WAVES

1. Doppler effect is applicable for
   a) Moving bodies
   b) One is moving and other are stationary
   c) For relative motion
   d) None of these
2. 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 temperature is 38°C in which the speed of sound is $336m/s$. The zero of the meter scale coincides with the top end of the Resonance column tube. When the first resonance occurs, the reading of the water level in the column is
   a) 14.0 cm
   b) 15.2 cm
   c) 16.4 cm
   d) 17.6 cm
3. In a resonance pipe the first and second resonance are obtained with at depth 22.7 cm and 70.2 cm respectively. What will be the correction?
   a) 1.05 cm
   b) 115.5 cm
   c) 92.5 cm
   d) 113.5 cm
4. When a sound wave goes from one medium to another, the quantity that remains unchanged is
   a) Frequency
   b) Amplitude
   c) Wavelength
   d) Speed
5. Source of sound and the observer are mutually at rest. If speed of sound is changed, then the frequency of sound heard by the observer will appear to be
   a) Increased
   b) Decreased
   c) Unchanged
   d) Decreasing exponentially
6. Which one of the following statements is true
   a) Both light and sound waves in air are longitudinal
   b) Both light and sound waves can travel in vacuum
   c) Both light and sound waves in air are transverse
   d) The sound waves in air are longitudinal while the light waves are transverse
7. An open tube is in resonance with string. If tube is dipped in water, so that 75% of length of tube is inside water, then ratio of the frequency (v_0) of tube to string is
   a) v_0
   b) $2v_0$
   c) $\frac{2}{3}v_0$
   d) $\frac{3}{2}v_0$
8. A stretched string of length $\boldsymbol{l}$ fixes at both ends can sustain stationary waves of wavelength λ, given by
   a) $\lambda = 2\boldsymbol{l}n$
   b) $\lambda = \frac{l^2}{n}$
   c) $\lambda = \frac{l^2}{2n}$
   d) $\lambda = \frac{n^2}{2l}$
9. A tuning fork of frequency 250 Hz produces a beat frequency of 10 Hz when sounded with a sonometer vibrating at its fundamental frequency. When the tuning fork is filed, the beat frequency decreases. If the length of the sonometer wire is 0.5 m, the speed of the transverse wave is
   a) 260 ms^{-1}
   b) 250 ms^{-1}
   c) 240 ms^{-1}
   d) 500 ms^{-1}
10. In a resonance tube, using a tuning fork of frequency 325 Hz, two successive resonance length are observed as 25.4 cm and 77.4 cm respectively. The velocity of sound in air is
    a) 338ms^{-1}
    b) 328ms^{-1}
    c) 330ms^{-1}
    d) 320ms^{-1}
11. A pulse or a wave train travels along a stretched string and reaches the fixed end of the string. It will be reflected back with
    a) The same phase as the incident pulse but with velocity reversed
    b) A phase change of 180°with no reversal of velocity
    c) The same phase as the incident pulse with no reversal of velocity

d) A phase change of 180° with velocity reversed

12. An open organ pipe is closed suddenly with the result that the second overtone of the closed pipe is found to be higher in frequency by 100 than the first overtone of the original pipe. Then the fundamental frequency of the open pipe is

a) $200 s^{-1}$ b) $100 s^{-1}$ c) $300\ s^{-1}$ d) $250\ s^{-1}$

13. With what velocity an observer should move relative to a stationary source so that he hears a sound of double the frequency of source

a) Velocity of sound towards the source

b) Velocity of sound away from the source

c) Half the velocity of sound towards the source

d) Double the velocity of sound towards the source

14. 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

15. A stone is hung in air from a wire which is stretched over a sonometer. The bridges of the sonometer are $L\ cm$ apart when the wire is in unison with a tuning fork of frequency N. When the stone is completely immersed in water, the length between the bridges is $l\ cm$ for re-establishing unison, the specific gravity of the material of the stone is

a) $\frac{L^2}{L^2+l^2}$ b) $\frac{L^2-l^2}{L^2}$ c) $\frac{L^2}{L^2-l^2}$ d) $\frac{L^2+l^2}{L^2}$

16. The phase difference between two points separated by 0.8 m in a wave of frequency 120 Hz is0.5π. The wave velocity is

a) $144 ms^{-1}$ b) $384 ms^{-1}$ c) $256 ms^{-1}$ d) $720 ms^{-1}$

17. Consider the following

I. Waves created on the surface of a water pond by a vibrating sources

II. Wave created by an oscillating electric field in air

III. Sound waves travelling under water

Which of these can be polarized

a) I and II b) II only c) II and III d) I, II and III

18. The temperature at which the speed of sound in air becomes double of its value at 27°C, is

a) -123°C b) 927°C c) 327°C d) 54°C

19. An observer A sees an asteroid with a radioactive element moving by at a speed =0.3c and measure the radioactivity decay time to beT_A. Another observer B is moving with the asteroid and measures its decay time as T_B. Then $T_A$and T_B are released as

a) $T_B < T_A$ b) $T_A = T_B$

c) $T_B > T_A$ d) Either (A) or (c) depending on whether the asteroid is approaching or moving away from A

20. In a resonance tube, using a tuning fork of frequency 325 Hz, two successive resonance lengths are observed as 25.4 cm and 77.4 cm respectively. The velocity of sound in air is

a) 338 ms^{-1} b) 328 ms^{-1} c) 330 ms^{-1} d) 320 ms^{-1}

21. A simple harmonic progressive wave is represented by the equation

$Y = 8\sin 2\pi(0.1x - 2t)$ where x and y are in cm and t is in seconds. At any instant, the phase difference between two particles separated by 2.0 cm in the x-direction is

a) 18^0 b) 54^0 c) 36^0 d) 72^0

22. The wavelength of two notes in air are $\frac{36}{195}$ m and $\frac{36}{193}$m. each note produces 10 beats per second separately with a third note of fixed frequency. The velocity of sound in air in m/s is

a) 330 b) 340 c) 350 d) 360

23. The intensity of sound wave while passing through an elastic medium falls down by 10% as it covers one metre distance through the medium. If the initial intensity of the sound wave was 100 *decibels*, its value after it has passed through 3 *metre* thickness of the medium will be
a) 70 *decibel* b) 72.9 *decibel* c) 81 *decibel* d) 60 *decibel*
24. Tuning fork F_1 has a frequency of 256 Hz and it is observed to produce 6 beats/second with another tuning fork F_2. When F_2 is loaded with wax, it still produces 6 beats/second with F_1. The frequency of F_2 before loading was
a) 253 Hz b) 262 Hz c) 250 Hz d) 259 Hz
25. Two closed organ pipes, when sounded simultaneously gave 4 beats per sec. If longer pipe has a length of $1m$. Then length of shorter pipe will be, $(v = 300\ m/s)$
a) 185.5 cm b) 94.9 cm c) 90 cm d) 80 cm
26. When two tuning forks (fork 1 and fork 2) are sounded simultaneously, 4 beats/s are heard. Now, some tape is attached on the prong of the fork2. When the tuning fork are sounded again, 6 beats/s are heard. If the frequency of fork 1 is 200Hz, then what was the original frequency of fork 2?
a) 200 Hz b) 202 Hz c) 196 Hz d) 204 Hz
27. Four wires of identical length, diameters and of the same material are stretched on a sonometre wire. If the ratio of their tensions is 1 : 4 : 9 : 16 then the ratio of their fundamental frequencies are
a) 16 : 9 : 4 : 1 b) 4 : 3 : 2 : 1 c) 1 : 4 : 2 : 16 d) 1 : 2 : 3 : 4
28. A wavelength 0.60 cm is produced in air and it travels at a speed of 300 ms^{-1}. It will be an
a) Audible wave b) Infrasonic wave c) Ultrasonic wave d) None of the above
29. A wire under tension vibrates with a fundamental frequency of 600 Hz. If the length of the wire is doubled, the radius is halved and the wire is made to vibrate under one-ninth the tension. Then the fundamental frequency will become
a) 400 Hz b) 600 Hz c) 300 Hz d) 200 Hz
30. 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 340 ms^{-1}, then the frequency of the turning fork is
a) 128 Hz b) 256 Hz c) 384 Hz d) 500 Hz
31. In Melde's experiment, three loops are formed by putting a weight of 8 g in a massless pan. The weight required to form two loop is
a) 18 g b) 8 g c) 36 g d) 24 g
32. At a certain instant a stationary transverse wave is found to have maximum kinetic energy. The appearance of string at that instant is
a) Sinusoidal shape with amplitude $\frac{a}{3}$
b) Sinusoidal shape with amplitude $\frac{a}{2}$
c) Sinusoidal shape with amplitude a
d) Straight line
33. Transverse waves can propagate in
a) Liquids b) Solids c) Gases d) None of these
34. The loudness and pitch of a sound depends on
a) Intensity and velocity
b) Frequency and velocity
c) Intensity and frequency
d) Frequency and number of harmonics
35. The wave described by $y = 0.25 \sin(10\pi x - 2\pi f)$ where x and y are in meters and t in seconds, is a wave travelling along the
a) Positive x direction with frequency 1 Hz and wavelength $\lambda = 0.2m$
b) Negative x direction with amplitude with amplitude 0.25 m and wavelength $\lambda = 0.2m$
c) Negative x direction with frequency 1 Hz
d) Positive x direction with frequency π Hz. and wavelength $\lambda = 0.2m$
36. At a moment is a progressive wave, the phase of a particle executing SHM is
$\frac{\pi}{3}$
Then the phase of the particle 15 cm ahead and at the

$\frac{T}{2}$
Will be, if the wavelength 60 cm

a) $\frac{\pi}{2}$ b) $\frac{2\pi}{3}$ c) Zero d) $\frac{5\pi}{6}$

37. Two waves are represented by $y_1 = a \sin\left(\omega t + \frac{\pi}{6}\right)$ and $y_2 = a \cos \omega t$. What will be their resultant amplitude

a) a b) $\sqrt{2}a$ c) $\sqrt{3}a$ d) $2a$

38. Two waves
$y_1 = A_1 \sin(\omega t - \beta_1), y_2 = A_2 \sin(\omega t - \beta_2)$
Superimpose to form a resultant wave whose amplitude is

a) $\sqrt{A_1^2 + A_2^2 + 2A_1A_2 \cos(\beta_1 - \beta_2)}$ b) $\sqrt{A_1^2 + A_2^2 + 2A_1A_2 \sin(\beta_1 - \beta_2)}$
c) $A_1 + A_2$ d) $|A_1 + A_2|$

39. In an open organ pipe... wave is present.

a) Transverse standing b) Longitudinal standing
c) Longitudinal moving d) Transverse moving

