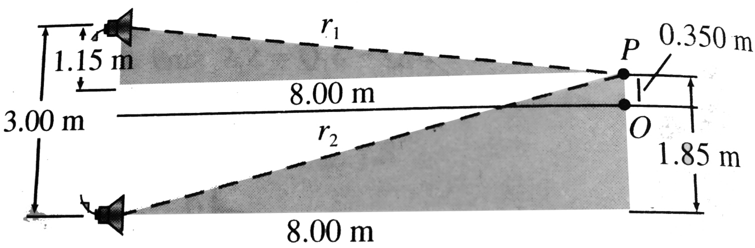
10. Two identical loudspeakers placed $3.00m$ apart are driven by the same oscillator as shown in Fig. 7.12. A listener is originally at point O , located $8.00m$ from the centre of the line connecting the two speakers. The listener then moves to point P, which is a perpendicular distance $0.350m$ from O , and she experiences the first minimum sound intensity . What is the frequency of the oscillator ?



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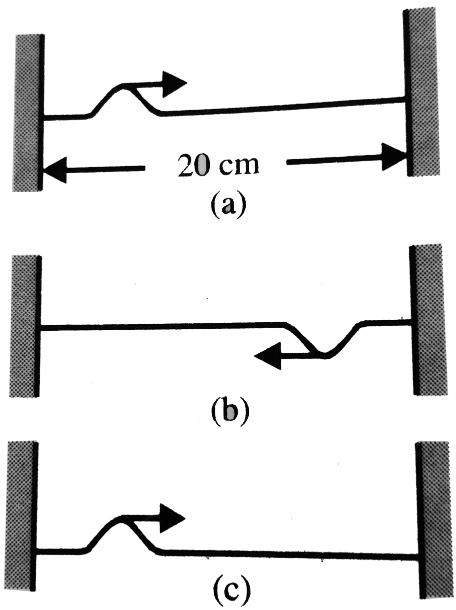
11. A string of length $20cm$ and linear mass density $0.40g/cm$ is fixed at both ends and is kept under a tension of $16N$. A wave pulse is produced at $t=0$ near an ends as shown in Fig. 7.17 (b) , which travels towards the other end . When will the string have the shape shown in the Fig . (c).



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12. Consider a string fixed at one end . A travelling wave given by the wave equation $y = A\sin(\omega t - kx)$ is incident on it . ltbr gt Show that at the fixed end of a string the waves suffers a phase change of π, i.e., as it travels back as if the wave is inverted.

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13. A progressive wave gets reflected at a boundary such that the ratio of amplitudes of the reflected and incident wave is $1:2$. Find the percentage of energy transmitted .

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14. A progrssive wave travels in a medium M_1 and enters into another medium M_2 in which its speed decreased to 75%. What is the ratio of the amplitude of the (a). Reflected and the incident waves , and

(b). Transmitted and the incident waves ?

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15. A long wire PQR is made by joining two wires PQ and QR of equal radii. PQ has a length 4.8m and mass 0.06 kg. QR has length 2.56 m and mass 0.2 kg. The wire PQR is under a tension of 80N. A sinusoidal wave pulse of amplitude 3.5 cm is sent along the wire PQ from the end P. No power is dissipated during the propagation of the wave pulse. Calculate:

(a) The time taken by the wave pulse to reach the other end R.

(b) The amplitude of the reflected and transmitted wave pulse after the incident wave pulse crosses the joint Q.

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16. A harmonic wave is travelling on string 1. At a junction with string 2 it is partly reflected and partly transmitted. The linear mass density of the second string is four times that of the first string, and that the boundary between the two strings is at x=0. If the expression for the incident wave is

$y_i = A_i \cos(k_1 x - \omega_1 t)$

(a) What are the expressions for the transmitted and the reflected waves in terms of A_i, k_1 and ω_1?

(b) Show that the average power carried by the incident wave is equal to the sum of the average power carried by the transmitted and reflected waves.

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17. In a stationary wave pattern that forms as a result of reflection pf waves from an obstacle the ratio of the amplitude at an antinode and a node is $\beta = 1.5$. What percentage of the energy passes across the obstacle ?

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18. Can two waves of the same frequency and amplitude travelling in the same direction give rise to a stationary wave after superposition ?

