PHYSICS

BOOKS - DISHA PUBLICATION PHYSICS (HINGLISH)

WAVES

Jee Main 5 Years At A Glance

1. The end correction of a resonance column is 1 cm. If the shortest length resonating with the tunning fork is 10 cm, the next resonating length should be :

A. 32cm

B. 40cm

C. 28cm

D. 36cm

Answer: A

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2. 5 beats / second are heared when a tuning fork is sounded with a sonometer wire under tension when the length of the sonometer wire is either 0.95 m or 1 The frequency of the fork will be :

A. 195Hz

B. 251Hz

C. 150Hz

D. 300Hz

Answer: A

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3. A granite rod of 60 cm length is clamped at its middle point and is set into longitudinal vibrations. The density of granite is $2.7 \times 10^3 kg/m^3$ and its Young's modulus is 9.27×10^{10} Pa. What will be the fundamental frequency of the longitudinal vibrations ?

A. 5kHz

B. 2.5kHz

C. 10kHz

D. 7.5kHz

Answer: A

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4. A standing wave is formed by the superposition of two waves travelling in opposite directions. The transverse displacement is given by $y(x, t) = 0.5 \sin\left(5\frac{\pi}{4}x\right)\cos(200\pi t)$ What is the speed of the travelling wave moving in the position x direction?

A. $160m / s$

B. $90m/s$

C. $180m/s$

D. $120m/s$

Answer: A

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5. A toy-car, blowing its horn, is moving with a steady speed of 5 m//s, away from a wall. An observer, towards whom the toy car is moving, is able to heat 5 beats per second. If the velocity of sound in air is 340 m/s, the frequency of the horn of the toy car is close to :

A. 680Hz

B. 510Hz

C. 340Hz

D. 170Hz

Answer: D

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6. A pipe open at both ends has a fundamental frequency f in air. The pipe is dipped vertically in water so that half of it is in water. The fundamental frequency of the air column is now :

A. 2f

B. f

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

D. $\frac{3f}{4}$

Answer: B

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7. A bat moving at $10ms^{-1}$ towards a wall sends a sound signal of 8000 Hz towards it. On reflection it hears a sound of frequency f. The value of g in Hz is close to (speed to sound $= 320ms^{-1}$) :-

A. 8516

B. 8258

C. 8424

D. 8000

Answer: A

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8. 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. 0.18

B. 0.24

C. 0.06

D. 0.12

Answer: D

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9. Two factories are sounding their sirens at 800 Hz. A man goes from one factory to the other at a speed of 2 m/s. The velocity of sound is 320 m/s. The number of beats heard by the person is 1 s will be

A. 2

B. 4

C. 8

D. 10

Answer: D

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10. A pipe of length 85 cm is closed one end. Find the number of possible natural oscillationsof air column in the pipe whose frequencies lie below 1250 Hz. The velocity of sound in air is 340 m/s.

A. 12

B. 8

C. 6

D. 4

Answer: C

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Exercise 1 Concept Builder

1. The equation $y = A\sin^2(kx - \omega t)$ represents a wave with

A. amplitude A, frequency $\omega / 2\pi$

B. amplitude $A/2$, frequency of $\frac{\omega}{\pi}$

C. amplitude 2A, frequency $\omega/4\pi$

D. it does not represent a wave motion

Answer: B

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2. Sound waves are propagating in a medium. The moduli of isothermal and adiabatic elasticity of the medium are E_r and E_s respectively. The velocity of sound waves is proportional to -

A. E

B. $\sqrt{E}$

C. $\sqrt{E'}$

D. $\frac{E}{E}$,

Answer: B

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3. The equation of plane progressive wave motion is $y = a\frac{\sin(2\pi)}{\lambda}(vt - x)$. Velocity of the particle is

A. $y\frac{dv}{dx}$

B. $v\frac{dy}{dx}$

C. $-y\frac{dv}{dx}$

D. $-v\frac{dy}{dx}$

Answer: B

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4. Three transverse waves are represented by