40. A set of 24 tuning fork are so arranged that each gives 6 beats/s with the previous one. If the frequency of the last tuning fork is double that of the first, frequency of the second tuning fork is

a) 138 Hz b) 132 Hz c) 144 Hz d) 272 Hz

41. An echo repeats two syllables. If the velocity of sound is 330ms^{-1}, then the distance of the reflecting surface is

a) 66.0 m b) 33.0 m c) 99.0 m d) 16.5 m

42. A pipe closed at one end and open at the other end, resonate with sound waves of frequency 135 Hz and also 165 Hz, But not with any wave of frequency intermediate between these two. Then the frequency of the fundamental note is

a) 30 Hz b) 15 Hz c) 60 Hz d) 7.5 Hz

43. If two tuning forks 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

44. A man standing on a cliff claps his hand hears its echo after 1 sec. If sound is reflected from another mountain and velocity of sound in air is 340 m/sec. Then the distance between the man and reflection point is

a) 680 m b) 340 m c) 85 m d) 170 m

45. In meld's experiment in the transverse mode, the frequency of the tuning fork and the frequency of the waves in the string are in the ratio

a) 2:1 b) 4:1 c) 1:1 d) 1:2

46. A rocket is receding away from earth with velocity = 0.2c.The rocket emit signal or frequency 4×10^7 Hz. The apparent frequency of the signal produced by the rocket observed by the observer on earth will be

a) 3×10^6Hz b) 4×10^6Hz c) 2.4×10^7Hz d) 5×10^7Hz

47. If the equation of transverse wave is $y = 5 \sin 2\pi \left[\frac{t}{0.04} - \frac{x}{40}\right]$, where distance is in cm and time in second, then the wavelength of the wave is

a) 60 cm b) 40 cm c) 35 cm d) 25 cm

48. If L_1 and L_2 are the lengths of the first and second resonating air columns in a resonance tube, then the wavelength of the note produced is

a) $2(L_2 + L_1)$ b) $2(L_2 - L_1)$ c) $2\left(L_2 - \frac{L_1}{2}\right)$ d) $2\left(L_2 + \frac{L_1}{2}\right)$

49. A train moves towards a stationary observer with speed 34ms^{-1}. The train sounds a whistle and its frequency registered by the observer is f_1. If the train's speed is reduced to 17ms^{-1}, the frequency registered is f_2. If the peed of sound is 340ms^{-1}, then the ratio f_1/f_2 is

a) $\frac{18}{19}$ b) $\frac{1}{2}$ c) 2 d) $\frac{19}{18}$

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

a) $\frac{v}{2l}$ b) $\frac{v}{4l}$ c) $\frac{v\Delta l}{2l^2}$ d) $\frac{v\Delta l}{l}$

51. Law of superposition is applicable to only

a) Light waves b) Sound waves c) Transverse waves d) All kinds of waves

52. In a stationary wave represented by y=2a cos kx sin ωt the intensity at a certain point is maximum when

a) cos kx is maximum b) cos kx is minimum c) Sin ωt is maximum d) sin ωt is minimum

53. 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 (in Hz) is

a) 98 b) 100 c) 103 d) 105

54. A motor car blowing a horn of frequency $124 vib/sec$ moves with a velocity 72 km/hr towards a tall wall. The frequency of the reflected sound heard by the driver will be (velocity of sound in air is 330 m/s)

a) 109 vib/sec b) 132 vib/sec c) 140 vib/sec d) 248 vib/sec

55. Two waves are approaching each other with a velocity of 16 m/s and frequency n. The distance between two consecutive nodes is

a) $\frac{16}{n}$ b) $\frac{8}{n}$ c) $\frac{n}{16}$ d) $\frac{n}{8}$

56. The apparent wavelength of the light from a star moving away from the earth is 0.2% more than its actual wavelength. Then the velocity of the star is

a) $6 \times 10^7\text{ms}^{-1}$ b) $6 \times 10^6\text{ms}^{-1}$ c) $6 \times 10^5\text{ms}^{-1}$ d) $6 \times 10^4\text{ms}^{-1}$

57. A stone is hung in air from a wire, which is stretched over a sonometer. The bridges of the sonometer are 40cm 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 material of 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) $256 \times \frac{40}{22}$

58. A resonance pipe is open at both ends and 30 cm of its length is in resonance with an external frequency 1.1 kHz. If the speed of sound is 330 m/s, which harmonic is in resonance?

a) First b) Second c) Third d) Fourth

59. The wave equation is $y = 030 \sin(314t - 1.57x)$ where t, x and y are in second, meter and centimeter respectively. The speed of the wave is

a) 100 m/s b) 200 m/s c) 300 m/s d) 400 m/s

60. In brass, the velocity of longitudinal wave is 100 times the velocity of the transverse wave. If $Y = 1 \times 10^{11}$ NM^{-2}, then stress in the wire is

a) 1×10^{13} Nm^{-2} b) 1×10^9 Nm^{-2} c) 1×10^{11} Nm^{-2} d) 1×10^7 Nm^{-2}

61. A 1000 Hz sound wave in air strikes the surface of a lake and penetrates into water. If speed of sound in water is 1500ms^{-1},the frequency and wavelength of waves in water are

a) 1500 Hz, 1m b) 1000 Hz, 1.5m c) 1000 Hz, 1m d) 1500 Hz, 1.5m

62. Under identical conditions of pressure and density, the speed of sound is highest in a

a) Monoatomic gas b) Diatomic gas c) Triatomic gas d) Polyatomic gas

63. If the length of a closed organ pipe is 1m and velocity of sound is 330 m/s, then the frequency for the second note is

a) $4 \times \frac{330}{4} Hz$ b) $3 \times \frac{330}{4} Hz$ c) $2 \times \frac{330}{4} Hz$ d) $2 \times \frac{4}{330} Hz$

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

a) $25\ m$ b) $20\ m$ c) $15\ m$ d) $10\ m$

65. The ratio of the velocity of sound in hydrogen (γ=7/5) to that helium $\left(\gamma = \frac{5}{3}\right)$ at the same temperature is

a) $\sqrt{\frac{5}{42}}$ b) $\sqrt{\frac{5}{21}}$ c) $\frac{\sqrt{42}}{5}$ d) $\sqrt{\frac{21}{5}}$

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

a) 40 Hz b) 35 Hz c) 30 Hz d) 25 Hz

67. The equation of a simple harmonic progressive wave is given by y=A sin ($100\pi t$-3x). find the distance between 2 particles having a phase difference of $\frac{\pi}{3}$.

a) $\frac{\pi}{9}$m b) $\frac{\pi}{18}$m c) $\frac{\pi}{6}$m d) $\frac{\pi}{3}$m

68. The equation $y = A\cos^2(2\pi\ nt - 2\pi\frac{x}{\lambda})$ represents a wave with

a) Amplitude $A/2$, frequency $2n$ and wavelength $\lambda/2$

b) Amplitude $A/2$, frequency $2n$ and wavelength λ

c) Amplitude A, frequency $2n$ and wavelength 2λ

d) Amplitude A, frequency n and wavelength λ

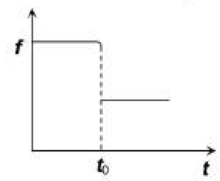
69. A transverse wave is represented by the equation

$y = y_0 \sin\frac{2\pi}{\lambda}(vt - x)$

For what value of λ, the maximum particle velocity equal to two times the wave velocity

a) $\lambda = 2\pi y_0$ b) $\lambda = \pi y_0/3$ c) $\lambda = \pi y_0/2$ d) $\lambda = \pi y_0$

70. A man is standing on a railway platform listening to the whistle of an engine that passes the man at constant speed without stopping. If the engine passes the man at time t_0. How does the frequency f of the whistle as heard by the man changes with time

a)


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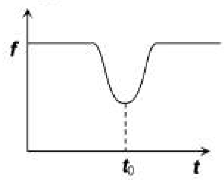
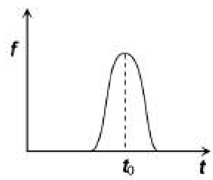


c)


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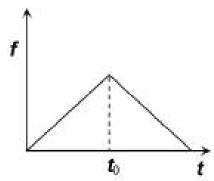
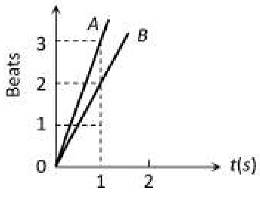


71. Two tuning forks P and Q are vibrated together. The number of beats produced are represented by the straight line OA in the following graph. After loading Q with wax again these are vibrated together and the beats produced are represented by the line OB. If the frequency of P is $341Hz$, the frequency of Q will be



a) $341\ Hz$ b) $338\ Hz$ c) $344\ Hz$ d) None of the above

72. If man were standing unsymmetrical between parallel cliffs, claps his hands and starts hearing a series of echoes at a intervals of 1 s. If speed of sound in air is $340ms^{-1}$, the distance between two cliffs would be

a) 340m b) 510m c) 170m d) 680m

73. A transverse wave is represented by $y = A\sin(wt - kx)$. For what value of the wavelength is the wave velocity equal to the maximum particle velocity

a) A b) $\pi A/2$ c) πA d) $2\pi A$

74. A cylindrical tube, open at both ends, has a fundamental frequency f_0 in air. The tube Is dipped vertically into water such that half of its length is inside water. The fundamental frequency of the air column now is
a) $3f_0/4$ b) f_0 c) $f_0/2$ d) $2f_0$

75. 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) $\frac{n}{3\sqrt{3}}$

76. Two closed pipes produce 10 beats per second when emitting their fundamental nodes. If their lengths are in ratio of 25 : 26. Then their fundamental frequency in Hz, are
a) 270, 280 b) 260, 270 c) 260, 250 d) 260, 280

77. Two waves are represented by $y_1 = 4\sin 404\pi t$ and $y_2 = 3\sin 400\pi t$. Then
a) Beat frequency is 4 Hz and the ratio of maximum to minimum intensity is 49 : 1
b) Beat frequency is 2 Hz and the ratio of maximum to minimum intensity is 49 : 1
c) Beat frequency is 2 Hz and the ratio of maximum to minimum intensity is 1 : 49
d) Beat frequency is 4 Hz and the ratio of maximum to minimum intensity is 1 : 49

78. The equation of a progressive wave can be given by y=15 sin (660 πt-0.02 πx) cm. the frequency of the wave is
a) 330 Hz b) 342 Hz c) 365 Hz d) 660 Hz

79. A source and an observer approach each other with same velocity 50 m/s. If the apparent frequency is $435 sec^{-1}$, then the real frequency is
a) $320\ s^{-1}$ b) $360 sec^{-1}$ c) $390 sec^{-1}$ d) $420 sec^{-1}$

80. A closed organ pipe of length L and open organ pipe contain gases of densities $p_1$and p_2 respectively. The compressibility of gases are equal in both the pipes. Both the pipes are vibrating in their first overtone with same frequency. The length of the open organ pipe is
a) $\frac{L}{3}$ b) $\frac{4L}{3}$ c) $\frac{4L}{3}\sqrt{\frac{p_1}{p_2}}$ d) $\frac{4l}{3}\sqrt{\frac{p_2}{p_2}}$

81. Two increase the frequency from 100 Hz to 400 Hz the tension in the string has to be changed by
a) 4 times b) 16 times c) 20 times d) None of these

82. The instantaneous displacement of a simple harmonic oscillator is given by= $a\cos\left[\omega t + \frac{\pi}{4}\right]$. Its speed will be maximum at the time
a) $\frac{2\pi}{\omega}$ b) $\frac{\omega}{2\pi}$ c) $\frac{\omega}{\pi}$ d) $\frac{\pi}{4\omega}$

83. In stationary waves
a) Energy is uniformly distributed
b) Energy is minimum at nodes and maximum at antinodes
c) Energy is maximum at nodes and minimum at antinodes
d) Alternating maximum and minimum energy producing at nodes and antinodes

