PHYSICS

BOOKS - SUNIL BATRA 41 YEARS IITJEE PHYSICS (HINGLISH)

WAVES

Jee Main And Advanced

1. A travelling wave has the frequency v and the particle displacement amplitude A. For the wave the particle velocity amplitude is ..... and the particle acceleration amplitude is .....

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2. Sound waves of frequency $660Hz$ fal normally on a perfectly reflecting wall. The shortest distance from the wall at which the pair particles have

maximum amplitude of vibration is ..... meters.

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3. Two simple harmonic motions are represented by the equations $y_1 = 10\sin(3\pi t + \pi/4)$ and $y_2 = 5\left(\sin 3\pi t + \sqrt{3}\cos 3\pi t\right)$ their amplitude are in the ratio of ..... .

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4. In a sonometer wire, the tension is maintained by suspending a $50kg$ mass from the free end of the wire. The suspended mass is completely submerged in water, the fundamental frequency will become ..... Hz.

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

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

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

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6. A cylinder resonance tube open at both enda has fundamental frequency F in air. Half of the length of the tube is dipped vertically in water. The fundamental frequency to the air culumn now is ..... .

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7. A bus is moving towards a gauge wall with a velocity of $5m/s^{-1}$. The driver sounds a horn of frequency $200Hz$. The frequency of the beats heard by a passenger of the bus will be ..... Hz (Speed of sound in air $= 342m/s^{-1}$)

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8. A main stands on the ground at a fixed distance from a siren which emits sound of fixed amplitude. The man hears the sound to be on a clear night than on a clear day.

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9. A plane wave of sound travelling in air is incident upon a plane water surface. The angle of incidence is $60\circ$. Assuming sneill's law to be valid for sound waves, it follows that the sound wave will be refrected into water away from the normal.

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

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

A. (a) $\frac{f}{2}$

B. (b) $\frac{3f}{4}$

C. (c) f

D. (d) $2f$

Answer: C

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

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

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

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

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

Answer: C

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13. An object of specific gravity ρ is hung from a thin steel wire. The fundamental frequency for transverse standing waves in wire is $300Hz$. The object is immersed in water so that one half of its volume is submerged. The new fundamental in Hz is

A. (a) $300\left(\frac{2\rho-1}{2\rho}\right)^{1/2}$

B. (b) $300\left(\frac{2\rho}{2\rho-1}\right)^{1/2}$

C. (c) $300\left(\frac{2\rho}{2\rho-1}\right)$

D. (d)$300\left(\frac{2\rho-1}{2\rho}\right)$

Answer: A

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

A. (a) A node occurs at $x = 0.15m$

B. (b) A antinode occurs at $x = 0.3m$

C. (c) A speed wave is $5ms^{-1}$

D. (d) A wave lengthis $0.3m$

Answer: C

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15. The extension in a string, obeying Hooke's law, is x. The speed of sound in the stretched string is v. If the extension in the string is increased to $1.5x$, the speed of sound will be :-

A. (a) $1.22v$

B. (b) $0.61v$

C. (c) $1.50v$

D. (d) $0.75v$

Answer: A

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16. An open pipe is suddenly closed at one end with the result that the frequency of third harmonic of the closed pipe is found to be higher by $100Hz$ then the fundamental frequency of the open pipe. The fundamental frequency of the open pipe is

A. (a) $200Hz$

B. (b) $300Hz$

C. (c) $240Hz$

D. (d) $480Hz$

Answer: A

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

A. (a) $A\omega$

B. (b) ω / k

C. (c) $d\omega / dk$

D. (d) x / t

Answer: A

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18. A train moves towards a stationary observer with speed $34m/s$. The train sounds a whistle and its frequency registered by the obsrever is f_1. If the train's speed is reduced to $17m/s$, the freuqncy registered is f_2. If the speed of sound of $340m/s$, then the ratio $f_1/f_2$is

A. (a) $18/19$

B. (b)$1/2$

C. (c) 2

D. (d) $19/18$

Answer: D

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19. Two vibrating strings of the same material but lengths L and $2L$ have radii $2r$ and r respectively. They are stretched under the same tension.

Both the string vibrate in their fundamental nodes, the one of length L with freuqency v_1 and the other with frequency v_2. $theraio$v_(1)//v_(2)` is given by

A. (a) 2

B. (b) 4

C. (c) 8

D. (d) 1

Answer: D

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20. Two monatomic ideal gases 1 and 2 of molecular masses m_1 and m_(2) $repectivelyareenclosed \in separateconta \in erskeptatthesametemprature$ $1 \to t \widehat{\in} gas2$` is given by

A. (a) $\sqrt{\frac{m_1}{m_2}}$

B. (b) $\sqrt{\frac{m_2}{m_2}}$

C. (c) $\frac{m_1}{m_2}$

D. (d) $\frac{m_2}{m_1}$

Answer: B

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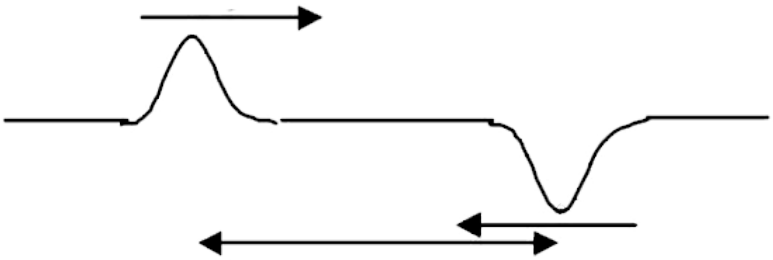
21. Two pulse in a stretched string whose centers are initially $8cm$ apart are moving towards each other as shown in the figure. The speed of each pulse is $2cm/s$. After $2\,\text{sec}\,onds$, the total energy of the pulse will be



A. (a) zero

B. (b) purely kinetic

C. (c) purely potential

D. (d) partly kinetic and partly potential

Answer: B

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22. The ends of a stretched wire of length L are fixed at $x = 0$ and $x = L$. In one experiment, the displacement of the wire is $y_1 = A\sin(\pi / L)\sin\omega t$ and energy is E_1 and in another experiment its displacement is $y_2 = A\sin(2\pi x / L)\sin 2\omega t$ and energy is E_2. Then