$y_1 = A\cos(kx - \omega t)$

$y_2 = A\cos(kx + \omega t)$

$y_3 = A\cos(ky - \omega t)$

The combination of waves which can produce stationary waves is

A. y_1 and y_2

B. y_2 and y_3

C. y_1 and y_3

D. y_1, y_2 and y_3

Answer: A

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5. The equation $Y = 0.02\sin(500\pi t)\cos(4.5x)$ represents

A. progressive wave of frequency 250 Hz along x-axis

B. a stationary wave of wavelength of 1.4 m

C. a transverse progressive wave of amplitude 0.02m

D. progressive wave of speed of about $350ms^{-1}$

Answer: B

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6. The equation $y = a \sin 2\pi / \lambda(vt - x)$ is expression for :-

A. stationary wave of single frequency along x-axis

B. a simple harmonic motion

C. a progressive wave of single frequency along x-axis

D. the resultant of two SHMs of slightly different frequencies

Answer: C

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7. The velocity of sound in hydrogen is $1224m/s$. Its velocity in a mixture of hydrogen and oxygen containing 4 parts by volume of hydrogen and 1 part oxygen is

A. $1224m/s$

B. $612m/s$

C. $2448m/s$

D. $306m/s$

Answer: B

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8. Sound waves of length λ travelling with velocity v in a medium enter into another medium in which their velocity is 4v. The wavelength in 2nd medium is:

A. 4λ

B. λ

C. $\lambda/4$

D. 16λ

Answer: A

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9. When a sound wave of frequency 300 Hz passes through a medium the maximum displacement of a particle of the medium is 0.1 cm . The maximum velocity of the particle is equal to

A. $60\pi cms^{-1}$

B. $30\pi cms^{-1}$

C. $30cms^{-1}$

D. $60cms^{-1}$

Answer: A

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10. A point source emits sound equally in all directions in a non-absorbing medium. Two point P and Q are at distance of $2m$ and $3m$ respectively from the source. The ratio of the intensities of the wave at P and Q is :

A. $3:2$

B. $2:3$

C. $9:4$

D. $4:9$

Answer: C

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11. A wave travelling in the $+ve$ x-direction having displacement along y-direction as $1m$, wavelength 2π m and frequency of $1/\pi$ Hz is represented by

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

B. $y = \sin(10\pi x - 20\pi t)$

C. $y = \sin(2\pi x + 2\pi t)$

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

Answer: D

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12. 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 units

B. 1.5 units

C. 22.5 units

D. 30 units

Answer: A

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13. The velocity of sound in a container of air at $-73^\circ C$ is $300 m/s$ It temp. of container were raised to $127^\circ C$

what would be the velocity of sound?

A. $300m/s$

B. $300\sqrt{2}m/s$

C. $300/\sqrt{2}m/s$

D. $600m/s$

Answer: b

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14. At room temperature the ratio of velocity of sound in air at 10 atmospheric pressure to the at 1 atmospheric pressure will be

A. $10:1$

B. $1:10$

C. $1:1$

D. cannot say

Answer: C

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15. यांत्रिक तरंगें NTP पर वायु में ध्वनि की चाल 332 मीटर है। NTP पर हाइड्रोजन में ध्वनि की चाल क्या होगी? (वायु हाइड्रोजन से 16 गुना भारी है)

A. 330

B. 1200

C. 600

D. 900

Answer: B

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16. A uniform wire of length 20 m and weighing 5 kg hangs vertically. If $g = 10ms^{-2}$, then the speed of transverse waves in the middle of the wire is

A. $10m/s$

B. $10\sqrt{2}m/s$

C. $4m/s$

D. zero

Answer: A

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17. A circular loop of rope of length L rotates with uniform angular velocity ω about an axis through its centre on a horizontal smooth platform. Velocity of pulse produced due to slight radial displacement is given by

A. ωL

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

C. $\frac{\omega L}{\pi}$

D. $\frac{\omega L}{4\pi^2}$

Answer: B

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18. A longitudinal wave is represented by

$$x = x_0 \sin 2\pi\left(\mathrm{nt} - \frac{\mathrm{x}}{\lambda}\right)$$

The maximum particle velocity will be four times the wave velocity if

A. $\lambda = \frac{\pi x_0}{4}$

B. $\lambda = 2\pi x_0$

C. $\lambda = \frac{\pi x_0}{2}$

D. $\lambda = 4\pi x_0$

Answer: C

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19. Two waves represented by $y_1 = a\sin\omega t$ and $y_2 = a\sin(\omega t + \phi)$ with $\phi = \frac{\pi}{2}$ are superposed at any point at a particular instant. The resultant amplitude is