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19. Two travelling waves of equal amplitudes and equal frequencies move in opposite direction along a string . They interfere to produce a standing wave having the equation .

$y = A\cos kx \sin \omega t$

in which $A = 1.0mm, k = 1.57cm^{-1}$ and $\omega = 78.5s^{-1}$. (a)

Find the velocity and amplitude of the component travelling waves . (b) Find the node closest to the origin in the region $x > 0$. (c) Find the antinode closest to the origin in the region $x > 0$. (d) Find the amplitude of the particle at $x = 2.33cm$.

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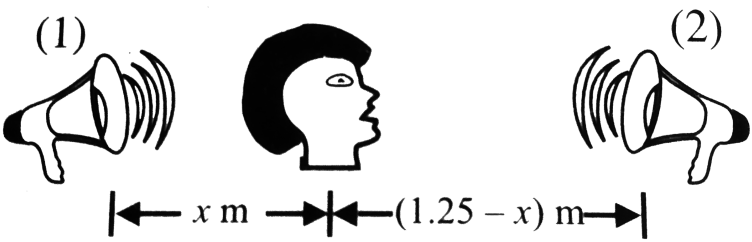
20. Two identical loudspeakers are driven in phase by a common oscillator at $800Hz$ and face each other at a distance of $1.25m$. Locate the points along the line joining the two speakers where relative minimum of sound pressure amplitude would be expected. (Use $v = 343m/s$.)



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21. Two sinusoidal waves combining in a medium are described by the equations

$y_1 = (3.0cm)\sin\pi(x + 0.60t)$

and $y_2 = (3.0cm)\sin\pi(x - 0.06t)$

where, x is in centimetres and t is in seconds. Determine the maximum displacement of the medium at

(a)x=0.250 cm,

(b)x=0.500 cm and

(c) x=1.50 cm.

(d) Find the three smallest values of x corresponding to antinodes.

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22. A string vibrates in its first normal mode with a frequency of 220 vibrations $/s$. The vibrating segment is $70.0cm$ long and has a mass of $1.20g$.

(a) Find the tension in the string.

(b) Determine the frequency of vibration when the string vibrates in three segments.

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

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24. The fundamental 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 wire when the length of the wire is increased by 20% , keeping the original tension in the wire constant.

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25. The length of a sonometer wire AB is 110 cm. Where should the two bridges be placed from A to divide the wire in 3 segments whose fundamental frequencies are in the ratio of $1:2:3$?

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26. Two tunning forks A and B produce $4 beats per \sec ond$ when sounded simultaneously . The frequency of A is known to be $256Hz$. When B is loaded with a little wax 4 beats per second are again produced . Find the frequency of B before and after loading .

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27. Two metallic strings A and B of different materials are connected in series forming a joint. The strings have similar cross - sectional area. The length of A is $l_A = 0.3m$ and B is $l_B = 0.75m$. One end of the combined string is tied with a support rigidly and the other end is loaded with a block of mass m passing over a frictionless pulley. Transverse waves are set up in the combined string using an external source of variable frequency, calculate

a. The lowest frequency for which standing waves are observed such that the joints is a node and

b. The total number of antinodes at this frequency. The densities of A and B are $6.3 \times 10^3 kg/m^3$ and $2.8 \times 10^3 kg/m^3$, respectively.

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28. In Melde's experiment , when a string is stretched by a piece of glass it vibrates with $7l\infty ps$. When the glass piece is completely immersed in water the string vibrates in $9l\infty ps$. What is the specific gravity of glass ?

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29. Middle C on a piano has a fundamental of $262Hz$, and the first A above middle C has a fundamental frequency of $440Hz$.

a. Calculate the frequencies of the next two harmonics of the C string .

b. If $A \text{ and } C$, strings have the same linear mass density μ and length L, determine the ratio opf tensions in the two strings .

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30. If look inside a real piano , you'll see that the assumption made in part (b) of Illustration 7.31 is only partially true . The strings are not likely to have the length of the A string is only 64% of the length of the C string . What is the ratio of their tensions ?