A. (a) $E_2 = E_1$

B. (b) $E_2 = 2E_1$

C. (c) $E_2 = 4E_1$

D. (d) $E_2 = 16E_1$

Answer: C

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23. A siren placed at a railway platform is emmitting sound of frequency $5kHz$. A passenger sitting in a moving train A records a frequency of $5.5kHz$ while the train approaches the siren. During his return journey in a different train B he records a frequency of $6.0kHz$ while approaching the same siren. the ratio the velocity of train of A is

A. (a) $242/252$

B. (b) 2

C. (c) $5/6$

D. (d) $11/6$

Answer: B

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24. A sonometer wire resonates with a given tuning fork forming standing waves with five antitodes between the two bridges when a mass of $9kg$ is suspended from the wire. when this same tuning fork forming three antitodes for the same positions of the bridges. the value of M is

A. (a) $25kg$

B. (b) $5kg$

C. (c) $12.5kg$

D. (d) $1/25kg$

Answer: A

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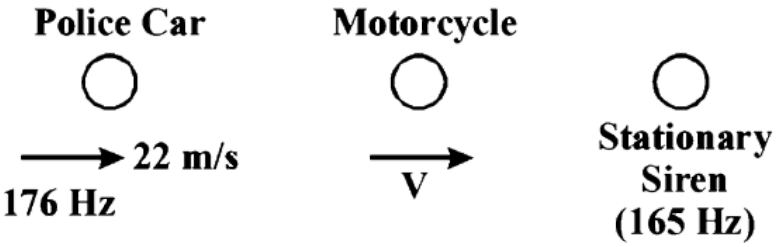
25. A police car moving at $22m/s$, chases motorcyclist. The police man sounds his horn at $176Hz$, while both of them move towards a ststionary siren of frequency $165Hz$. Calculate the speed of the motorcycle, if it is

given that he does not observes any beats.



A. (a) $33m/s$

B. (b) $22m/s$

C. (c)$zero$

D. (d) $11m/s$

Answer: B

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26. In the eperiment for the determinetion of the speed of sound in air using the resonance column method, the length of the air column that resonates in the fundamental mode, with a tuning fork is $0.1m$. When this length is changed to $0.35m$, the same tuning fork resonates with the first overone. calculate the end correction.

A. (a) $0.012m$

B. (b) $0.025m$

C. (c) $0.05m$

D. (d) $0.024m$

Answer: B

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27. A pipe of length l_1, closed at one end is kept in a chamber of gas of density ρ_1. A second pipe open at both ends is placed in a second chamber of gas of density ρ_2. The compressibility of both the gases is

equal. Calculate the length of the second pipe if frquency of first overtone in both the cases is equal

A. (a) $\frac{4}{3}l_1\sqrt{\frac{\rho_2}{\rho_1}}$

B. (b) $\frac{4}{3}l_1\sqrt{\frac{\rho_1}{\rho_2}}$

C. (c) $l_1\sqrt{\frac{\rho_2}{\rho_1}}$

D. (d) $l_1\sqrt{\frac{\rho_1}{\rho_2}}$

Answer: B

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28. In a resonance tube with tuning fork of frequency $512Hz$, first resonance occurs at water level equal to $30.3cm$ and second resonance ocuurs at $63.7cm$. The maximum possible error in the speed of sound is

A. (a) $51.2cm/s$

B. (b) $102.4cm/s$

C. (c) 204.8cm//s`

D. (d) $153.6cm/s$

Answer: C

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29. An open pipe is in resonance in $2nd$ harmonic with frequency f_1. Now one end of the tube is closed and frequency is increased to f_2 such that the resonance again ocuurs in nth harmonic. Choose the corrct option

A. (a) $n = 3, f_2 = \frac{3}{4}f_1$

B. (b) $n = 3, f_2 = \frac{5}{4}f_1$

C. (c) $n = 5, f_2 = \frac{3}{4}f_1$

D. (d) $n = 5, f_2 = \frac{5}{4}f_1$

Answer: D

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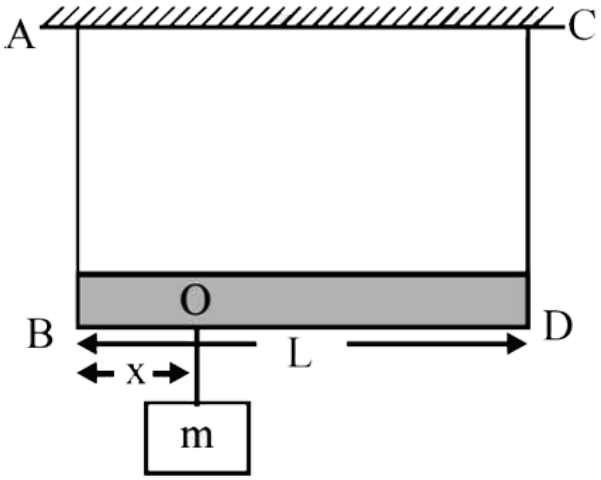
30. A massless rod of length L is suspened by two identical string AB and CD of equal length. A block of mass m is suspended from point O such that BO is equal ti 'x'. Further it is obsreved that the frequency of $1st$ harmonic in AB is equal to $2nd$ harmonic frequency in CD. 'x' is



A. (a) $\frac{L}{5}$

B. (b) $\frac{4L}{5}$

C. (c) $\frac{3L}{4}$

D. (d) $\frac{L}{4}$

Answer: A

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31. In the experiment to determine the speed of sound using a resonance column,

A. (a) prongs of the tuning fork are kept in a vertical plane

B. (b) prongs of the tuning fork are kept in a horizontal plane

C. (c) in one of the two resonance observed, the length of the resonating air column is close to the wavelength of sound in air

D. (d) in one of the two resonance observed, the length of the resonating air column is close to half of the wavelength of sound in air