A. a

B. 4a

C. $\sqrt{2}a$

D. zero

Answer: C

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20. The distance between two consecutive crests in a wave train produced in string is 5 m. If two complete waves pass through any point per second, the velocity of wave is :-

A. $2.5m/s$

B. $5.0m/s$

C. $8.0m/s$

D. $10.0m/s$

Answer: D

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21. A closed organ pipe has a frequency $'n'$. If its length is doubled and radius is halved , its frequency nearly becomes .

A. $n/2$

B. $n/3$

C. n

D. 2n

Answer: A

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22. An open and closed organ pipe have the same length the ratio pth mode of frequency of vibration of air in two pipe is

A. 1

B. p

C. $p(2p+1)$

D. $\frac{2p}{(2p-1)}$

Answer: D

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23. 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. 1.22v

B. 0.61v

C. 1.50v

D. 0.75v

Answer: A

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24. In a stationary wave that forms as a result of reflection of wave from an obstacle, the ratio of this amplitude at an antinode to the amplitude at node is n. The fraction of energy reflected is

A. $\left[\frac{x-1}{x}\right]^2$

B. $\left[\frac{x}{x+1}\right]^2$

C. $\left[\frac{x-1}{x+1}\right]^2$

D. $\left[\frac{1}{x}\right]^2$

Answer: C

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25. 60 सेमी लम्बाई के तने हुए तार के कम्पन की मूल आवृत्ति 256 हर्ट्ज है । यदि तार की लम्बाई 15 सेमी हो जाए परन्तु तनाव वही रहे तो मूल आवृत्ति हो जायेगी -

A. 1024

B. 572

C. 256

D. 64

Answer: A

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26. 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. 105 Hz

B. 1.05 Hz

C. 1050 Hz

D. 10.5Hz

Answer: A

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27. The fundamental frequency of an open organ pipe is 300Hz. The first overtone of this has same frequency as that of first overtone of a closed organ pipe. If speed of sound is 330m/s, then the length of closed of organ pipe will be

A. 41cm

B. 37cm

C. 31cm

D. 80cm

Answer: A

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

A. $1:2$

B. $2:3$

C. $3:4$

D. $4:3$

Answer: B

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29. In the sonometer experiment , a tuning fork of frequency $256Hz$ 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

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30. A wave in a string has an amplitude of $2cm$. The wave travels in the $+ve$ direction of x axis with a speed of 1 $28ms^{-1}$ and it is noted that 5 complete waves fit in $4m$ length of the string. The equation describing the wave is

A. $y = (0.02)m\sin(15.7x + 2010t)$

B. $y = (0.02)m\sin(15.7x + 2010t)$

C. $y = (0.02)m\sin(7.85x + 1005t)$

D. $y = (0.02)m\sin(7.85x + 1005t)$

Answer: C

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31. 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 to that of P_2 is-

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

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

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

D. $\frac{1}{3}$

Answer: B

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

A. $1/2$

B. 2

C. $1/4$

D. 4

Answer: A

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34. Where should the two bridges be set in a 110cm long wire so that it is divided into three parts and the ratio of the frequencies are $3:2:1$?

A. 20cm from one end and 60cm from other end

B. 30 cm from one end and 70cm from other end

C. 10 cm from one end and 50 cm from other end

D. 50 cm from one end and 40 cm from other end

Answer: A

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35. If there are six loops for 1m length in transverse mode of Melde's experiment, the number of loops in longitudinal mode under the indentical conditions would be

A. 3

B. 6

C. 12

D. 8

Answer: A

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36. A cylinderical 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 air column is now

A. $n/2$

B. n

C. 2n

D. 4n

Answer: B

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37. A fork of frequency 256Hz resonates with a closed organ pipe of length 25.4cm. If the length of the pipe is increased by 2mm then the number of beat/s will be