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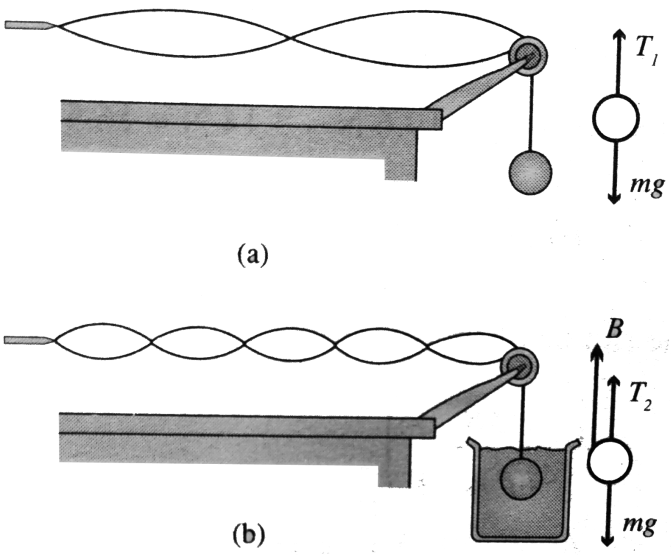
31. One end of a horizontal string is attached to a vibrating blade , and the other end passes over a pulley as in Fig. 7.49 (a). A sphere of mass $2.00kg$ hangs at the end of the string . The string is vibrating in its second harmonic . A container of water is raised under the sphere so that the sphere is completely submerged . In this configuration , the string vibrates in its fifth harmonic as shown in Fig . 7.49 (b). What is the radius of the sphere ?



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32. Two adjacent natural frequencies of an organ pipe are found to be $550Hz$ and $650Hz$. Calculate the fundamental frequency and length of this pipe .(Use $v = 340m/s$.)

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33. A shower stall has dimensions $86.0cm \times 86.0cm \times 210cm$. If you singing in this shower , which frequencies would sound the richest (because of resonance) ? Assume the stall acts as a pipe closed at both ends , with nodes at opposite sides . Assume the voices of various singers range from $130Hz \text{to} 2000Hz$. Let the speed of sound in the hot air be $355m/s$.

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34. A section of driange culvert $1.23m$ in length makes a howling noise when the wind blows across its open ends .

a. Determine the frequencies of the first harmonics of the culvert , if it is cylindrical in shape and open at both ends . Take $v = 343m/s$ as the speed of sound in air .

b. What are the three lowest natural frequencies of the culvert if it is blocked at one end ?

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35. Find the number of possible natural oscillations of air column in a pipe frequencies of which lie below $v_0 = 1250Hz.$ The length of the pipe is $l = 85cm.$ The velocity of sound is $v = 340m/s.$ Consider two cases

i. the pipe is closed from the end ,

ii. the pipe is open from both ends.

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36. In a Kundt's tube experiment , with a wooden rod $170cm$ along , clamped at the middle , the lycopodium powder gets heated up at regular intervals of $13.4cm$, the experiment being performed with air . If the frequency of vibrations be $1270Hz$, find the velocity of sound in air and in the wooden rod.

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37. A Kundt's tube experiment is conducted with a $1m$ long glass rod , twice , one with air and the other with hydrogen , gas filled in the tube . In the first case , there were 11 heaps of lycopodium powder within a length of $64.4cm$ between the first and the last . The corresponding parameters in the second case are 5 nodal heaps within $99.7cm$ length.

Find the velocity of sound in glass and in hydrogen m if that in air be $335m/s$.

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38. 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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39. The first two lengths of an air column , in a resonance column method , were found to be $32.1cm$ and $99.2cm$, respectively . Determine the end correction for the tube . If it is known that velocity of sound in the laboratory is $332m/s$, then find the frequency of the vibrating tunning fork.