Answer: A

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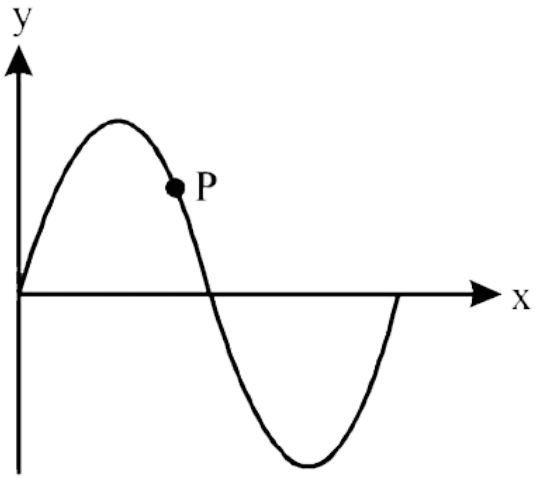
32. A transverse sinusoidal wave moves along a string in the positive x-direction at a speed of $10cm/s$. The wavelength of ythe wave is $0.5m$ and its amplitude is $10cm$. At a particular time t, the snap-shot of the wave is shown in figure. The velocity of point P when its displacement is $5cm$ is -



A. (a) $\frac{\sqrt{3}}{50}\hat{J}m/s$

B. (b) $-\frac{\sqrt{3}}{50}\hat{J}m/s$

C. (c) $\frac{\sqrt{3}}{50}\hat{i}m/s$

D. (d) $-\frac{\sqrt{3}}{50}\hat{i}m/s$

Answer: A

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33. A vibrating string of certain length l under a tension T resonates with a maode corresponding to the first overtone (third harmonic) of an air column of length $75cm$ inside a tube closed at one end. The string also gereates 4 beats per second when excited along with a tuning fork of frequency n. now when the tension of the string is slightly increased the number of beats reduces 2 per second. assuming the velocity of sound in air ti be $340m/s$, the frequency n of the tuning fork in Hz is

A. (a) 344

B. (b) 336

C. (c) 117.3`

D. (d) 109.3`

Answer: A

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34. A hollow pipe of length $0.8m$ is closed at one end. At its open end a $0.5m$ long uniform string is vibrating in its second harmonic and it resonates with the fundamental frequency of the pipe. If the tension in the wire is $50N$ and the speed of sound is $320ms^{-1}$, the mass of the string is

A. (a) $5grams$

B. (b) $10grams$

C. (c) $20grams$

D. (d) $40grams$

Answer: B

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35. A police car with a siren of frequency $8KHz$ is moving with uniform velocity $36Km/hr$ towards a ball building which reflects the sound waves. The speed of sound in air is $320m/s$. The frequency of the siren heard by the car driver is

A. (a) $8.50KHz$

B. (b) $8.25KHz$

C. (c) $7.75KHz$

D. (d) $7.50KHz$

Answer: A

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36. A student is performing the experiment of resonance column. The diameter of the column tube is $4cm$. The frequency of the tuning fork is $512Hz$. The air tempreture is $38 \circ C$ in which the speed of sound is $336m/s$. The zero of the meter scale coincide with the top end of the resonance column tube. when the first resonance ocuurs, the reading of the water level in the column is

A. (a) $14.0cm$

B. (b) $15.2cm$

C. (c) $16.4cm$

D. (d) $17.6cm$

Answer: B

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37. A wave equation which gives the displacement along the y-direction is given by $y = 10^{-4}\sin(60t + 2x)$ where x and y are in meters and t is time in secinds. This represents a wave

A. (a) travelling with a velocity of $30m/s$ in the nrgative x dierction

B. (b) of wavelength πm

C. (c) of frequency $30/\pi hertz$

D. (d) of amplitude 10^{-4m} travelling along the negative x- direction

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

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38. A travelling wave is described by the equation $y = y_0 \sin\left(\left(ft - \frac{x}{\lambda}\right)\right)$. The maximum particle velocity is equal to four times the wave velocity if

A. (a) $\lambda = \pi \frac{y_0}{4}$

B. (b) $\lambda = \pi \frac{y_0}{2}$

C. (c) $\lambda = \pi y_0$

D. (d) $\lambda = 2\pi y_0$

Answer: B

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39. An air columbn 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. (a) 31.25

B. (b) 62.50

C. (c) 93.75

D. (d) 125

Answer: A::C

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40. A tube, closed at one end and containing air, produces, when excited, the fundamental note of frequency $512Hz$. If the tube is open at both ands the fundamental frequency that can be excited is (in Hz)

A. (a) 1024

B. (b) 512

C. (c) 256

D. (d) 128

Answer: A

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41. The displacement of partcles in a string streched in the x-direction is by y. Among the following expressions for y, those describing wave motion are :

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

B. (b) $k^2x^2 - \omega^2t^2$

C. (c) $\cos^2(kx + \omega t)$

D. (d) $\cos\left(k^2x^2 - \omega^2t^2\right)$

Answer: A::C

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42. An organ pipe P_1 open at one end vibrating in its first harmonicare and another pipe P_2 open at ends vibrating in its third harmonic are in

resonance with a given tuning fork. The ratio of the length of P_1 to that P_2 is

A. (a) $8/3$

B. (b) $3/8$

C. (c) $1/6$

D. (d) $1/3$

Answer: C

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43. velocity of sound in air is $320m/s$. A pipe closed at one end has of $1m$. Negative end corrections, the air column in air pipe can resonate for sound of frequency :

A. (a) $80Hz$

B. (b) $240Hz$

C. (c) $320Hz$

D. (d) $400Hz$

Answer: A::B::D

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44. A wave is represented by the equation

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

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

A. (a) a wave travelling in the positive x-direction with a velocity $1.5m/s$.

B. (b) a wave travelling in the negative x-direction with a velocity $1.5m/s$.

C. (c) a wave travelling in the negative x-direction having a wavelength $0.2m$.

D. (cd) a wave travelling in the positive x-direction having a wavelength $0.2m$.

Answer: B::C

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45. Two idential straight wires are stretched so as to produce 6 beats per second when vibrating simultaneously. On changing the tension slightly in one of them, the beat frequency remains unchanged. Denoting by T_1, T_2 the higher and the lower initial tension in the strings, then it could be said that while making the above changes in tension,