A. 4

B. 1

C. 2

D. 3

Answer: C

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38. In a resonance column, first and second resonance are obtained at depths 22.7 cm and 70.2 cm. The third resonance will be obtained at a depth

A. 117.7cm

B. 92.9cm

C. 115.5cm

D. 113.5cm

Answer: A

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39. Vibrations are produced in a vertical tube of length 150cm closed at one end by a tuning fork of frequency 340 Hz. Now water is filled slowly in the tube. IF the speed of sound in air is $340m/s$ then the minimum height of water required for resonance is:

A. 90cm

B. 75cm

C. 50cm

D. 25cm

Answer: D

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40. 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. 4kg

D. 16kg

Answer: D

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41. Three sound sources p,q and r have frequencies 400 Hz, 401 Hz and 402 Hz respectively. Calculate the number of beats nodes per second.

A. 0

B. 1

C. 3

D. 2

Answer: B

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42. Three waves of equal frequency having amplitudes $10\mu m$, $4\mu m$, $7\mu m$ arrive at a given point with successive phase difference of $\pi/2$, the amplitude of the resulting wave in μm is given by

A. 7

B. 6

C. 5

D. 4

Answer: C

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43. Two travelling waves $y_1 = A\sin[k(x - ct)]$ and $y_2 = A\sin[k(x + ct)]$ are superimposed on string. The distance between adjacent nodes is

A. ct/π

B. $ct/2\pi$

C. $\pi/2k$

D. π/k

Answer: D

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44. Two waves having the intensities in the ratio of $9:1$ produce interference. The ratio of maximum to minimum intensity is equal to

A. $2:1$

B. $4:1$

C. $9:1$

D. $10:8$

Answer: B

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45. 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. 80 and 40

B. 100 and 50

C. 44 and 22

D. 72 and 36

Answer: D

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

A. 200400

B. 205410

C. 195390

D. 100200

Answer: A

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47. In the figure shown the wave speed is v. The velocity of car is v_0 The beat frequency for the observer will be

A. $\frac{2f_0vv_0}{v^2+v_0^2}$

B. $\frac{2f_0v^2}{v^2-v_0^2}$

C. $\frac{2f_0vv_0}{v^2-v_0^2}$

D. $\frac{f_0vv_0}{v^2-v_0^2}$

Answer: C

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48. What will be the frequency of beats formed from the superposition of two harmonic waves shown below?

A. 20Hz

B. 11Hz

C. 9Hz

D. 2Hz

Answer: D

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49. Two sound sources S_2 and S_1 emit pure sinusoidal coherent waves in phase. IF the speed of sound in $340 m/s$. Then find out the frequencies for which construcive interference occurs at P.

A. 170 Hz

B. 340 Hz

C. 510 Hz

D. All of these

Answer: D

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50. The fundamental frequency of a somometer wire of length l is f_0. A bridge is now introduced at a distance of $\triangle l$ from the centre of the wire $(\Delta l << l)$. The number of beats heard if both sides of the bridges are set into vibration in their fundamental modes are `

A. $\frac{8f_0\Delta l}{l}$

B. $\frac{f_0\Delta l}{l}$

C. $\frac{2f_0\Delta l}{l}$

D. $\frac{4f_0\Delta l}{l}$

Answer: A

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51. A source of sound is moving with a uniform speed along a circle. The frequency of sound as heard by listener stationed all the centre of the path

A. increases

B. decreases

C. remains the same

D. may increase and decrease alternately

Answer: C

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52. A whistle of frequency 385Hz rotates in a horizontal circle of radius 50cm at an angular speed of 20 radians s^{-1} the lowest frequency heard by a listener a long distance way at rest with velocity to the centre of the circle given velocity of sound equal to $340ms^{-1}$ is

A. 396Hz

B. 363Hz

C. 374Hz

D. 385Hz

Answer: C

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

A. $\frac{v + v_m}{v + v_b} f$

B. $\frac{v + v_m}{v - v_b} f$

C. $\frac{2v_b(v + v_m)}{v^2 - v_b^2} f$

D. $\frac{2v_m(v + v_b)}{v^2 - v_m^2} f$

Answer: C

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54. a sound source emits frequency of $180h_Z$ when moving towards a rigid wall with speed $5m/s$ and an observer is moving away from with speed $5m/s$. Both source and observer moves on a straight line which is perpendicular to the wall. The number of beatd per second heard by the observer will be [speed of sound = $335m/s$]