84. What is minimum length of a tube, open at both ends, that resonates with tuning fork of frequency 350 Hz ? [velocity of sound in air = 350 m/s]
a) 50 cm b) 100 cm c) 75 cm d) 25 cm

85. A wave is reflected from a rigid support. The change in phase on reflection will be
a) $\pi/4$ b) $\pi/2$ c) π d) 2π

86. Two string A and B are slightly out tune and produces beats of frequency 5Hz. Increasing the tension in B reduces the beat frequency to 3Hz. If the frequency of string A is 450 Hz, calculate the frequency of string B.
a) 460 Hz b) 455 Hz c) 445 Hz d) 440 Hz

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

a) 0.05 s b) 0.10 s c) 0.20 s d) 0.40 s

88. A man is standing on the platform and one train is approaching and another train is going away with speed of4 ms^{-1}, frequency of sound produced by train is 240 Hz. What will be the number of beats heard by him per second?

a) 12 b) Zero c) 6 d) 3

89. Which of the following functions represent a wave?

a) $(x - vt)^2$ b) $ln(x + vt)$ c) $e^{-(x+vt)2}$ d) $\frac{1}{x + vt}$

90. On which principle does sonometer works?

a) Hooke's law b) Elasticity c) Resonance d) Newton's law

91. A boy is walking away from a wall towards an observer at a speed of 1 $metre/sec$ and blows a whistle whose frequency is 680 Hz. The number of beats heard by the observer per second is (Velocity of sound in air = 340 $metres/sec$)

a) Zero b) 2 c) 8 d) 4

92. A stretched string of length $l$fixed at both ends can sustain stationary waves of wavelength λ given by

a) $\lambda = 2ln$ b) $\lambda = 2l/n$ c) $\lambda = l^2/2n$ d) $\lambda = n^2/2l$

93. A cylindrical tube containing air is open at both ends. If the shortest length of the tube for resonance with a given fork is 2 cm, the next shortest length for resonance with the same fork will be

a) 60 cm b) 40 cm c) 90 cm d) 80 cm

94. An observer moves towards a stationary source of sound of frequency n. The apparent frequency heard by him is $2n$. If the velocity of sound in air is 332 m/sec, then the velocity of the observer is

a) 166 m/sec b) 664 m/sec c) 332 m/sec d) 1328 m/sec

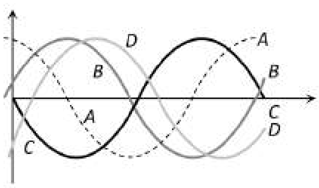
95. The equation of sound wave is

$y = 0.0015 \sin(62.4x + 316t)$

The wavelength of this wave is

a) 0.2 unit b) 0.1 unit c) 0.3 unit d) Cannot be calculated

96. Which of the following curves represents correctly the oscillation given by $y = y_0 \sin(\omega t - \phi)$, where $0 < \phi < 90$



a) A b) B c) C d) D

97. If you set up the ninth harmonic on a string fixed at both ends, its frequency compared to the seventh harmonic

a) Higher b) Lower c) Equal d) None of the above

98. The transverse displacement of a string fixed at both ends is given by $y = 0.06 \sin\left(\frac{2\pi x}{3}\right) \cos(120\pi t)$ y and x are in metres and t in seconds. The wavelength and frequency of the two superposing waves are

a) $2m, 120\ Hz$ b) $\frac{2}{3}m, 60Hz$ c) $\frac{3}{2}m, 120Hz$ d) $3m, 60Hz$

99. When two sinusoidal waves moving at right angles to each other superimpose, they produce

a) Beats b) Interface c) Stationary waves d) Lissajous figure

100. Two tuning fork, A and B produce notes of frequencies 258 Hz and 262 Hz. An unknown note sounded with a produces certain beats. When the same note is sounded with B, the beat frequency gets doubled, the unknown frequency is

a) 256 Hz b) 254 Hz c) 300 Hz d) 280 Hz

101. Two waves of frequencies 20 Hz and 30 Hz. Travels out from a common point. The phase difference between them after 0.6 sec is

a) Aero b) $\frac{\pi}{2}$ c) π d) $\frac{3\pi}{2}$

102. A vibrating string of certain length I under a tension T resonates with a mode corresponding to the second overtone (third harmonic) of an air column of length 75 cm inside a tube closed at one end. The string also generate 4 beats/s when excited along with a tuning fork of frequency n. now when the tension of the string also generate 4 beats/s 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 to be $340ms^{-1}$, the frequency n of the tuning fork in Hz is

a) 344 b) 336 c) 117.3 d) 109.3

103. Find the frequency of minimum distance between compression & rarefaction of a wire. If the length of the wire is 1 m & velocity of sound in air is 360 m/s

a) 90 sec^{-1} b) 180 sec^{-1} c) 120 sec^{-1} d) 360 sec^{-1}

104. The stationary wave $y = 2a \sin kx \cos \omega t$ in a closed organ pipe is the result of the superposition of $y = a \sin(\omega t - kx)$ and

a) $y = -a \cos(\omega t + kx)$ b) $y = -a \sin(\omega t + kx)$ c) $y = a \sin(\omega t + kx)$ d) $y = a \cos(\omega t + kx)$

105. A train moves towards a stationary observer with speed34 ms^{-1}. The train sounds a whistle and its frequency registered by the observer isv_1. If the train's speed is reduced to17 ms^{-1}, the frequency registered isv_2. If the speed of sound is 340 ms^{-1}, then the ratio $v_1/v_2$is

a) 2 b) 1/2 c) 18/19 d) 19/18

106. The displacement x(in meter) of a particle performing simple harmonic, motion is related to time t(in second) as $x = 0.05\cos\left(4\pi t + \frac{\pi}{4}\right)$.The frequency of the motion will be

a) 05 Hz b) 1.0 Hz c) 1.5 Hz d) 2.0 Hz

107. A person feels 2.5% difference of frequency of a motor-car horn. If the motor-car is moving to the person and the velocity of sound is 320 m/sec, then the velocity of car will be

a) 8 m/s (approx.) b) 800 m/s c) 7 m/s d) 6m/s (approx.)

108. When a open pipe I producing third harmonic, number of nodes is

a) 1 b) 2 c) 3 d) 4

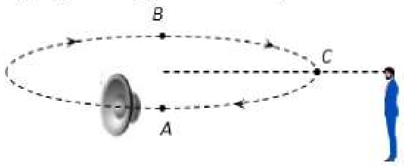
109. Wave equations of two particles are given by

$y_1 = a \sin(\omega t - kx), y_2 = a \sin(kx + \omega t)$, then

a) They are moving in opposite direction b) Phase between them is 90°

c) Phase between them is 180° d) Phase between them is 0°

110. A small source of sound moves on a circle as shown in the figure and an observer is standing on O. Let n_1, n_2 and n_3 be the frequencies heard when the source is at A, B and C respectively. Then



a) $n_1 > n_2 > n_3$ b) $n_2 > n_3 > n_1$ c) $n_1 = n_2 > n_3$ d) $n_2 > n_1 > n_3$

111. The equation of transverse wave is given by

$y = 100 \sin \pi(0.04z - 2t)$

Where y and z are in cm and t is in seconds. The frequency of the wave in Hz is

a) 1 b) 2 c) 25 d) 100

112. Doppler effect is independent of

a) Distance between source and listener
b) Velocity of source
c) Velocity of listener
d) None of the above

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

a) His watch is set 3 sec. faster
b) His watch is set 3 sec. slower
c) His watch is set correctly
d) None of the above

114. A wave of wavelength $2m$ is reflected from a surface. If a node is formed at $3m$ from the surface, then at what distance from the surface another node will be formed

a) $1m$
b) $2m$
c) $3m$
d) $4m$

115. The frequency of the sinusoidal wave
$y = 0.40 \cos[2000t + 0.80x]$ would be

a) $1000\,\pi\,Hz$
b) $2000\,Hz$
c) $20\,Hz$
d) $\frac{1000}{\pi} Hz$

116. Three waves of equal frequency having amplitudes 10 mm, 4 mm, and 7 mm arrive at a given point with successive phase difference of $\frac{\pi}{2}$, the amplitude of the resulting wave in mm is given by

a) 7
b) 6
c) 5
d) 4

117. If separation between screen and source is increased by 2% what would be the effect on the intensity

a) Increases by 4%
b) Increases by 2%
c) Decreases by 2%
d) Decreases by 4%

118. The source producing sound and an observer both are moving along the direction of propagation of sound waves. If the respective velocities of sound, source and an observer are v, v_s and v_o, then the apparent frequency heard by the observer will be (n = frequency of sound)

a) $\frac{n(v + v_o)}{v - v_o}$
b) $\frac{n(v - v_o)}{v - v_s}$
c) $\frac{n(v - v_o)}{v + v_s}$
d) $\frac{n(v + v_o)}{v + v_s}$

119. A tuning fork of frequency 392 Hz, resonates with 50 cm length of a string under tension (T). If length of the string is decreased by 2%, keeping the tension constant, the number of beats heard when the string and the tuning fork made to vibrate simultaneously is

a) 4
b) 6
c) 8
d) 12

120. Ultrasonic, Infrasonic and audible waves travel through a medium with speeds V_u, V_i and V_a respectively, then

a) V_u, V_i and V_a are nearly equal
b) $V_u \geq V_a \geq V_i$
c) $V_u \leq V_a \leq V_i$
d) $V_a \leq V_u$ and $V_u \approx V_i$

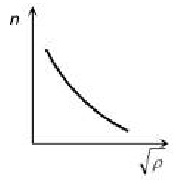
121. The relation between frequency 'n' wavelength 'λ' and velocity of propagation 'v' of wave is

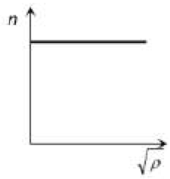
a) $n = v\lambda$
b) $n = \lambda/v$
c) $n = v/\lambda$
d) $n = 1/v$

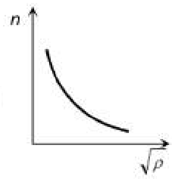
122. The phenomenon of sound propagation in air is

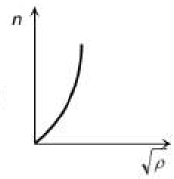
a) Isothermal process
b) Isobaric process
c) Adiabatic process
d) None of these

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

a) 

b) 

c) 

d) 

124. An open tube is in resonance with string (frequency of vibration of tube is n_0). If tube is dipped in water so that 75% of length of tube is inside water, then the ratio of the frequency of tube to string now will be

a) 1
b) 2
c) $\frac{2}{3}$
d) $\frac{3}{2}$

125. Beats are the result of

a) Diffraction
b) Destructive interference
c) Constructive and destructive interference
d) Superposition of two waves of nearly equal frequency

126. When a wave travels in a medium, the particle displacement is given by the equation $y = a\sin 2\pi(bt - cx)$ where a, b and c are constants. The maximum particle velocity will be twice the wave velocity if

a) $c = \frac{1}{\pi a}$ b) $c = \pi a$ c) b=ac d) $b = \frac{1}{ac}$

127. Which of the following equations represents a wave?

a) $y = A\sin\omega t$ b) $y = A\cos kx$
c) $y = A\sin(at - dx + c)$ d) $y = A(\omega t - kx)$