A. (a) T_2 was decreased

B. (b) T_2 was increased

C. (c) T_1 was decreased

D. (d) T_1 was increased

Answer: B::C

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46. 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 considered to be a result of the superposition of

A. (a) two

B. (b) three

C. (c) four

D. (d) five

Answer: B

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47. A sound wave of frequency f travels horizontally to the right. It is reflected from a large vertical plane surface moving to left with a speed v. The speed of sound in mwdium is C

A. (a) The number of wave strinking the surface per second is $f\left(\frac{c+v}{c}\right)$

B. (b) The wavelength of reflected wave is $\frac{c(c-v)}{f(c+v)}$

C. (c) The frequency of the reflected wave is $f\left(\frac{(c+v)}{(c-v)}\right)$

D. (d) The number of beats heard by a stationary listener to the left if the reflecting surface is $\frac{vf}{c-v}$

Answer: A::B::C

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

A. (a) $0.04s$

B. (b)$0.10s$

C. (c) $0.20s$

D. (d) $0.40s$

Answer: B

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

A. (a) $a\cos(\pi x / 2L)\cos(\pi y / 2L)$

B. (b) $a\sin(\pi x / L)\sin(\pi y / L)$

C. (c) $a\sin(\pi x / L)\sin(2\pi y / L)$

D. (d) $a\cos(2\pi x / 2L)\sin(\pi y / L)$

Answer: B::C

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

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

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

C. (c) $f = 10^{3}Hz/(2\pi)$

D. (d) $f = 10^{4}Hz$

Answer: A::C

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

A. (a) pulse is moving in + x direction

B. (b) in $2s$ it will travel a distance of $2.5m$

C. (c) its maximum displacement is $0.16m$

D. (d) it is a sysmmetric pulse

Answer: B::C::D

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

A. (a) electric field

B. (b) magnetic field

C. (c) displacement

D. (d) pressure

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

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53. Standing waves can be produced

A. (a) on a string clamped at both the ends.

B. (b) on a string clamped at one end free at the other.

C. (c) when incident wave gets reflected from a wall

D. (d) when two identical waves with a phase difference of π are moving in the same direction

Answer: A::B::C

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54. As a wave propagates,

A. (a) the wave intensity remains constant for a sine wave

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

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

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

Answer: A::C::D

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55. A student performed the experiment to measured the speed of sound in air using resonance air-column method. Two resonances in the air-column were obtained by lowering the water level. The resonance with the shoter air-column is the first resinance and that with the longer air-column is the second resonance. then,

A. (a) the intensity of the sound heard at the first resonance was more than that at the second resonance

B. (b) the prongs of the tuning fork were kept in a horizontal plane above the resonance tube

C. (c) the amplitude of vibration of the ends of the prongs is typically around $1cm$

D. (d) the length of the air-column at the first resonance was somewhat shorter than $1/4th$ of the wavelength of the sound in air

Answer: A::D

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56. A person blows into open- end of a long pipe. As a result, a high pressure pulse of air travel down the pipe. When this pulse reaches the other end of the pipe,

A. (a) a high -pressure pulse starts travelling up the pipe, if the other end of the pipe is open.

B. (b) a low -pressure pulse starts travelling up the pipe, if the other end of the pipe is open.

C. (c) a low -pressure pulse starts travelling up the pipe, if the other end of the pipe is closed.

D. (d) a high -pressure pulse starts travelling up the pipe, if the other end of the pipe is closed.

Answer: B::D

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57. A horizontal stretched string, fixed at two ends, is vibrating in its fifth harmonic according to the equation, $t(x, t) = (0.01m)\sin\left[\left(62.8m^{-1}\right)t\right]$. Assuming $\pi = 3.14$, the correct statement (s) is (are)

A. (a) The number of nodes is 5

B. (b) The length of the string is $0.25m$

C. (c) The maximum displacement of the midpoint of the string, from its equilibrium position is $0.01m$

D. (d) The fundamental frequency is $100Hz$

Answer: B::C

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58. Two vehicles, each moving with speed u on the same horizontal straight road, are spproaching each other. Wind blows along the road with velocity w. One of these vehicles blows a whistle of frequency f_1. An observer in the other vehicle hears the frequency of the whistle to be f_2. the speed of sond in still air is VC. the correct statement $(s)$is (are)

A. (a) If the wind blows from the observer to the source, $f_2 > f_1$

B. (b) If the wind blows from the source to the observer , $f_2 > f_1$

C. (c) If the wind blows from the observer to the source, $f_2 < f_1$

D. (d) If the wind blows from the source to the observer , $f_2 < f_1$

Answer: A::B

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59. A student is performing an experiment using a resonance column and a tuning fork of frequency $244s^{1-}$. He is told that the air in the tube has been replaced by another gas (assuming that the air column ramains filled with the gas). If the minimum height at which resonace occurs is $(0.350 \pm 0.005)m$, the gas in the tube is (Useful information : $\sqrt{167RT} = 640J^{1/2} \text{ mod } e^{-1/2}$,

sqrt(140RT) = 590J^(-1//2). $themolarmassesM \in gramsaregiven \in theoptions. takethevaluesofsqrt((10)/(M))`$ for each gas as given there.)