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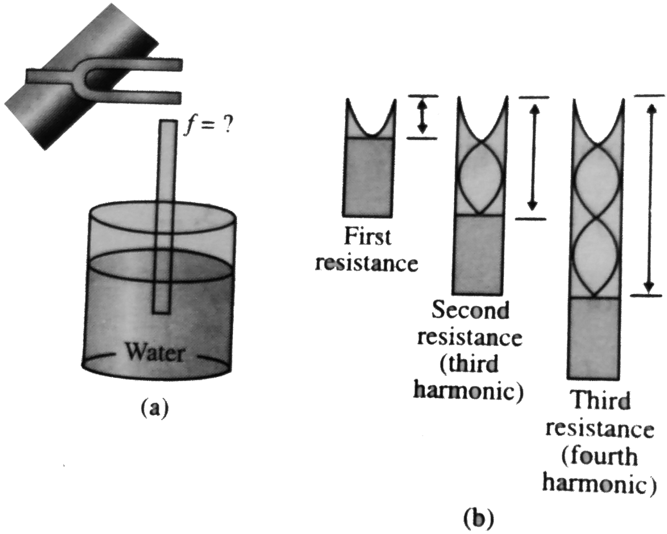
40. A simple apparatus for demonstrating resonance in an air column is depicted in Fig. 7.59.A vertical pipe open at both ends is partially submerge in water , and a tuning fork vibration at an unknown frequency is placed near the top of the pipe . The length L of the air column can be adjusted by moving the pipe vertically . The sound waves generated by the fork are reinforced of the pipe . For a certain pipe , the smallest value of L for which a peak occurs in the intensity is $9.00cm$.

a. What is the frequency of the tuning fork ?

b. What are the values of L for the next two resonance



conditions?

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41. An air column in a glass tube , is open at one end and closed at the other by a movable piston . The air in the tube is warmed above room temperature , and a $384 Hz$ tuning fork is held at the open end. Resonance is heard when the piston is $22.8 cm$ from the open end and again when it is $68.3 cm$ from the open end . (a) What speed of sodium is impliedby these data ? (b) How far from the open end will the piston be when the next resonance is heard ?

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42. An open pipe $40cm$ long a closed pipe $31cm$ long , both having same diameter , are producing their first overtone , and these are in unison. Determine the end correction of these pipes.

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43. An aluminimum rod $1.60m$ long is held at its centre. It is stroked with a rosin - coated cloth to set up a longitudinal vibration. The speed of sound in thin rod of aluminium is $5100m/s$. (a) What is the fundamental frequency of the waves established in the rod ? (b) What harmonics are set up in the rod held in this manner ? (c) What would be the fundamental frequency if the rod were copper , in which the speed of sound is $3650m/s$?

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44. A metallic rod of length $1m$ is rigidly clamped at its midpoint. Longitudinal stationary waves are set up in the rod in such a way that there are two nodes on either side of the mid - point and those of constituent waves in the rod . $\left(Y = 2 \times 10^{11} N/m^2 \text{ and } \rho = 8 \times 10^3 kg/m^3\right)$

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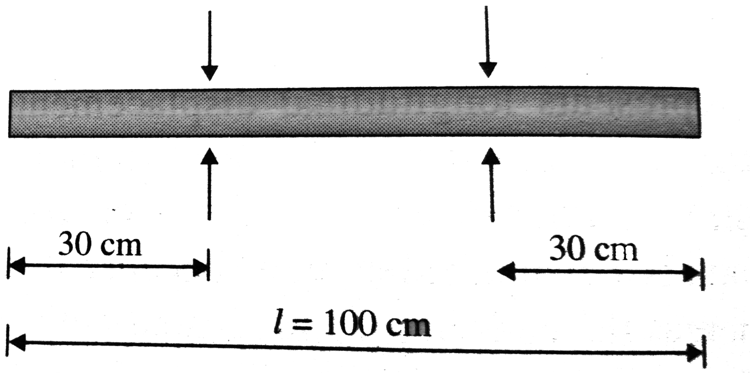
45. A metal rod length l=100 cm is changed at two points A and B as shown in fig. Distance of each clamp from neared and is a=30 cm. if density and Young's modulus of elesticity of rod material are $\rho = 9000 kg/m^3$ and $Y = 144 Gpa$, respectively, calculate minimum and next higher frequency of natural longitudinal oscillations of the rod.



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46. Two identical piano strings of length $0.750m$ are each tunned exactly to $440Hz$. The tension in one of the strings is then increased by 1.0%. If they are now struck, what is the beat frequency between the fundamental of the two strings ?

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47. Wavelength of two notes in air is $(90/175)m$ and $(90/173)m$, respectively . Each pof these notes produces $4beats/s$ with a third note of a fixed frequency . Calculate the velocity of sound in air .