128. Two identical wires have the same fundamental frequency of 400 Hz when kept under the same tension. If the tension in one wire is increased by 2% the number of beats produced will be

a) 4 b) 2 c) 8 d) 1

129. The intensity ratio of two waves is 1:9. The ratio of their amplitudes, is

a) 3:1 b) 1:3 c) 1:9 d) 9:1

130. A tuning fork of known frequency 256 Hz makes 5 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) (256+2)Hz b) (256-2)Hz c) (256-5)Hz d) (256+5)Hz

131. Three sources of equal intensities with frequencies 400, 401 and 402 vib/s are sounded together. The number of beats/s is

a) Zero b) 1 c) 2 d) 4

132. A man x can hear only upto 10 kHz and another man y upto 20 kHz. A note of frequency 500 Hz is produced before them from a stretched string. Then

a) Both will hear sounds of same pitch but different quality
b) Both will hear sounds of different pitch but same quality
c) Both will hear sounds of different pitch and different quality
d) Both will hear sounds of same pitch and same quality

133. A wave of frequency 500 Hz has velocity 360 m/sec. The distance between two nearest points 60^0 out of phase, is

a) 0.6 cm b) 12 cm c) 60 cm d) 120 cm

134. A string in a musical instrument is 50 cm long and its fundamental frequency is 800 Hz. If a frequency of 1000 Hz is to be produced, the required length of string is

a) 62.5 cm b) 50 cm c) 40 cm d) 37.5 cm

135. An observer is moving away from source of sound of frequency 100 Hz. This speed is 33 m/s. If speed of sound is 330 m/s, then the observed frequency is

a) 90 Hz b) 100 Hz c) 91 Hz d) 110 Hz

136. When a guitar string is sounded with a 440 Hz tuning fork, a beat frequency of 5 Hz is heard. If the experiment is repeated with a tuning fork of 437 Hz, the beat frequency is 8 Hz. The string frequency (Hz) is

a) 445 b) 435 c) 429 d) 448

137. The first overtone of a stretched wire of given length is 320 Hz. The first harmonic is

a) 320 Hz b) 160 Hz c) 480 Hz d) 640 Hz

138. The echo of a gun shot is heard 8 sec. after the gun is fired. How far from him is the surface that reflects the sound (velocity of sound in air = 350 m/s)

a) 1400 m b) 2800 m c) 700 m d) 350 m

139. A tuning fork produced 4 beats/s when sounded with a sonometer wire of vibrating length is 50 cm. what is the frequency of the tuning fork?

a) 196 Hz b) 284 Hz c) 375 Hz d) 460 Hz

140. The wavelength of light observed on the earth from a moving star is found to decrease by 0.05%. the star is

a) Coming closer with a velocity of $1.5 \times 10^4 \text{ms}^{-1}$

b) Moving away with a velocity of $1.5 \times 10^4 \mathrm{ms}^{-1}$

c) Coming closer with a velocity of $1.5 \times 10^5 \mathrm{ms}^{-1}$

d) Moving away with a velocity of 1.5×10^{-1}

141. A note has a frequency 128 Hz. The frequency of a note two octaves higher than it is

a) 256 Hz   b) 64 Hz   c) 32 Hz   d) 512 Hz

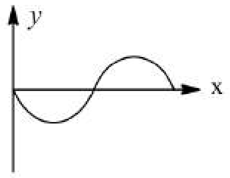
142. A wave travelling in stretched string is described by the equation $y = A\sin(kx - \omega t)$.The maximum particle velocity is

a) $A\omega$ b) ω/k c) $d\omega/dk$ d) x/t

143. A source of sound of frequency 90 vibrations/sec is approaching a stationary observer with a speed equal to $1/10$ the speed of sound. What will be the frequency heard by the observer

a) 80 vibrations/sec b) 90 vibrations/sec c) 100 vibrations/sec d) 120 vibrations/sec

144. In a sine wave, position of different particles at time $t = 0$ is shown in figure. The equation for this wave travelling along positive $x - axis$ can be



a) $y = A\sin(\omega t - kx)$ b) $y = A\cos(kx - \omega t)$ c) $y = A\cos(\omega t - kx)$ d) $y = A\sin(kx - \omega t)$

145. The ratio of speed of sound in nitrogen and helium gas at 300 K is

a) $\sqrt{\frac{2}{7}}$ b) $\frac{\sqrt{1}}{7}$ c) $\frac{\sqrt{3}}{5}$ d) $\frac{\sqrt{6}}{5}$

146. The equation of a simple harmonic wave is given by$y = 5\sin\frac{\pi}{2}(100t - x)$, where x and y are in metre and time is in second. The period of the wave in second will be

a) 0.04   b) 0.01   c) 1   d) 5

147. 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

148. An air column in a pipe, which is closed at one end, will be in resonance with a vibrating body of frequency 166 Hz, if the length of the air column is

a) 2.00 m b) 1.50 m c) 1.00 m d) 0.50 m

149. The equation of a transverse wave is given by

$y = 10\sin\pi(0.01x - 2t)$

Where x and y are in cm and t is in second. Its frequency is

a) 10 $\sec^{-1}$ b) 2 $\sec^{-1}$ c) 1 $\sec^{-1}$ d) 0.01 $\sec^{-1}$

150. Beats are produced by frequencies $v_1 and\ v_2 (v_1 >_2)$. The duration of time between two successive maximum or minima is equal to

a) $\frac{1}{v_1 + v_2}$ b) $\frac{2}{v_1 - v_2}$ c) $\frac{2}{v_1 + v_2}$ d) $\frac{1}{v_1 - v_2}$

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

a) V cannot be equal to v b) $V - v$,if $A = \lambda/2\pi$

c) $V - v$,if $A = 2\pi\lambda$ d) $V - v$,if $\lambda = A/\pi$

152. Out of the given 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 sources S_1, S_2, S_3 and S_4 respectively, interference phenomena would be observed in space under appropriate conditions when

a) Sources S_1 emits wave (1) and S_2 emits wave (2)
b) Source S_3 emits wave (3) and S_4 emits wave (4)
c) Source S_2 emits wave (2) and S_4 emits wave (4)
d) S_4 emits waves (4) and S_3 emits waves (3)

153. Two uniform wires are vibrating simultaneously in their fundamental notes. The tension , lengths diameters and the densities of the two wires are in the ratio 8:1, 36:35, 4:1,and 1:2 respectively. If the note of the higher pitch has a frequency 360 Hz, the number of beats produced per second is

a) 5 b) 15 c) 10 d) 20

154. A sound source is moving towards stationary listener with $\frac{1}{10}$th of the speed of sound. The ratio of apparent to real frequency is

a) $\left(\frac{9}{10}\right)^2$ b) 10/9 c) 11/10 d) $\left(\frac{11}{10}\right)^2$

155. A source of sound gives 5 beats s^{-1} when sounded with another source of frequency 100 Hz. The second harmonic of the source together with a source of frequency 205 Hz gives 5 beats s^{-1}. What is the frequency of the source?

a) 105 Hz b) 205 Hz c) 95 Hz d) 100 Hz

156. A sound source of frequency 170 Hz is placed near a wall. A man walking from a source towards the wall finds that there is a periodic rise and fall of sound intensity. If the speed of sound in air is 340 m/s. then distance (in $metres$) separating the two adjacent position of minimum intensity is

a) 1/2 b) 1 c) 3/2 d) 2

157. The displacement y(in cm) produced by a simple harmonic waves is $y = \frac{10}{\pi}\sin\left(2000\pi t - \frac{\pi x}{17}\right)$. The periodic time and maximum velocity of the particles in the medium will respectively be

a) $10^{-3} sec$ and 330 m/sec
b) $10^{-4} sec$ and 20 m/sec
c) $10^{-3} sec$ and 200 m/sec
d) $10^{-2} sec$ and 2000 m/sec

158. In a plane progressive wave given by $y = 25\cos(2\pi t - \pi x)$, the amplitude and frequency are respectively

a) 25,100 b) 25,1 c) 25,2 d) 50π, 2

159. The function $\sin^2(\omega t)$ represents

a) A periodic, but not simple harmonic motion with a period $2\pi/\omega$
b) A periodic, but not simple harmonic motion with a period π/ω
c) A simple harmonic motion with a period $2\pi/\omega$
d) A simple harmonic motion with a period π/ω

160. The phase difference between the two particles situated on both the sides of a node is

a) 0° b) 90° c) 180° d) 360°

161. The displacement y of a particle is given by$y = 4\cos^{-4}\left(\frac{t}{2}\right)\sin(1000t)$. This expression may be considered to be a result of the superposition of how many simple harmonic motions?

a) 2 b) 3 c) 4 d) 5

162. A car is moving with a speed of 72 kmh^{-1}towards a hill. Car blows horn at a distance of 1800 m from the hill. If echo is heard after 10s, the speed of sound ($in\ ms^{-1}$)is

a) 300 b) 320 c) 340 d) 360

163. A tuning fork of frequency 480 Hz produces 10 beats s^{-1} when sounded with a vibrating sonometer string. What must have been the frequency of string if slight increase in tension produces fewer beats s^{-1} than before?

a) 490 Hz b) 470 Hz c) 460 Hz d) 480 Hz

164. 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

a) n b) $\frac{n}{\sqrt{2}}$ c) $\frac{n}{2}$ d) $\frac{n}{2\sqrt{2}}$

165. An open organ pipe of length / vibrates in its fundamental mode. The pressure vibration is maximum

a) At the two ends
b) At the distance 1/2 inside the ends
c) At the distance 1/4 inside the ends
d) At the distance 1/8 inside the ends

166. Compressional wave pulse are sent to the bottom of sea from a ship and the echo is heard after 2s. if bulk modulus of elasticity of water is $2 \times 10^9 Nm^{-2}$and mean temperature is 4°C, the depth of the sea will be

a) 1014 m b) 1414 m c) 2828 m d) None of these

167. Out of following incorrect statement is

a) In meld's experiment p^2T remain constant. (p=loop, T=Tension)
b) In Kundt's experiment distance between two heaps of powder is $\lambda/2$
c) Quink's tube experiment is related with beats.
d) Echo phenomena are related with reflection of sound.