A. (a) $Neon\left(M = 20, \sqrt{\frac{10}{20}} = \frac{7}{10}\right)$

B. (b) $Nitro \geq n\left(M = 28, \sqrt{\frac{10}{28}} = \frac{3}{5}\right)$

C. (c) $Oxy \geq n\left(M = 32, \sqrt{\frac{10}{32}} = \frac{9}{16}\right)$

D. (d) $Argon\left(M=36, \sqrt{\frac{10}{36}}=\frac{17}{32}\right)$

Answer: D

Watch Video Solution

60. One end of a taut string of length $3m$ along the x-axis is fixed at $x=0$. The speed of the waves in the string is $100ms^{-1}$. The other end of the string is vibrating in the y-direction so that stationary waves are set up in the string. The possible wavelength(s) of these sationary waves is (are)

A. (a) $y(t)=A\frac{\sin(\pi x)}{6}\frac{\cos(50\pi t)}{3}$

B. (b) $y(t)=A\frac{\sin(\pi x)}{3}\frac{\cos(100\pi t)}{3}$

C. (c) $y(t)=A\frac{\sin(5\pi x)}{6}\frac{\cos(250\pi t)}{3}$

D. (d) $y(t)=A\frac{\sin(5\pi x)}{2}\cos 250\pi t$

Answer: A::C::D

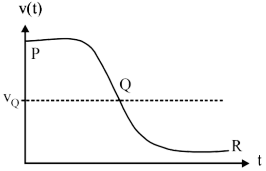
Watch Video Solution

61. Two loudspeaker M and N are located $20m$ apart and emit sound at frequencies $118Hz$ and $121Hz$, respectively. A car is intially at a point P, $1800m$ away from the midpoint Q of the line MN and $moves \rightarrow wards$ Q$cons\tan tlyat$60 km//hr$alongtheperpedicarbi\sec \rightarrow rof$MN . $itcrosses$Q and $eventuallyreachesap$$\oint$R, 1800m$awayomQ.$ $\leq$ tv(t) $representthebeatequencymeasuredbyapersonsi \in g \in thecarattime$t . $\leq$ tv_(P), v_(Q) and v_(R)$bethebeatequenciesmeasuredatlocations$P, Q and R, respectively. the speed of sound in air is $330ms^{-1}$. which of the following statement (s) is (are) true regarding the sound heard by the person?

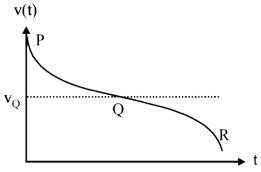
A. (a) $v_P + v_R = 2v_Q$

B. (b) The rate of changes in beat frequency is maximum when the car passes through Q

C. (c) The plot below represents schematically the variation of beat frequency with time



D. (d) The plot below represents schematically the variation of beat frequency with time

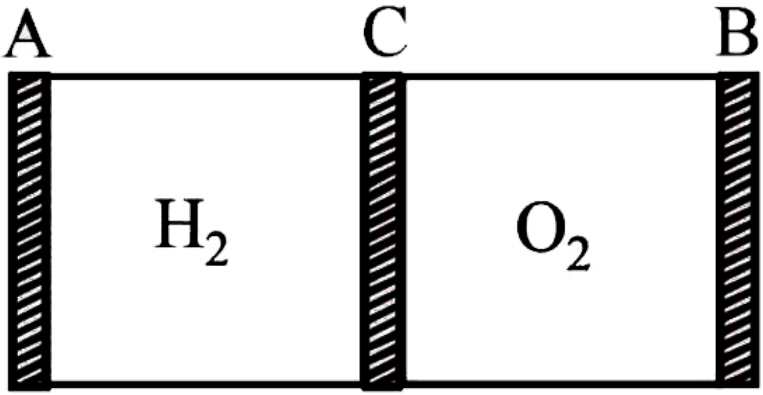


Answer: A::B::C

Watch Video Solution

62. AB is a ccylinder of length $1m$ fitted with a thin flexible diaphragn C at the middle and other thin flexible diaphragms A and B at the ends. The portions AC and BC contain hydrogen and oxygen gases respectively. The diaphragms A and B are set into vibrations of same frequency. what is the minimum frequency of these vibrations for which diaphragms C is a node? (Under the conditions of experiment

$v_{H_2=1100m/s}$, v_(0_(2) = 300m//s`).



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63. A copper wire is held at the two ends by rigid supports. At $30^\circ C$, the wire is just taut, with negligible tension. Find the speed of transverse waves in this wire at $10^\circ C$.

Given : Young modulus of copper $= 1.3 \times 10^{11} N/m^2$.

Coefficient of linear expansion of copper $= 1.7 \times 10^{-5}$ ^ $(\circ)C^{-1}$.

Density of copper $= 9 \times 10^3 kg/m^3$.

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

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

Watch Video Solution

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

Watch Video Solution

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

the string decreases beat frequency. if the speed of sound in air is $320m/s$, find the tension in the string.

Watch Video Solution

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

Watch Video Solution

68. A steel wire of length $1m$, $mass 0.1kg$ and uniform cross-sectional area $10^{-6}m^2$ is rigidly fixed at both ends. The temperature of the wire is lowered by $20^{\circ}C$. If transverse calculate the frequency of the fundamental mode of vibration.

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

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

Watch Video Solution

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

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

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

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

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

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

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

Watch Video Solution

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

Watch Video Solution

71. The following equations represent transverse waves :

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

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

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

Watch Video Solution

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

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

(ii) the distance from the hill at which the echo from the hill is heard by

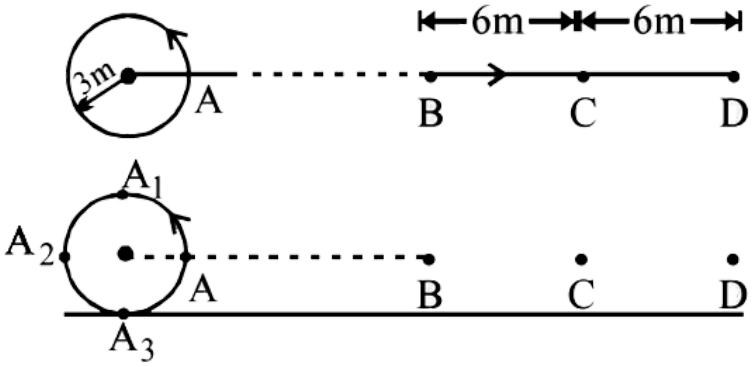
the driver and its frequency.