A. $5beats/s$

B. $10beats/s$

C. $6beats/s$

D. $8beats/s$

Answer: A

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55. A police car moving at $22m/s$. Chases a motorcyclist. The policeman sound his horn at 176Hz, while both of them move towards a stationary siren of frequency 165Hz. The speed of the motorcycle if it is given that he does not observe any beats is

A. $33m/s$

B. $22m/s$

C. zero

D. $11m/s$

Answer: B

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56. A train approaching a hill at a speed of $60km/hour$ sounds a whistle of frequency 600Hz when it is distance of 1km from the hill. Wind is blowing in the direction of the train with a speed of $60km/h$ Find the frequency of the whistle heard by an observer on the hill:speed of sound in air 1200km/h)

A. 610Hz

B. 620Hz

C. 630Hz

D. 650Hz

Answer: C

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57. Two trains are moving towards each other at speeds of 20 m/s and 15 m/s relative to the ground. The first train sounds a whistle of frequency 600 Hz . the frequency of the whistle heard by a passenger in the second train before the train meets is (the speed of sound in air is 340 m/s)

A. 600Hz

B. 585Hz

C. 645Hz

D. 666Hz

Answer: D

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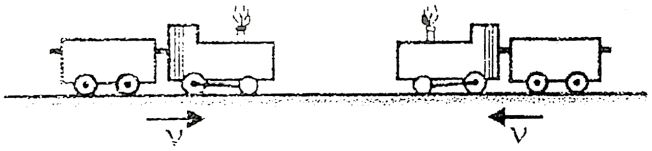
58. Two trains move towards each other with same speed. Speed of sound is $340m/s$. If the pitch of the tone of the whistle of one train when heard on the other train changes to $9/8$ times, then the speed of each train is :



A. $20m/s$

B. $2m / s$

C. $200m / s$

D. $2000m / s$

Answer: A

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Exercise 2 Concept Applicator

1. When two sound waves travel in the same direction in a medium, the displacement of a particle located at x at time t is given by

$y_1 = 0.05\cos(0.50\pi x - 10\pi t) y_2 = 0.05\cos(0.46\pi x - 92\pi t)$

where y_1, y_2 and x in meters and t in seconds. The speed of sound in the medium is:

A. $92m/s$

B. $200m/s$

C. $100m/s$

D. $332m/s$

Answer: B

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2. A progressive sound wave of frequency 500 Hz is travelling through air with a speed of 350 m/z. If a compression appears at a place at a instant, hten the

minimum time interval after which the rarefaction occurs at the same point will be

A. 200s

B. $\frac{1}{250}s$

C. $\frac{1}{500}s$

D. $\frac{1}{1000}s$

Answer: D

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3. A tuning fork arrangement (pair) produces $4beats/\sec$ with one fork of frequency $288cps$. A little wax is placed

on the unknown fork and it then produces $2 beats / \sec.$

The frequency of the unknown fork is

A. 286 cps

B. 292 cps

C. 294 cps

D. 288 cps

Answer: B

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

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

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

A. 2.0

B. 4.0

C. 0.5

D. 1.0

Answer: C

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5. A and B are two sources generating sound waves. A listener is situated at C. The frequency of the source of A

is 500Hz. A now moves towards C with a speed $4m/s$. The number of beats heard at C is 6. When A moves away from C with speed $4m/s$. The number of beats heard at Cis 18. The speed of sound is $340m/s$. The frequency of the source at B is:

A. 500Hz

B. 506Hz

C. 512Hz

D. 494Hz

Answer: C

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6. A whistle S of frequency f revolves in a circle of radius R at a constant speed v. What is the ratio of largest and smallest frequency detected by a detector D at rest at a distance 2R from the centre of circle as shown in figure?

A. $\left(\frac{c+v}{c-v}\right)$

B. $\sqrt{2}\left(\frac{c+v}{c-v}\right)$

C. $\sqrt{2}$

D. $\frac{(c+v)}{c\sqrt{2}}$

Answer: A

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7. A sonometer wire of length 114 cm is fixed at both the ends. Where should the two bridges be placed so as to divide the wire into three segments whose fundamental frequencies are in the ratio $1:3:4$?