168. Water waves are

a) Longitudinal
b) Transverse
c) Both longitudinal and transverse
d) Neither longitudinal nor transverse

169. A source and listener are both moving towards each other with speed $\frac{v}{10}$, where v is the speed of sound. If the frequency of the note emitted by the source is f, the frequency heard by the listener would be nearly

a) 1.11 f b) 1.22 f c) f d) 1.27 f

170. A source of sound is approaching an observer with speed of 30 ms^{-1} and the observer is approaching the source with a speed 60 ms^{-1}. Then the fractional change in the frequency of sound in air ($330ms^{-1}$) is

a) $\frac{1}{3}$ b) $\frac{3}{10}$ c) $\frac{2}{5}$ d) $\frac{2}{3}$

171. Standing waves are produced by the superposition of two waves $y_1 = 0.05\sin(3\pi t + 2x)$ $y_2 = 0.05\sin(3\pi t + 2x)$ Where x and y are in meters and t is in second. What is the amplitude of the particle at $x = 0.5$ m? Given $cos57.3^0 = 0.54$.

a) 2.7 cm b) 5.4 cm c) 8.1 cm d) 10.8 cm

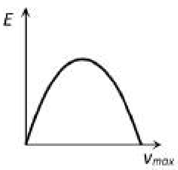
172. Two periodic waves of intensities I_1 and I_2 pass through a region at the same time in the same direction. The sum of the maximum and minimum intensities is

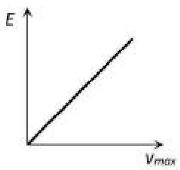
a) $I_1 + I_2$ b) $\left(\sqrt{I_1} + \sqrt{I_2}\right)$ c) $\left(\sqrt{I_1} - \sqrt{I_2}\right)^2$ d) $2(I_1 + I_2)$

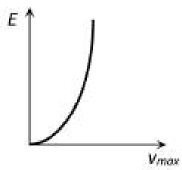
173. A source and an observer are moving towards each other with a speed equal to $\frac{v}{2}$ where v is the speed of sound. The source is emitting sound of frequency n. The frequency heard by the observer will be

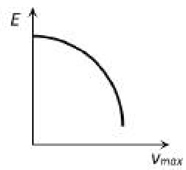
a) Zero b) n c) $\frac{n}{3}$ d) $3n$

174. A sound source emits sound waves in a uniform medium. If energy density is E and maximum speed of the particles of the medium is $v_{\max}$. The plot between E and $v_{\max}$ is best represented by

a) 

b) 

c) 

d) 

175. 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) 205 Hz c) 190 Hz d) 210 Hz

176. 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 air column is now

a) $f/2$ b) f c) $3f/4$ d) $2f$

177. A wave is represented by the equation : $y = a\sin(0.01x - 2t)$ where a and x are in cm. velocity of propagation of wave is

a) 10 cm/s b) 50 cm/s c) 100 cm/s d) 200 cm/s

178. A 5.5 m length of string has a mass of 0.035 kg. If the tension in the string is 77 N, the speed of a wave on the string is
a) $110 ms^{-1}$ b) $165 m^{-1}$ c) $77 ms^{-1}$ d) $102 ms^{-1}$

179. 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) 1 N b) 4 N c) 8 N d) 16 N

180. A sound wave of frequency n travels horizontally to the right. It is reflected from a large vertical plane surface moving to the left with speed v. The speed of the sound in the medium is c. Then
a) The frequency of the reflected wave is $n\left[\frac{c+v}{c-v}\right]$
b) The wavelength of the reflected wave is $\left[\frac{c}{n}\right]\left[\frac{c+v}{c-v}\right]$
c) The number of waves strike the surface per second is $n\left[\frac{c+v}{c}\right]$
d) The number of beats heard by a stationary listener to the left to the reflecting surface is $\left[\frac{nv}{c-v}\right]$

181. The relation between phase difference ($\Delta\phi$) and path difference (Δx) is
a) $\Delta\phi = \frac{2\pi}{\lambda}\Delta x$ b) $\Delta\phi = 2\pi\lambda\Delta x$ c) $\Delta\phi = \frac{2\pi\lambda}{\Delta x}$ d) $\Delta\phi = \frac{2\Delta x}{\lambda}$

182. Two waves of wavelength 99 cm and 100 cm both travelling with velocity $396 ms^{-1}$ are made to interface. The number of beats produced by them per second are
a) 1 b) 2 c) 4 d) 8

183. Fundamental frequency of pipe is 100 Hz and other two frequencies are 300 Hz and 500 Hz, then
a) Pipe is open at both the ends b) Pipe is closed at both the ends
c) One end is open and another end is closed d) None of the above

184. $y = 3\sin\pi\left(\frac{1}{2}-\frac{x}{4}\right)$ Represents an equation of a progressive wave, where t is in second an x is in metre. The distance travelled by the wave in 5 s is
a) 8m b) 10m c) 5m d) 32m

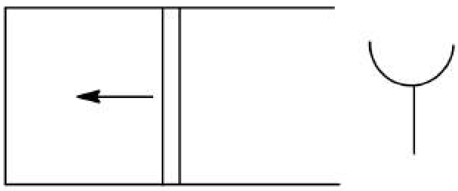
185. A transverse progressive wave on a stretched string has a velocity of $10 ms^{-1}$ and a frequency of 100 Hz. The phase difference between two particles of the string which are 2.5 cm apart will be
a) $\pi/8$ b) $\pi/4$ c) $3\pi/8$ d) $\pi/2$

186. 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 is 1 $meter$
a) $2a$ b) $a\sqrt{3}$ c) $a\sqrt{2}$ d) a

187. A police car horn emits a sound at a frequency 240 Hz the frequency 240 Hz when the car is at rest. If the speed of sound is $330 ms^{-1}$, the frequency heard by an observer who is approaching the car at speed of 11 ms^{-1}, is
a) 248 Hz b) 244 Hz c) 240 Hz d) 230 Hz

188. A stretched wire of length 110 cm is divided into three segments whose frequencies are in ratio 1 : 2 : 3. Their lengths must be
a) 20 cm ; 30 cm ; 60 cm b) 60 cm ; 30 cm ; 20 cm c) 60 cm ; 20 cm ; 30 cm d) 30 cm ; 60 cm ; 20 cm

189. A piston fitted in cylindrical pipe is pulled as shown in the figure. A tuning fork is sounded at open end and loudest sound is heard at open length 13cm, 41 cm and 69 cm, the frequency of tuning fork if velocity of sound is $350 ms^{-1}$ is



a) 1250 Hz b) 625 Hz c) 417 Hz d) 715 Hz

190. A man sets his watch by whistle that is 2 km away. How much will his watch be in error. (speed of sound in air 330 m/sec)
a) 3 seconds fast b) 3 seconds slow c) 6 seconds fast d) 6 seconds slow

191. A source emits a sound of frequency of 400 Hz, but the listener hearts its 390 Hz. Then
a) The listener is moving towards the source
b) The source is moving towards the listener
c) The listener is moving away from the source
d) The listener has a defective ear

192. The equation of a transverse wave travelling along positive x-axis with amplitude 0.2m, velocity 360 ms^{-1} and wavelength 60 m be written as
a) $y = 0.2 \sin \pi \left[6t + \frac{x}{60}\right]$
b) $y = 0.2 \sin \pi \left[6t - \frac{x}{60}\right]$
c) $y = 0.2 \sin 2\pi \left[6t - \frac{x}{60}\right]$
d) $y = 0.2 \sin 2\pi \left[6t + \frac{x}{60}\right]$

193. A closed organ pipe has fundamental frequency 100 Hz. What frequency will be produced, if its other end is also opened?
a) 200,400,600,800…
b) 200,300,400,500…
c) 100,300,500,700…
d) 100,200,300,400…

194. The wavelengths of two waves are 50 and 51 cm respectively. If the temperature of the room is 20°C, then what will be the number of beats produced per second by these waves, when the speed of sound at 0°C is 332 m/sec
a) 14 b) 10 c) 24 d) None of these

195. A whistle revolves in a circle with an angular speed of 20 rad/sec using a string of length 50 cm. If the frequency of sound from the whistle is 385 Hz, then what is the minimum frequency heard by an observer, which is far away from the centre in the same plane? ($v = 340\ m/s$)
a) 333 Hz b) 374 Hz c) 385 Hz d) 394 Hz

196. The equation of a simple harmonic wave is given by y=6sin 2 π (2t-0.1x), where x and y are in mm and t is in second. The phase difference between two particles 2 mm apart at any instant is
a) 18° b) 36° c) 54° d) 72°

197. The musical interval between two tones of frequencies 320 Hz and 240 Hz is
a) 80 b) $\left(\frac{4}{3}\right)$ c) 560 d) 320×240

198. With the propagation of a longitudinal wave through a material medium, the quantities transmitted in the propagation direction are
a) Energy, momentum and mass
b) Energy
c) Energy and mass
d) Energy and linear momentum

199. Ultrasonic waves are those waves
a) To which man can hear
b) Man can't hear
c) Are of high velocity
d) Of high amplitude

200. The frequency of a sound wave is n and its velocity is v. If the frequency is increased to $4n$, the velocity of the wave will be
a) v b) $2v$ c) $4v$ d) $v/4$

201. Two sound waves (expressed in CGS units) given by $y_1 = 0.3 \sin \frac{2\pi}{\lambda}(vt - x)$ and $y_2 = 0.4 \sin \frac{2\pi}{\lambda}(vt - x + \theta)$ interfere. The resultant amplitude at a place where phase difference is $\pi/2$ will be
a) 0.7 cm b) 0.1 cm c) 0.5 cm d) $\frac{1}{10}\sqrt{7}\ cm$

202. Sound waves of wavelength greater than that of audible sound are called

a) Seismic waves b) Sonic waves c) Ultrasonic waves d) Infrasonic waves

203. A bus is moving with a velocity of $5ms^{-1}$ towards a huge wall. The driver sounds a horn of frequency 165 Hz. If the speed of sound in air is 335 ms^{-1}, the number of beats heard per second by a passenger inside the buss will be

a) 3 b) 4 c) 5 d) 6

204. 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 cm/s b) 30 cm/s c) 60 π cm/s d) 30π cm/s

205. Standing waves are produced in a 10 m long stretched string. If the string vibrates in 5 segments and the wave velocity is 20 m/s, the frequency is

a) 2 Hz b) 4 Hz c) 5 Hz d) 10 Hz

206. The fundamental frequencies of an open and a closed tube, each of same length L with v as the speed of sound in air, respectively are

a) $\frac{v}{2L}$ and $\frac{v}{L}$ b) $\frac{v}{L}$ and $\frac{v}{2L}$ c) $\frac{v}{2L}$ and $\frac{v}{4L}$ d) $\frac{v}{4L}$ and $\frac{v}{2L}$

207. Energy is not carried by which of the following waves

a) Stationary b) Progressive c) Transverse d) Electromagnetic

208. When the temperature of an ideal gas is increased by 600 K, the velocity of sound in the gas becomes $\sqrt{3}$ times the initial velocity in it. The initial temperature of the gas is

a) -73°C b) 27°C c) 127°C d) 327°C

209. Find the fundamental frequency of a closed pipe, if the length of the air column is 42 m. (speed of sound in air $= 332\ m/sec$)

a) 2 Hz b) 4 Hz c) 7 Hz d) 9 Hz

210. When 2 tuning forks (fork 1 and fork 2) are sounded simultaneously, 4 beats s^{-1} are heard. Now, some tape is attached on the prong of fork 2. When the tuning forks are sounded again, 6 beats s^{-1} are heard if the frequency of fork 1 is 200 Hz, then what was the original frequency of fork 2?

a) 196 Hz b) 200 Hz c) 202 Hz d) 204 Hz

211. Sound of the wavelength λ passes through a Quincke's tube, which is adjust to give a maximum intensityI_0. Through what distance should the sliding tube be moved to give intensity$I_0/2$?

a) $\lambda/2$ b) $\lambda/3$ c) $\lambda/4$ d) $\lambda/8$

212. Two waves represented by y=a sin (ωt - kx) and y= a cos (ωt-kx) are superposed. The resultant wave will have an amplitude

a) a b) $\sqrt{2}a$ c) 2a d) Zero

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

a) 1.05 cm b) 115.5 cm c) 92.5 cm d) 113.5 cm

214. A transverse wave is described by the equation $y = y_0 \sin 2\pi \left[ft - \frac{x}{\lambda}\right]$.The maximum particle velocity is equal to four times the wave velocity if

a) $\lambda = \pi y_0/4$ b) $\lambda = 2\pi y_0$ c) $\lambda = \pi/y_0$ d) $\lambda = \pi y_0/2$