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

Watch Video Solution

73. A source of sound is moving along a circular orbit of radius $3 meter$ with an angular velocity of $10 rad/s$. A sound detector located far away from the source is executing linear simple harmonic motion along the line BD with an amplitude $BC = CD = 6 meters$. the frequency of oscillation of the detector is $\frac{5}{\pi}$ per second. the source is at the point A when the detector is at the point B. if the source emits a continous sound wave of frequency $340 Hz$, find the maximum and the mnimum

frequencies recorded by the detector.



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

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

(b) Write the equation for the reflected wave.

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

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

Watch Video Solution

75. Two radio stations broadcast their programmes at the same amplitude A and at slightly different frequencies ω_1 and ω_2 respectively, where $\omega_1 - \omega_2 = 10^3 HzA$ detector receives the signals from the two stations simultaneously. it can only detect signals of intensity $\geq 2A^2$.

(i) Find the time interval 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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76. A whistle emmitting a sound of frequency $440Hz$ is tied to a string of $1.5m$ length and rotated with an angular velocity of `20rad s^(-1) in the

horizontal plane. Calculate the range of frequencies heard by an observer stationed at a large distance from the whistle.

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

Watch Video Solution

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

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

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

column?

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

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

Watch Video Solution

79. A long wire PQR is made by joining two wires PQ and QR of equal radii PQ has length $4.8m$ and mass $0.06kg$. QR has length $2.56m$ and mass $0.2kg$. The wire PQR is under a tension of $80N$. A sinusoidal wave-pulse of amplitude $3.5cm$ is sent along the wire PQ from end P. No power is dissipated during the propagation of the wave-pulse. caculate,

(a) the time taken by the wave-pulse to reach the other end R of the wire, and

(b) the amplitude of the reflected and transmitted wave-pulse after the incident wave-pulse crosses the jjoint Q.

Watch Video Solution

80. A $3.6m$ long vertical pipe resonates with a source of frequency $212.5Hz$ when water level is at certain height in the pipe. Find the height of water level (from the bottom of the pipe) at which resonance occurs. Neglect end correction. Now , the pipe is filled to a height $H(\approx 3.6m)$. A small hole is drilled very close to its bottom and water is allowed to leak. Obtain an expression for the rate of fall of water level in the pipe as a function of H. If the radii of the pipe and the hole are $2 \times 10^{-2}m$ and $1 \times 10^{-3}m$ respectively, calculate the time interval between the occurance of first two resonances. Speed of sound in air $340m/s$ and $g = 10m/s^2$.

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81. A boat is travelling in a river with a speed $2m/s$. From this boat, a sound transmitter is lowered into the river through a rigid support. The wavelength of the sound emitted from the transmitter inside the water is $14.45mm$. Assume that attenuation of sound in water and air is negligible.

(a) What will be the frequency detected by a receiver kept inside the river downstream?

(b) The transmitter and the receiver are now pulled up into air. the air is blowing with a speed $5m/s$ in the direction opposite the river stream. Determine the frequency of the sound detected by the receiver.

(Temperature of the air and water = 20^(@)C, $Densityofriverwater$= 10^(3) kg//m^(3), $Bk \bmod usofthewater$= 2.088 xx 10^(9) Pa, $gascons\tan tR$ = 8.31 J//mol-K, $Meanmo \leq carmassofair$= 28.8 xx 10^(-3) kg//mol, C_(P)//C_(V)f or air= 1.4`)

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82. 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 distomic gas of molar mass M_B. Both gases are at the same tempreture.

(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 M_B/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.

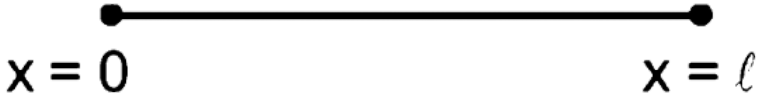
Watch Video Solution

83. A tuning fork of frequency $480Hz$ resonates with a tube closed at one end of length $16cm$ and diameter $5cm$ in fundamental mode. Calculate velocity of sound in air.

Watch Video Solution

84. A string tied between $x = 0$ and $x = l$ vibrates in fundamental mode. The amplitude A, tension T and mass per unit length μ is given.

Find the total energy of the string.



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85. A whistling train approaches a junction. An observer standing at juction obsrever the frequency to be $2.2KHz$ and $1.8KHz$ of the approaching and the receding train respectively. Find the speed of the train (speed of sound $300m/s$)

Watch Video Solution

86. A transverse harmonic disturbance is produced in a string. The maximum transverse velocity is $3m/s$ and maximum transverse acceleration is $9om/s$. If the wave velocity is $20m/s$ then find the waveform.

Watch Video Solution

87. 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 along x-axis. (Here x is in m and t is in second)

(1) Find the number of times intensity is maximum in time interval of $1\,\sec$

.

A. (a) 4

B. (b) 6

C. (c) 8

D. (d) 10

Answer: A

Watch Video Solution

88. 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 along x-axis. (Here x is in m and t is in second)

(2) The wave velocity of louder sound is

A. (a) $100m/s$

B. (b) $192m/s$

C. (c) $200m/s$

D. (d) $96m/s$

Answer: C

Watch Video Solution

89. 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 along x-axis. (Here x is in m and t is in second)

(3) The number of times $y_1 + y_2 = 0$ at $x = 0$ in $1\,\text{sec}$ is

A. (a) 100

B. (b) 46

C. (c) 192

D. (d) 96

Answer: D

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90. two trains A and B moving with speeds $20m/s$ and $30m/s$ respectively in the same direction on the same straight track, with B ahesd of A. The engines are at the front ends. The engine of train A blows a long whistle.

Assume that the sound of the whistle is composed of components varying in frequency from $f_1 = 800Hz$ to $f_2 = 1120Hz$, as shown in the figure. the spread in the frequency (highest frequency - lowest frequency) is thus $320Hz$. the speed of sound in still air is $340m/s$.