A. At 36cm and 84 cm from one end

B. At 24cm and 72 cm from one end

C. At 48 cm and 96 cm from one end

D. At 72cm and 96 cm from one end

Answer: D

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8. While measuring the speed of sound by performing a resonance column experiment, a student gets the first resonance condition at a column length of $18cm$ during winter. Repeating the same experiment during summer, she measures the column length to be xcm for the second resonance. Then

A. $18 > x$

B. $x > 54$

C. $54 > x > 36$

D. $36 > x > 18$

Answer: B

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9. A train has just completed a U-curve in a trach which is a semi circle. The engine is at the forward end of the semi circular part of the trach while the last carriage is at the rear end of the semi circular track. The driver blows a whistle of frequency 200 Hz. Velocity of sound is $340\frac{m}{s}$. Then the apparent frequency as observed by a passenger in the middle of the train, when the speed of the train is 30 m/s, is

A. 181 Hz

B. 200 Hz

C. 188 Hz

D. 210 Hz

Answer: B

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10. A sonometer wire resonates with a given tuning fork forming a standing wave with five antinodes between the two bridges when a mass of $9kg$ is suspended from the wire. When this mass is replaced by a mass 'M' kg, the wire resonates with the same tuning fork forming three antinodes for the same positions of the bridges. Find the value of M.

A. 25 kg

B. 5 kg

C. 12.5 kg

D. $1/25kg$

Answer: A

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11. In a transverse wave the distance between a crest and neighbouring trough at the same instant is 4.0 cm and the distance between a crest and trought at the same place is 1.0cm. The next crest appears at the same place after a time interval of 0.4s. The maximum speed of the vibrating particles in the medium is:

A. $\frac{3\pi}{2} cm/s$

B. $\frac{5\pi}{2} cm / s$

C. $\frac{\pi}{2} cm / s$

D. $2\pi cm / s$

Answer: B

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

A. $32 m / s$

B. $27.5m/s$

C. $60m/s$

D. $30m/s$

Answer: D

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13. A transverse sinusoidal wave moves along a string in the positive x-direction at a speed of $10cm/s$. The wavelength of the wave is 0.5 m 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. $\frac{\sqrt{3\pi}}{50} jm/s$

B. $-\frac{\sqrt{3\pi}}{50} jm/s$

C. $\frac{\sqrt{3\pi}}{50} Im/s$

D. $-\frac{\sqrt{3\pi}}{50} im/s$

Answer: A

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14. The frequency of a stretched uniform wire under tension is in resonance with the fundamental frequency of a closed tube. If the tension in the wire is increased by

8 N , it is in resonance with the first overtone of the closed tube. The initial tension in the wire is

A. 1N

B. 4N

C. 8N

D. 16N

Answer: A

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15. A man is watching two trains, one leaving and the other coming in with equal speed of 4 m/s. If they sound their whistles, each of frequency 240 Hz, the number of

beats heard by the man (velocity of sound in air is $320\frac{m}{s}$) will be equal to

A. 6

B. 3

C. 0

D. 12

Answer: A

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16. An organ pipe, open from both end produces 5 beats per second when vibrated with a source of frequency 200 Hz . The second harmonic of the same pipes produces 10

beats per second with a source of frequency 420 Hz . The frequency of source is

A. 195 Hz

B. 205Hz

C. 190Hz

D. 210Hz

Answer: B

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17. An earthquake generates both transverse (S) and longitudinal (P) sound waves in the earth. The speed of S waves is about 4.5 km /s and that of P waves is about 8.0

km/s . A seismograph records P and S waves from an earthquake. The first P wave arrives 4.0 min before the first S wave. The epicenter of the earthquake is located at a distance about

A. 25 km

B. 250 km

C. 2500 km

D. 5000 km

Answer: C

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18. An isotrophic point source S of sound emits constant power, Two points A and B separated by a distance r are situated near the source as shown in figure. The difference of the intensity level of sound at the points A and B is about

A. 3dB

B. 2dB

C. 6dB

D. 12dB

Answer: C

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19. A column of air and a tuning fork produce 4 beats per second when sounded together. The tuning fork gives the lower note. The temperature of air is $15^{\circ}C$. When the temperature falls to $10^{\circ}C$, the two produce 3 beats per second. Find the frequency of the fork.