215. A tuning fork produces waves in a medium. If the temperature of the medium changes, then which of the following will change

a) Amplitude b) Frequency c) Wavelength d) Time-period

216. From a point source, if amplitude of waves at a distance r is A, its amplitude at a distance $2r$ will be

a) A b) $2A$ c) $A/2$ d) $A/4$

217. If T is the reverberation time of an auditorium of volume V then

a) $T \propto \frac{1}{V}$ b) $T \propto \frac{1}{V^2}$ c) $T \propto V^2$ d) $T \propto V$

218. In an experiment, it was found that string vibrates in n loops when a mass M is placed o the pan. What mass should be placed on the pa to make it vibrate in $2n$ loops, with same frequency. Neglect the mass of the pan.

a) $M/4$ b) $4M$ c) $2M$ d) $M/2$

219. A source of sound emits waves with frequency f Hz and speed V m/sec. Two observers move away from this source in opposite directions each with a speed 0.2 V relative to the source. The ratio of frequencies heard by the two observers will be

a) 3 : 2 b) 2 : 3 c) 1 : 1 d) 4 : 10

220. Speed of sound at constant temperature depends on

a) Pressure b) Density of gas c) Above both d) None of the above

221. Which of the following has high pitch in their sound

a) Lion b) Mosquito c) Man d) Woman

222. When temperature increases, the frequency of a tuning fork

a) Increases b) Decreases

c) Remains same d) Increases or decreases depending on the material

223. The type of waves that can be propagated through solid is

a) Transverse b) Longitudinal c) Both (a) and (b) d) None of these

224. The equation of stationary wave along a stretched string is given by $y = 5\sin\frac{\pi x}{3}\cos 40\pi t$ where x and y are in centimetre and t in second. The separation between two adjacent nodes is :

a) 6 cm b) 4 cm c) 3 cm d) 1.5 cm

225. A pipe open at both ends produces a note of frequency f_1. When the pipe is kept with $\frac{3}{4}th$ of its length in water, it produced a note of frequency f_2. The ratio $\frac{f_1}{f_2}$ is

a) $\frac{3}{4}$ b) $\frac{4}{3}$ c) $\frac{1}{2}$ d) 2

226. The source of sound generating a frequency of 3kHz reaches an observer with a speed of 0.5 times, the velocity of sound in air. The frequency heard by the observer is

a) 1 kHz b) 2 kHz c) 4 kHz d) 6 kHz

227. A long cylindrical tube carries a highly polished piston and has a side opening. A tuning fork of frequency n is sounded at the sound heard by the listener charges if the piston is moves in or out. At a particular position of the piston is moved through a distance of 9 cm, the intensity of sound becomes minimum, if the speed of sound is 360 m/s, the value of n is

a) 129.6 Hz b) 500 Hz c) 1000 Hz d) 2000 Hz

228. n_1 Is the frequency of the pipe closed at one end and n_2 is the frequency of the pipe open at both ends. If both are joined end to end, find the fundamental frequency of closed pipe so formed

a) $\frac{n_1 n_2}{n_2 + 2n_1}$ b) $\frac{n_1 n_2}{2n_2 + n_1}$ c) $\frac{n_1 + 2n_2}{n_2 n_1}$ d) $\frac{2n_1 + n_2}{n_2 n_1}$

229. Two sounding bodies producing progressive waves are given by $y_1 = 4\sin 400\pi t$ and $y_2 = 3\sin 404\pi t$ one situated very near to the ear 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 4/3 between maxima and minima

d) 4 beats/s with intensity ratio 4/3 between maxima and minima

230. In two similar wires of tension 16 N and T, 3 beats are heard, then T=

a) 49 N b) 25 N c) 64 N d) None of these

231. An observer is moving towards the stationary source of sound, then

a) Apparent frequency will be less than the real frequency

b) Apparent frequency will be greater than the real frequency
c) Apparent frequency will be equal to real frequency
d) Only the quality of sound will charge

232. The disc of a siren containing 60 holes rotates at a constant speed of 360 rpm. The emitted sound is in unison with a tuning fork of frequency
a) 10 Hz
b) 360 Hz
c) 216 Hz
d) 60 Hz

233. Consider the three waves, z_1, z_2 and z_3 as
$z_1 = A\sin(kx - \omega t)$
$z_2 = A\sin(kx + \omega t)$
$z_3 = A\sin(kx - \omega t)$
Which of the following represent a standing wave?
a) $z_1 + z_2$
b) $z_2 + z_3$
c) $z_3 + z_1$
d) $z_1 + z_2 + z_3$

234. The apparent frequency of the whistle of an engine changes in the ratio 9:8 as the engine passes a stationary observer. If the velocity of the sound is $340ms^{-1}$, then the velocity of the engine is
a) 40 $\mathrm{ms^{-1}}$
b) 20 $\mathrm{ms^{-1}}$
c) 340 $\mathrm{ms^{-1}}$
d) 180 $\mathrm{ms^{-1}}$

235. Equation of a progressive wave is given by
$y = 4\sin\left\{\pi\left(\frac{t}{5} - \frac{x}{9}\right) + \frac{\pi}{6}\right\}$
Then which of the following is correct
a) $v = 5m/sec$
b) $\lambda = 18m$
c) $a = 0.04\ m$
d) $n = 50\ Hz$

236. An underwater sonar source operating at a frequency of 60 kHz directs its beam towards the surface. If the velocity of sound in air is 330 m/s, the wavelength and frequency of waves in air are:
a) 5.5 mm, 60 kHz
b) 330 m, 60 kHz
c) 5.5 mm, 20 kHz
d) 5.5 mm, 80 kHz

237. Frequency range of the audible sounds is
a) $0\ Hz - 30\ Hz$
b) $20\ Hz - 20\ kHz$
c) $20\ kHz - 20{,}000\ kHz$
d) $20\ kHz - 20\ MHz$

238. If at same temperature and pressure, the densities for two diatomic gases are respectively d_1 and d_2, then the ratio of velocities of sound in these gases will be
a) $\sqrt{\frac{d_2}{d_1}}$
b) $\sqrt{\frac{d_1}{d_2}}$
c) $d_1 d_2$
d) $\sqrt{d_1 d_2}$

239. A man fires a bullet standing between two cliffs. First echo is heard after 3 seconds and second echo is heard after 5 seconds. If the velocity of sound is 330 m/s, then the distance between the cliffs is
a) 1650 m
b) 1320 m
c) 990 m
d) 660 m

240. Unlike a laboratory sonometer, a stringed instrument is seldom plucked in the middle. Supposing a sitar string is plucked at about $\frac{1}{4}th$ of its length from the end. The most prominent harmonic would be
a) Eighth
b) Fourth
c) Third
d) Second

241. Two wires made up of same material are of equal lengths but their radii are in the ratio 1:2. On stretching each of these two string by the same tension, the ratio between the fundamental frequencies is
a) 1:2
b) 2:1
c) 1:4
d) 4:1

242. The frequency and velocity of sound wave are 600 Hz and 360 m/s respectively. Phase difference between two particles of medium are 60°, the minimum distance between these two particles will be
a) 10 cm
b) 15 cm
c) 20 cm
d) 50 cm

243. The beats are produced by two sound sources of same amplitude and of nearly equal frequencies. The maximum intensity of beats will be … that of one source
a) Same
b) Double
c) Four times
d) Eight times

244. Which of the following do not require medium for transmission
a) Cathode ray
b) Electromagnetic wave
c) Sound wave
d) None of the above

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

a) 1 b) 2 c) 3 d) 4

246. When beats are produced by two progressive waves of the same amplitude and of nearly the same frequency, the ratio of maximum loudness to the loudness of one of the waves will be n. Where n is

a) 3 b) 1 c) 4 d) 2

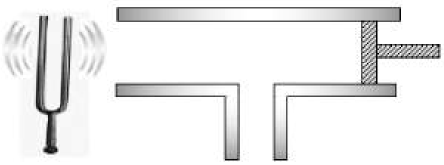
247. The displacement y of a particle in a medium can be expressed as $y = 10^{-6}\sin\left(100t + 20x + \frac{\pi}{4}\right)$m, where $t$is in second and x in metre. The speed of the wave is

a) 2000 ms^{-1} b) 5 ms^{-1} c) 20 ms^{-1} d) 5π ms^{-1}

248. A whistle giving out 450 Hz approaches a stationary observer at a speed of 33ms^{-1}. The frequency heard by the observer in Hz is [velocity of sound in air=333ms^{-1}]

a) 409 b) 429 c) 517 d) 500

249. Vibrating tuning fork of frequency n is placed near the open end of a long cylindrical tube. The tube has a side opening and is 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. then n is



a) 500 Hz b) 1000 Hz c) 2000 Hz d) 4000 Hz

250. The length of a sonometer wire tuned to a frequency of 250 Hz is 0.60 $metre$. The frequency of tuning fork with which the vibrating wire will be in tune when the length is made 0.40 $metre$ is

a) 250 Hz b) 375 Hz c) 256 Hz d) 384 Hz

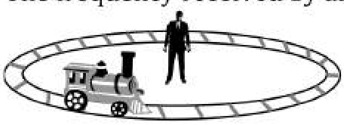
251. Transverse waves of same frequency are generated in two steel wires A and B. The diameter of A is twice of B and the tension in A is half that in B. The ratio of velocities of wave in A and B is

a) $1 : 3\sqrt{2}$ b) $1 : 2\sqrt{2}$ c) $1 : 2$ d) $\sqrt{2} : 1$

252. The phase difference between two points separated by 0.8 m in a wave of frequency is 120 Hz is $\pi/2$. The velocity of wave is

a) 720 m/s b) 384 m/s c) 250 m/s d) 1 m/s

253. An engine is moving on a circular track with a constant speed. It is blowing a whistle of frequency 500 Hz. The frequency received by an observer standing stationary at the centre of the track is



a) 500 Hz b) More than 500 Hz

c) Less than 500 Hz d) More or less than 500 Hz depending on the actual speed of the engine