(4) The speed of sound of the whistle is

A. (a) $340m/s$ for passengers in A and $310m/s$ for passengers in B

B. (b) $360m/s$ for passengers in A and $310m/s$ for passengers in B

C. (c) $310m/s$ for passengers in A and $360m/s$ for passengers in B

D. (d) $340m/s$ for passengers in both the trains

Answer: B

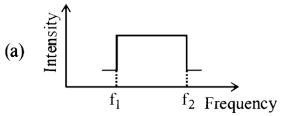
Watch Video Solution

91. two trains A and B moving with speeds $20m/s$ and $30m/s$ respectively in the same direction on the same straight track, with B ahesd of A. The engines are at the front ends. The engine of train A blows a long whistle.

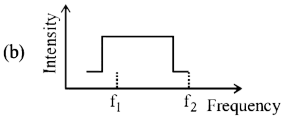
Assume that the sound of the whistle is composed of components varying in frequency from $f_1 = 800Hz$ to $f_2 = 1120Hz$, as shown in the figure. the spread in the frequency (highest frequency - lowest frequency) is thus $320Hz$. the speed of sound in still air is $340m/s$.

(5) The distribution of the sound intensity of the whistle as observed by the passengers in train A is best represented by

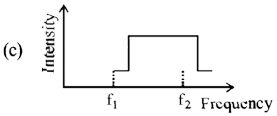
A. (a)



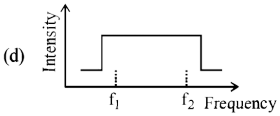
B. (b)



C. (c)



D. (d)



Answer: A

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92. two trains A and B moving with speeds $20m/s$ and $30m/s$ respectively in the same direction on the same straight track, with B ahesd of A. The engines are at the front ends. The engine of train A blows a long whistle.

Assume that the sound of the whistle is composed of components varying in frequency from $f_1 = 800Hz$ to $f_2 = 1120Hz$, as shown in the figure. the spread in the frequency (highest frequency - lowest frequency) is thus $320Hz$. the speed of sound in still air is $340m/s$.

The spread of frequency as observed by the passenger in train B is

A. (a) $310Hz$

B. (b) $330Hz$

C. (c) $350Hz$

D. (d) $290Hz$

Answer: A

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93. A $20cm$ long string, having a mass of $1.0g$, is fixed at both the ends. The tension in the string is $0.5N$. The string is into vibrations using an external vibrator of frequency $100Hz$. Find the separation (in cm) between the successive nodes on the string.

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94. A stationary source is emmitting sound at a fixed frequency f_0, which is reflected by two cars approaching the source. The difference between the frequencies of sound reflected from the cars is $1.2\,\%$ of f_0. What is the difference in the speeds of the cars (in km per hour) to the nearest integer ? The cars are moving at constant speeds much smaller than the speed of sound which is $330ms^{-1}$.

Watch Video Solution

95. When two progressive waves $y_1 = 4\sin(2x - 6t)$ and $y_2 = 3\sin\left(2x - 6t - \frac{\pi}{2}\right)$ are superimposed, the amplitude of the

resultant wave is

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96. Four harmonic waves of equal freuencied and equal intensity I_0 have phase angles $0, \frac{\pi}{3}, \frac{2\pi}{3}$ and π. When they are superposed, the intensity of the resulting wave is nI_0. The value of n is

Watch Video Solution

97. Length of a string tied to two rigid support is $40cm$. Maximum length (wavelength in cm) of a stationary wave produced on it is

A. (a) 20

B. (b) 80

C. (c) 40

D. (d) 120

Answer: B

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98. Tube A has both ends open while tube B has one closed, otherwise they are identical. The ratio of fundamental frequency of tube A and B is

A. (a) $1:2$

B. (b) $1:4$

C. (c) $2:1$

D. (d) $4:1$

Answer: C

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99. A tuning fork arrangement (pair) produces $4 beats / \sec$ with one fork of frequrncy $288 cps$. A little wax is placed on the unknown fork and it then produces $2 beats / \sec$. The frequency of the unknown fork is

A. (a) $286 cps$

B. (b) $292 cps$

C. (c) $294 cps$

D. (d) $288 cps$

Answer: B

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100. A wave $y = a \sin(\omega t - kx)$ on a string meets with another wave producing a node at $x = 0$. Then the equation of the unknown wave is

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

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

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

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

Answer: B

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101. When temreture increases, the frequency of a tuning fork

A. (a) increases

B. (b) decreases

C. (c) remains same

D. (d) increases or decreases depending on the material

Answer: B

Watch Video Solution

102. The displacement y of a wave travelling in the x-direction is given by $y = 10^{04} \sin\left(\left(600t - 2x + \frac{\pi}{3}\right) meters\right.$ where x is expressed in meters and t in seconds. The speed of the wave-motion, in ms^{-1}, is

A. (a) 300

B. (b) 600

C. (c) 1200

D. (d) 200

Answer: A

Watch Video Solution

103. A metal wire of linear mass density of $9.8g/m$ is stretched with a tension of $10kg - wt$ between two rigid support $1meter$ apart. The wire passes at its middle point between the poles of a permanent magnet, and

it vibrates in resonance when carrying an alternating current of frequency n. the frequency n of the alternating source is

A. (a) $50Hz$

B. (b) $100Hz$

C. (c) $200Hz$

D. (d) $25Hz$

Answer: A

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104. A tuning fork of known frequency $256Hz$ makes 5 beats per second with the vibrating string of a piano. The beat frequency decreases to 2 beats per second when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was

A. (a) $256 + 2Hz$

B. (b) $256 - 2Hz$

C. (c) $256 - 5Hz$

D. (d) $256 + 5Hz$

Answer: C

Watch Video Solution

105. The displacement y of a partcle in a medium can be expressed as, $y = 10^{-6} \sin\left(\left(100t + 20x + \frac{\pi}{4}\right)m$ where t is in second and x in meter. The speed of the wave is

A. (a) $20m / s$

B. (b) $5m / s$

C. (c) $2000m / s$

D. (d) $5\pi m / s$

Answer: B

Watch Video Solution

106. When two tuning forks (fork 1 and fork 2) are sounded simultaneously, 4 beats per second are heard. Now some tape is attached on the prong of the fork 2. When the tuning fork are sounded again, 6 beats per second are heard. If the frequency of fork 1 is $200Hz$, then what was the original frequency of fork 2 ?