A. 210 Hz

B. 113 Hz

C. 112 Hz

D. 110 Hz

Answer: D

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20. The temperature of a mono-atomic gas in an uniform container of length L varies linearly from T_0 to T_L as shown in the figure. IF the molecular weight of the gas is M_0 then the time taken by a wave pulse in travelling from end A to end B is

A. $\frac{2L}{\left(\sqrt{T_L}+\sqrt{T_0}\right)}\sqrt{3\frac{M}{5}R}$

B. $\sqrt{\frac{3(T_L-R_0)}{5RM_0L}}$

C. $\frac{L}{\left(\sqrt{T_L}-\sqrt{T_0}\right)}\sqrt{3\frac{M}{5}R}$

D. $L\sqrt{\frac{M_0}{2R(T_L-T_0)}}$

Answer: A

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21. A fork of unknown frequency gives 4 beats per second when sounded with another of frequency 256. The fork is now loaded with a piece of wax and again 4 beats per second are heard. Calculate the frequency of the unknown fork.

A. 256 Hz

B. 252 Hz

C. 264 Hz

D. 260 Hz

Answer: D

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22. 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. 262

C. 252

D. 260

Answer: C

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23. A source of sound is travelling at $\frac{100}{3} ms^{-1}$ along a road, towards a point A. when the source is 3m away from A, a person standing at a point O on a road perpendicular to the track hears a sound of frequency v. The distance of O from A at the time is 4m. IF the original frequency is 640 Hz, then the value of v is

A. 620 Hz

B. 680Hz

C. 720Hz

D. 840 Hz

Answer: B

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24. The vibrations of a string of length 60 cm fixed at both the ends are represented by the equation $y = 2\sin\left(\frac{4\pi x}{15}\right)\cos(96\pi t)$ where x and y are in cm. The maximum number of loops that can be formed in it is

A. 4

B. 16

C. 5

D. 15

Answer: B

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25. String 1 is connected with string 2. The mass per unit length is string 1 is μ_1 and the mass per unit length in string 2 is 4 μ_1. The tension in the strings is T. A travelling wave is coming from the left. What fraction of the energy in the incident wave goes into string 2?

A. $1/8$

B. $4/9$

C. $2/3$

D. $8/9$

Answer: D

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26. 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. $\alpha = 25.00\pi, \beta = \pi$

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

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

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

Answer: A

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27. A thick uniform rope of length L is hanging from a rigid support . A transverse wave of wavelength λ_0 is set up at the middle of rope as shown in the figure. The wavelength of the wave as it reaches to the topmost point is

A. $2\lambda_0$

B. $\sqrt{2}\lambda_0$

C. $\frac{\lambda_0}{\sqrt{2}}$

D. λ_0

Answer: B

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28. An engine running at speed $\frac{v}{10}$ sounds a whistle of frequency 600 Hz. A passenger in a train coming from the oppsite side at speed of $\frac{v}{15}$ experiences this whistle to be of frequency f. If v is speed of sound in air and there is no wind. F is nearest to

A. 710 Hz

B. 630 Hz

C. 580 Hz

D. 510 Hz

Answer: A

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29. A tuning fork of frequency 512 Hz makes 4 beats//s with the vibrating string of a piano. The beat frequency decreases to 2 beats//s when the tension in the piano string is slightly increased.The frequency of the piano string before increasing the tension was

A. 510 Hz

B. 514 Hz

C. 516 Hz

D. 508 Hz

Answer: D

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30. A uniform tube of length 60.5 cm is held vertically with its lower end dipped in water. A sound source of frequency 500 Hz sends sound a waves into the tube. When the length of tube above water is 16cm and again when it is 50cm, the tube resonates with the source of sound . Two lowest frequencies to which tube will resonate when it is taken out of water are,

A. 281562

B. 281843

C. 276552

D. 272544

Answer: D

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