254. A man sitting in a moving train hears the whistle of the engine. The frequency of the whistle is 600 Hz

a) The apparent frequency as heard by him is smaller than 600 Hz

b) The apparent frequency is larger than 600 Hz

c) The frequency as heard by him is 600 Hz

d) None of the above

255. In a stationary wave, all particles are

a) At rest at the same time twice in every period of oscillation

b) At rest at the same time only once in every period of oscillation

c) Never at rest at the same time

d) Never at rest at all

256. In a resonance column cist and second resonance are obtained at depths 22.7 cm and 70.2 cm. The third resonance will be obtained at a depth

a) 117.7 cm b) 92.9 cm c) 115.5 cm d) 113.5 cm

257. Tube A has both ends open while tube B has one end closed. Otherwise they are identical. Their fundamental frequencies are in the ratio

a) 4:1 b) 2:1 c) 1:4 d) 1:4

258. Equation of a progressive wave is given by

$y = 0.2 \cos \pi \left(0.04t + .02x - \frac{\pi}{6}\right)$

The distance is expressed in cm and time in second. What will be the minimum distance between two particles having the phase difference of $\pi/2$

a) 4 cm b) 8 cm c) 25 cm d) 12.5 cm

259. If the frequency of human heart beat is 1.25 Hz, the number of heart beats in 1 minute is

a) 80 b) 65 c) 90 d) 75

260. A tuning fork A produces 4 $beats/sec$ with another tuning fork B of frequency 320 Hz. On filing the fork A, 4 $beats/sec$ are again heard. The frequency of fork A, after filing is

a) 324 Hz b) 320 Hz c) 316 Hz d) 314 Hz

261. Two strings with mass per unit length of 9 gcm^{-1} and 25 gcm^{-1} are joined together in series. The reflection coefficient for the vibration waves are

a) $\frac{9}{25}$ b) $\frac{3}{5}$ c) $\frac{1}{16}$ d) $\frac{9}{16}$

262. Light from two coherent sources of the same amplitude A and wavelength λ illuminates the screen. The intensity of the central maximum is I_0. If the sources were incoherent, the intensity at the same point will be

a) $4I_0$ b) $2I_0$ c) I_0 d) $I_0/2$

263. A table is revolving on its axis at 5 revolutions per second. A sound source of frequency 1000 Hz is fixed on the table at 70 cm from the axis. The minimum frequency heard by a listener standing at a distance from the table will be (speed of sound 352ms^{-1})

a) 1000 Hz b) 1066 Hz c) 941 Hz d) 352 Hz

264. A train is approaching with velocity $25ms^{-1}$towards a pedestrian standing on the track, frequency of horn of train is 1 kHz. Frequency heard by the pedestrian is ($v = 30ms^{-1}$)

a) 1077 Hz b) 1167 Hz c) 985 Hz d) 954 Hz

265. An engine moving towards a wall with a velocity 50 ms^{-1} emits a note of 1.2 kHz. Speed of sound in air is 350 ms^{-1}. The frequency of the note after reflection from the wall as heard by the driver of the engine is

a) 2. 4kHz b) 0.24 kHz c) 1.6 kHz d) 1.2 kHz

266. A tuning fork of frequency 340 Hz is vibrated just above the tube of 120 cm height. Water is poured slowly in the tube, what is the minimum height of water necessary for the resonance?

a) 45 cm b) 30 cm c) 35 cm d) 25 cm

267. When a tuning fork produces sound waves in air, which one of the following is same in the material of tuning fork as well as in air

a) Wavelength b) Frequency c) Velocity d) Amplitude

268. The frequency of a sonometer wire is 100 Hz. When the weights producing the tension are completely immersed in water, the frequency becomes 80 Hz and on immersing the weights in a certain liquid, the frequency becomes 60 Hz. The specific gravity of the liquid is

a) 1.42 b) 1.77 c) 1.21 d) 1.82

269. A stone is dropped into a lake from a tower 500 $metre$ high. The sound of the splash will be heard by the man approximately after

a) 11.5 seconds b) 21 seconds c) 10 seconds d) 14 seconds

270. A racing car moving towards a cliff sounds its horn. The drivers observe that the sound reflected from the cliff has a pitch one octave higher than the actual sound of the horn. If v=the velocity of sound, the velocity of the car is

a) $v/\sqrt{2}$ b) $v/2$ c) $v/3$ d) $v/4$

271. A hollow pipe of length 0.8m is closed a one end. At its open end a 0.5 m 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 320 ms^{-1}, the mass of the string is

a) 5 g b) 10 g c) 20 g d) 40 g

272. The waves in which the particles of the medium vibrate in a direction perpendicular to the direction of wave motion is known as

a) Transverse wave b) Longitudinal waves c) Propagated waves d) None of these

273. Two points on a travelling wave having frequency 500 Hz and velocity 300 ms^{-1} are 60° out of phase, then the minimum distance between two points is

a) 0.2 b) 0.1 c) 0.5 d) 0.4

274. Beats are produced by two travelling waves each of loudness I and nearly equal frequencies n_1 and n_2. The beat frequency will be .... and maximum loudness hard will be

a) $(n_1 - n_2)$,$2I$ b) $(n_1 - n_2)$,$4I$ c) $(n_1 - n_2)$,$3I$ d) $(n_1 - n_2), I$

275. The equation $y = a \sin 2\pi \left(\frac{t}{T} - \frac{x}{\lambda}\right)$, where the symbols carry the usual meaning and a, T and λ ate positive, represents a wave of

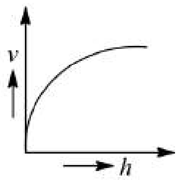
a) Amplitude 2a b) Period T/λ

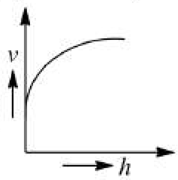
c) Speed xλ d) Speed (λ/T)

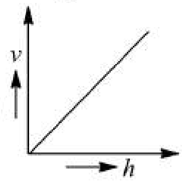
276. The length of an elastic string is a metre when the longitudinal tension is 4 N and b metre when the longitudinal tension is 5 N. the length of the string in metre when longitudinal tension is 9N, is

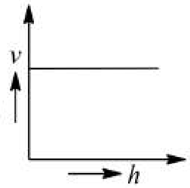
a) a-b b) 5b-4a c) $2\text{b} - \frac{1}{4}\text{a}$ d) 4a-3b

277. A uniform rope having mass m hangs vertically from a rigid support. A transverse wave pulse is produced at the lower end. The speed (v) of wave pulse varies with height h from the lower end as shown in figure.

a) 

b) 

c) 

d) 

278. Two wires made up of the same material are of equal length but their radii are in the ratio of 1:2. On stretching each of these two strings by the same tension, the ratio between the fundamental frequencies is

a) 1:4 b) 4:1 c) 2:1 d) 1:2

279. The speed of sound in a gas of density ρ at a pressure P is proportional to

a) $\left(\frac{p}{\rho}\right)^2$ b) $\left(\frac{P}{\rho}\right)^{3/2}$ c) $\sqrt{\frac{\rho}{P}}$ d) $\sqrt{\frac{P}{\rho}}$

280. Two waves of wavelength 1.00m and 1.01m produces 10 beats in 3s. What is the velocity of the wave?

a) 150 ms^{-1} b) 115.2 ms^{-1} c) 336.6 ms^{-1} d) 200 ms^{-1}

281. How many times more intense is a 60 dB sound than a dB sound?

a) 1000 b) 2 c) 100 d) 4

282. If the phase difference between two sound waves of wavelength λ is 60°, the corresponding path difference is

a) $\frac{\lambda}{6}$ b) $\frac{\lambda}{2}$ c) 2λ d) $\frac{\lambda}{4}$

283. The equation of progressive wave is $y = 0.2 \sin 2\pi \left[\frac{t}{0.01} - \frac{x}{0.3}\right]$, where x and y are in metre and t is in second. The velocity of propagation of the wave is

a) 30 ms^{-1} b) 40 ms^{-1} c) 300 ms^{-1} d) 400 ms^{-1}

284. The velocity of sound hydrogen is 1224ms^{-1}. Its velocity in mixture of hydrogen and oxygen containing 4 parts by volume of hydrogen and 1 part oxygen is

a) 1224ms^{-1} b) 612ms^{-1} c) 2448ms^{-1} d) 306ms^{-1}

285. Two adjacent piano keys are struck simultaneously. The notes emitted by them have frequencies n_1 and n_2. The number of beats heard per second is

a) $\frac{1}{2}(n_1 - n_2)$ b) $\frac{1}{2}(n_1 + n_2)$ c) $n_1 \sim n_2$ d) $2(n_1 - n_2)$

286. Two sound waves with wavelengths 5.0 m and 5.5 m respectively, each propagate in a gas with velocity 330 m/s We expect the following number of beats per second

a) 1 b) 6 c) 12 d) 0

287. A progressive wave y=a sin [(kx-ωt)] is reflected by a rigid wall at x=0. Then the reflected wave can be represented by

a) y=a sin (kx+ωt) b) y=a cos (kx+ωt) c) y=-a sin (kx-ωt) d) y=-a sin (kx+ωt)

288. Mechanical waves on the surface of a liquid are

a) Transverse b) Longitudinal
c) Torsional d) Both transverse and longitudinal

289. It is possible to hear beats from the two vibrating sources of frequency

a) 100 Hz and 150 Hz b) 20 Hz and 25 Hz
c) 400 Hz and 500 Hz d) 1000 Hz and 1500 Hz

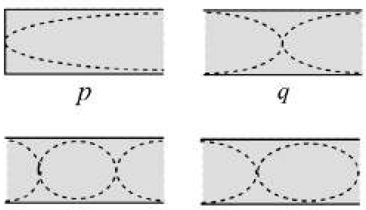
290. If v is the speed of sound in air then the shortest length of the closed pipe which resonates to a frequency v, is

a) $\frac{v}{2v}$ b) $\frac{v}{4v}$ c) $\frac{4v}{v}$ d) $\frac{2v}{v}$

291. Radar waves are sent towards a moving aeroplane and the reflected wave are received. When the aeroplane is moving towards the radar, the wavelength of the wave

a) Decreases
b) Increases
c) Remains the same
d) Sometimes increases or decreases

292. The vibrating of four air columns are represented in the figure. The ratio of frequencies $n_p : n_q : n_r : n_s$ is



a) 12:6:3:5 b) 1:2:4:3 c) 4:2:3:1 d) 6:2:3:4

293. If wave $y = a\cos(\omega t + kx)$ is moving along x-axis, the shape of pulse at t=0 and t=2s

a) Are different b) Are same c) May not be same d) None of these

294. The equation of a wave is given by y=10 sin $\left(\frac{2\pi}{45}t + a\right)$. If the displacement is 5 cm at t=0, then the total phase at t=7.5s is

a) π b) $\frac{\pi}{6}$ c) $\frac{\pi}{2}$ d) $\frac{\pi}{3}$

295. A micro-wave and an ultrasonic sound wave have the same wavelength. Their frequencies are in the ratio (approximately)

a) $10^6 : 1$ b) $10^4 : 1$ c) $10^2 : 1$ d) $10 : 1$

296. A stationary source is emitted sound at a fixed frequency f_0, which is reflected by two cars approaching the source. The difference between the is frequencies of sound reflected from the car is 1.2% of f_0. What is the difference in the speed 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 $330 ms^{-1}$

a) 7.128 km/h b) 7 km/h c) 8.128 km/h d) 9 km/h

297. A travelling wave represented by $y = a\sin(\omega t - kx)$ is superimposed on another wave represented by $y = a\sin(\omega t + kx)$. The resultant is

a) A standing wave having nodes at $x = \left(n + \frac{1}{2}\right)\frac{\lambda}{2}, n = 0,1,2$

b) A wave travelling along + x direction

c) A wave travelling along - x direction

d) A standing wave having nodes at $x = \frac{n\lambda}{2}; n = 0,1,2$

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

a) $I = 100I_0$ b) $I = 10I_0$ c) $I = I_0$ d) $I = \sqrt{10}I_0$

299. When both the listener and source are moving towards each other, then which of the following is true regarding frequency and wavelength of wave observed by the observer?