A. (a) $202Hz$

B. (b) $200Hz$

C. (c) $204Hz$

D. (d) $196Hz$

Answer: D

Watch Video Solution

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

A. (a) $0.5\ \%$

B. (b) zero

C. (c) $20\ \%$

D. (d) $5\ \%$

Answer: C

Watch Video Solution

108. A whistle producing sound waves of frequencies $9500HZ$ and above is approaching a stationary person with speed vms^{-1}. The velocity of sound in air is $300ms^{-1}$. If the person can hear frequencies upto a maximum of $10,\ 000HZ$, the maximum value of v upto which he can hear whistle is

A. (a) $15\sqrt{2}$

B. (b) $\frac{15}{\sqrt{2}} ms^{-1}$

C. (c) $15ms^{-1}$

D. (d) $30ms^{-1}$

Answer: C

Watch Video Solution

109. A string is stretched between fixed points separated by $75.0cm$. It is observed to have resonant frequencies of $420Hz$ and $315Hz$. There are no other resonant frequencies between these two. Then, the lowest resonant frequency for this string is

A. (a) $105Hz$

B. (b) $1.05Hz$

C. (c) $1050Hz$

D. (d) $10.5Hz$

Answer: A

Watch Video Solution

110. A sound absorber attenuates the sound level by $20dB$. The intensity decreases by a factor of

A. (a) 100

B. (b) 1000

C. (c) 10000

D. (d) 10

Answer: A

Watch Video Solution

111. While measuring the speed of sound by performing a resonace column experiment, a student gets the first resonance condition at a

column length of $18cm$ during winter. Repeating the same experiment during summer, the resonance. Then

A. (a) $18 > x$

B. (b) $x > 54$

C. (c) $54 > x > 36$

D. (d) $36 > x > 18$

Answer: B

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112. A wave travelling along the x-axis is described by the equation $v(x, t) = 0.005\cos(\alpha x - \beta t)$. If the wavelength and the time period of the wave are $0.08m$ and $2.0s$, respectively, then α and β in appropriate units are

A. (a) $\alpha = 25.00\pi, \beta = \pi$

B. (b) $\alpha = \frac{0.08}{\pi}, \beta = \frac{2.0}{\pi}$

C. (c) $\alpha = \frac{0.04}{\pi}, \beta = \frac{1.0}{\pi}$

D. (d) $\alpha = 12.50(\pi), \beta = \frac{\pi}{2.0}$

Answer: A

Watch Video Solution

113. Three sound waves of equal amplitudes have frequencies $(v-1), v, (v+1)$. They superpose to give beats. The number of beats produced per second will be :

A. (a) 3

B. (b) 2

C. (c) 1

D. (d) 4

Answer: B

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114. A motor cycle starts from rest and accelerates along a straight path at $2m/s^2$. At the starting point of the motor cycle there is a stationary electric siren. How far has the motor cycle gone when the driver hears the frequency of the siren at 94% of its value when the motor cycle was at rest ? (Speed of sound = 330ms^(-2))`

A. (a) $98m$

B. (b) $147m$

C. (c) $196m$

D. (d) $49m$

Answer: A

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115. the equation of a wave on a string of linear mass density $0.04kgm^{-1}$ is given by

$$y = 0.02(m)\sin\left[2\pi\left(\frac{t}{0.04(s)} - \frac{x}{0.50(m)}\right)\right].$$

Then tension in the string is

A. (a) $4.0N$

B. (b) $12.5N$

C. (c) $0.5N$

D. (d) $6.25N$

Answer: D

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116. The transverse displacement $y(x, t)$ of a wave on a string is given by $y(x, t) = e^{-\left(ax^2+bt^2+2\sqrt{(ab)}xt\right)}$. This represents a :

A. (a) wave moving in -x direction with speed $\sqrt{\frac{b}{a}}$

B. (b) standing wave of frequency $\sqrt{b}$

C. (c) standing wave of frequency $\frac{1}{\sqrt{b}}$

D. (d) wave moving in +x direction with speed $\sqrt{\frac{a}{b}}$

Answer: A

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117. A cylindrical tube open at both ends, has a fundamental frequency f in air. The tube is dipped vertically 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. (a) f

B. (b) $f/2$

C. (c) $3f/4$

D. (d) $2f$

Answer: A

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118. A sonometer wire of length $1.5m$ is made of steel. The tension in it produces an elastic strain of 1%. What is the fundamental frequency of steel if density and elasticity of steel are $7.7 \times x10^3 kg/m^3$ and $2.2 \times 10^{11} N/m^2$ respectively ?

A. (a) $188.5Hz$

B. (b) $178.2Hz$

C. (c) $200.5Hz$

D. (d) $770Hz$

Answer: B

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119. A pipe of length $85cm$ is closed from one end. Find the number of possible natural oscillations of air column in the pipe whose frequencies lie below $1250Hz$. The velocity of sound in air is $34m/s$.

A. (a) 12

B. (b) 8

C. (c) 6

D. (d) 4

Answer: C

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120. A train is moving on a straight track with speed $20ms^{-1}$. It is blowing its whistle at the frequency of $1000Hz$. The percentage change in the frequency heard by a person standing near the track as the train passes him is (speed of sound $= 320ms^{-1}$) close to :

A. (a) 18%

B. (b) 24%

C. (c) 6%

D. (d) 12%

Answer: D

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121. A uniform string of length $20m$ is suspended from a rigid support. A shirt wave pulse is introduced at its lowest end. It starts moving up the string. The time taken to reach the support is :

(take $g = 10ms^{-2}$)

A. (a) $2\sqrt{2s}$

B. (b) $\sqrt{2s}$

C. (c) $2\pi\sqrt{2s}$

D. (d) $2s$

Answer: A

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122. A cylindrical tube open at both ends, has a fundamental frequency f in air. The tube is dipped vertically 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. (a) $2f$

B. (b) f

C. (c) $\frac{f}{2}$

D. (d) $3\frac{f}{4}$

Answer: B

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