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48. In certain ranges of a piano keyboard , more than one string is tuned to the same note to provide extra loudness . For example , the note at $110Hz$ has two strings at this frequency . If one string slips from its normal tension of $600N\text{to}540N$, what beat frequency is heard when the hammer strikes the two strings simultaneously ?

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49. Two wires are together end to end . The wires are made of the same material , but the diameter of one is twice that of the other . They are subjected to a tension of $4.60N$. The thin wire has a length of $40.0cm$ and a linear mass density of $2.00g/m$. The combination is fixed at both ends and vibrated in such a way that two antinodes are present , with the node between them being precisely at the weld . (a) What is the frequency of vibration ? (b) Find the length of the thick wire .

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Solved Example

1. How is the frequency of a stretched string related to:

Its tension?

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2. The water level in a vertical glass tube $1.0m$ long can be adjusted to any position in the tube . A tuning fork vibrating at $660H_Z$ is held just over the open top end of the tube . At what positions of the water level wil they be in resonance? Speed of sound is $330m/s$.

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3. Two radio stations broadcast their programmes at the same amplitude A, and at slightly different frequencies ω_1 and ω_2 respectively , where $\omega_2 - \omega_1 = 10^3 Hz$. A detector receives the signals from the two stations simultaneously . It can emit signals only of intensity $\geq 2A^2$.

(i). Find the time intervals between successive maxima of the intensity of the signal received by the detector .

ii. Find the time for which the detector remains idle in each cycle of the intensity of the signal .

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

Calculate

i. the frequency of the fork and

ii. the density of material of wire

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5. An aluminium wire of cross-sectional area $\left(10^{-6}\right)m^2$ is joined to a steel wire of the same cross-sectional area. This compound wire is stretched on a sonometer pulled by a weight of 10kg. The total length of the compound wire between the bridges is 1.5m of which the aluminium wire is $0.6m$ and the rest is steel wire. Transverse vibrations are setup in the wire by using an external source of variable frequency. Find the lowest frequency of excitation for which the standing waves are formed such that the joint in the wire is a node. What is the total number of nodes at this frequency? The density of aluminium is $2.6 \times \left(10^3\right)kg/m^3$ and that of steel is $1.04 \times 10^4 kg/m^2 \left(g = 10m/s^2\right)$

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6. A uniform rope of length 12 mm and mass 6 kg hangs vertically from a rigid support. A block of mass 2 kg is attached to the free end of the rope. A transverse pulse of wavelength 0.06 m 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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7. The vibrations of a string of length 60 cm 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.

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

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

(c)What is the velocity of the particle at x=7.5cm and t=0.25s?

(d)Write down the equations of the component waves whose superposition gives the above wave.

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8. The first overtone of an open organ pipe beats with the first overtone of a closed organ pipe with a beat frequency $2.2Hz$. The fundamental frequency of the closed organ pipe is $110Hz$, find the lengths of the pipes . Take velocity of sound $= 330m/s$.

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9. The air column in a pipe closed at one end is made to vibrated in its second overtone by a tuning fork of frequency $440H_Z$. The speed of sound in air is $330m/s$. End corrections may be neglected. Let p_o denotes the mean pressure at any point in the pipe, end Δp_o the maximum amplitude of pressure variation.

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

(b) What is the amplitude of varitation 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 pressure at the closed end of the pipe ?

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10. 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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11. In a resonance tube experiment to determine the speed of sound in air, a pipe of diameter $5cm$ is used . The column in pipe resonates with a tuning fork of frequency $480H_Z$ when the minimum length of the air column is $16cm$. Find the speed in air column at room temperature.

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12. Two narrow cylindrical pipes A and B have the same length. Pipe A is open at both ends and is filled with a monoatomic gas of molar mass M_A. Pipe B is open at one end and closed at the other end and is filled with a diatomic gas of molar mass M_B. Both gases are at the same temperature.

(a) If the frequency of the second harmonic of the fundamental mode in pipe A is equal to the frequency of the third harmonic of the fundamental mode in pipe B, determine the value of $\frac{m_A}{M_B}$

.

(b) Now, the open end of pipe B is also closed (so that the pipe is closed at both ends.) Find the ratio of the fundamental frequency in pipe A to that in pipe B.

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