a) More frequency, less wavelength

b) More frequency, more wavelength

c) Less frequency, less wavelength

d) More frequency, constant wavelength

300. If you set up the seven overtone on a string fixed at both ends, how many nodes and antinodes are set up in it?

a) 6,5 b) 5,4 c) 4,3 d) 3,2

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

a) Wave moving in x- direction with speed $\sqrt{\frac{b}{a}}$

b) Standing wave of frequency $\sqrt{b}$

c) Standing wave of frequency $\frac{1}{\sqrt{b}}$

d) Wave moving in +x direction with speed $\sqrt{\frac{a}{b}}$

302. When a longitudinal wave propagates through a medium, the particles of the medium execute simple harmonic oscillations about their mean positions. These oscillations of a particle are characterised by an invariant

a) Kinetic energy

b) Potential energy

c) Sum of kinetic energy and potential energy

d) Difference between kinetic energy and potential energy

303. Which of the following equation represent a progressive wave?

a) y=A cos ax sin bt b) y=A sin bt c) y=A cos (ax+bt) d) y=A tan (ax+bt)

304. The equation of a simple harmonic wave is given by $y = 5\sin\frac{\pi}{2}(100t - x)$ where x and y are in meter and time is in second. The period of the wave in second will be

a) 0.04 b) 0.01 c) 1 d) 5

305. A tuning fork gives 4 beats with 50 cm length of a sonometer wire. If the length of the wire is shortened by 1 cm, the number of beats is still the same. The frequency of the fork is

a) 396 b) 400 c) 404 d) 384

306. Choose the correct statement

a) Beats are due to destructive interference

b) Maximum beat frequency audible to a human being is 20

c) Beats are as a result of Doppler's effect

d) Beats are due to superposition of two waves of nearly equal frequencies

307. In stationary waves, antinodes are the points where there is

a) Minimum displacement and minimum pressure change

b) Minimum displacement and maximum pressure change

c) Maximum displacement and maximum pressure change

d) Maximum displacement and minimum pressure change

308. Two sound waves of wavelengths $5m$ and $6m$ formed 30 beats in 3 seconds. The velocity of sound is

a) 300 ms^{-1} b) 310 ms^{-1} c) 320 ms^{-1} d) 330 ms^{-1}

309. What is the phase difference between two successive crests in the wave?

a) π b) $\pi/2$ c) 2π d) 4π

310. Velocity of sound waves in air is 330ms^{-1}. For a particular sound in air, a path difference of 40cm is equivalent to a phase difference of 1.6π.The frequency of the wave is

a) 165 Hz b) 150 Hz c) 660 Hz d) 330 Hz

311. Velocity of sound in air

I. increases with temperature

II. Decreases with temperature

III. Increase with pressure

IV. Is independent of pressure

V. Is independent of temperature

Choose the correct answer

a) Only I and II are true b) Only I and III are true

c) Only II and III are true d) Only I and IV are true

312. An open pipe resonates with a tuning fork of frequency 500 Hz. It is observed that two successive nodes are formed at distance 16 and 46 cm from the open end. The speed of sound in air in the pipe is

a) 260 ms^{-1} b) 300 ms^{-1} c) 320 ms^{-1} d) 360 ms^{-1}

313. Each of the two strings of length 51.6 cm and 49.1 cm are tensioned separately by 20 N force. Mass per unit length of both the strings is same and equal to 1 g/m. When both the string vibrate simultaneously the number of beats is

a) 5 b) 7 c) 8 d) 3

314. A source of sound of frequency n is moving towards a stationary observer with a speed S. If the speed of sound in air is V and the frequency heard by the observer is n_1, the value of n_1/n is

a) $(V+S)/V$ b) $V/(V+S)$ c) $(V-S)/V$ d) $V/(V-S)$

315. Sounds wave transfer

a) Only energy not momentum b) Energy

c) Momentum d) Both (a) and (b)

316. Which of the following is the example of transverse wave

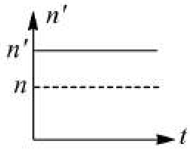
a) Sound waves b) Compressional waves in a spring

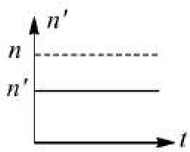
c) Vibration of string d) All of these

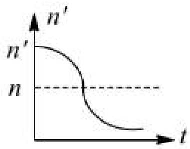
317. A string vibrates according to the equation $y = 5\sin\left(\frac{2\pi x}{3}\right)\cos 20\pi t$ where x and y are in cm and t in second. The distance between two adjacent nodes is

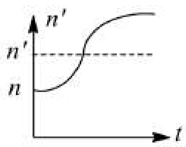
a) 3 cm b) 4.5 cm c) 6 cm d) 1.5 cm

318. Source and observer, both start moving simultaneously from origin, one along X-axis and the other along Y-axis with speed of source equal to twice the speed of observer. The graph between the apparent frequency (n') observed by observer and time t in figure would be

a) 

b) 

c) 

d) 

319. Two wires are fixed in a sonometer. Their tensions are in the ratio 8:1. The lengths are in the ratio 36:35. The diameters are in the ratio 4:1. Densities of the materials are in the ratio 1:2. If the higher frequency in the setting is 360 Hz, the beat frequency when the two wires are sounded together, is
a) 8
b) 5
c) 10
d) 6

320. Equation of a progressive wave is given by $y = a\sin\pi\left[\frac{t}{2} - \frac{x}{4}\right]$, where t is in seconds and x is in meters. The distance through which the wave moves in 8 sec is (in meter)
a) 8
b) 16
c) 2
d) 4

321. Two monoatomic ideal gases 1 and 2 of molecular masses m_1 and m_2 respectively are enclosed in separate containers kept at the same temperature. The ratio of the speed of sound in gas 1 to that in gas 2 is given by
a) $\sqrt{\frac{m_1}{m_2}}$
b) $\sqrt{\frac{m_2}{m_1}}$
c) $\frac{m_1}{m_2}$
d) $\frac{m_2}{m_1}$

322. The equation of a progressive wave is $y = 8\sin\left[\pi\left(\frac{t}{10} - \frac{x}{4}\right) + \frac{\pi}{3}\right]$. The wavelength of the wave is
a) $8\ m$
b) $4\ m$
c) $2\ m$
d) $10\ m$

323. An observer standing at station observes frequency 219 Hz when a train approaches and 184 Hz when train goes away from him. If velocity of sound in air is 340 m/s, then velocity of train and actual frequency of whistle will be
a) $15.5\ ms^{-1}, 200Hz$
b) $19.5\ ms^{-1}, 205Hz$
c) $29.5\ ms^{-1}, 200Hz$
d) $32.5\ ms^{-1}, 205Hz$

324. The first overtone in a closed pipe has a frequency
a) Same as the fundamental frequency of an open tube of same length
b) Twice the fundamental frequency of an open tube of same length
c) Same as that of the first overtone of an open tube of same length
d) None of the above

325. Standing stationary waves can be obtained in an air column even if the interfering waves are
a) Of different pitches
b) Of different amplitudes
c) Of different qualities
d) Moving with different velocities

326. If fundamental frequency of closed pipe is 50 Hz then frequency of 2^{nd} overtone is
a) 100 Hz
b) 50 Hz
c) 250 Hz
d) 150 Hz

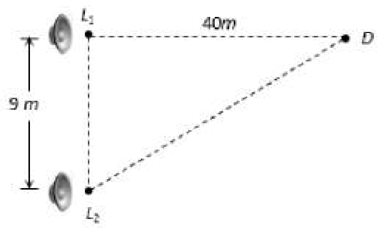
327. Two sound sources emitting sound each of wavelength λ are fixed at a given distance apart. A listener moves with a velocity u along the line joining the two sources. The number of beats heard by him per second is
a) $2u/\lambda$
b) u/λ
c) $\frac{u}{3\lambda}$
d) $\frac{2\lambda}{u}$

328. A source of sound placed at the open end of a resonance column sends an acoustic wave of pressure amplitude ρ_0 inside the tube. If the atmospheric pressure is ρ_A, then the ratio of maximum and minimum pressure at the closed end of the tube will be
a) $\frac{(\rho_A + \rho_0)}{(\rho_A - \rho_0)}$
b) $\frac{(\rho_A + 2\rho_0)}{(\rho_A - 2\rho_0)}$
c) $\frac{\rho_A}{\rho_0}$
d) $\frac{\left(\rho_A + \frac{1}{2}\rho_0\right)}{\left(\rho_A - \frac{1}{2}\rho_0\right)}$

329. Sound velocity is maximum in

a) H_2 b) N_2 c) He d) O_2

330. 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 330 ms^{-1} then the frequency at which the first maximum is observed is



a) 165 Hz b) 330 Hz c) 496 Hz d) 660 Hz

331. It takes 2.0 s for a sound wave to travel between two fixed points when the day temperature is 10°C. if the temperature rises to 30°C the sound wave travels between the same fixed parts in

a) 1.9s b) 2.0s c) 2.1s d) 2.2s

332. An open pipe of length 33 cm resonates with frequency of 100 Hz. If the speed of sound is 330 m/s, then this frequency is

a) Fundamental frequency of the pipe b) Third harmonic of the pipe
c) Second harmonic of the pipe d) Fourth harmonic of the pipe

333. A car sounding a horn of frequency 1000 Hz passes an observer. The ratio of frequencies of the horn noted by the observer before and after passing of the car is 11 : 9. If the speed of sound is v, the speed of the car is

a) $\frac{1}{10}v$ b) $\frac{1}{2}v$ c) $\frac{1}{5}v$ d) v

334. If the speed of a wave doubles as it passes from shallow water deeper water, its wavelength will be

a) Unchanged b) Halved c) Doubled d) Quadrupled

335. When an aeroplane attains a speed higher than the velocity of sound in air, a loud bang is heard. This is because

a) It explodes
b) It produces a shock wave which is received as the bang
c) Its wings vibrate so violently that the bang is heard
d) The normal engine noises undergo a Doppler shift to generate the bang

336. A standing wave having 3 nodes and 2 antinodes is formed between two atoms having a distance 1.21 Å between them. The wavelength of the standing wave is

a) 1.21Å b) 1.42Å c) 6.05Å d) 3.63Å

337. Two identical plain wires have a fundamental frequency of 600 cycle per second when kept under the same tension. What fractional increase in the tension of one wires will lead to the occurrence of 6 beats per second when both wires vibrate simultaneously

a) 0.01 b) 0.02 c) 0.03 d) 0.04

338. An unknown frequency x produces 8 beats per seconds with a frequency of 250 Hz and 12 beats with 270 Hz source, then x is

a) 258 Hz b) 242 Hz c) 262 Hz d) 282 Hz

339. If the temperature increases, then what happens to the frequency of the sound produced by the organ pipe

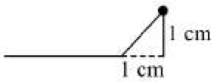
a) Increases b) Decreases c) Unchanged d) Not definite

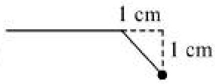
340. If the tension and diameter of a sonometer wire of fundamental frequency n are doubled and density is halved then its fundamental frequency will become

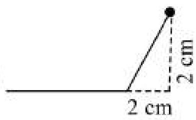
a) $\frac{n}{4}$ b) $\sqrt{2}n$ c) n d) $\frac{n}{\sqrt{2}}$

341. A wave equation which gives the displacement along y-direction is given by $y = 0.001\sin(100t + x)$ where x and y are in meter and t is time in second. This represented a wave
a) Of frequency $100/\pi\ Hz$
b) Of wavelength one metre
c) Travelling with a velocity of $50/\pi\ ms^{-1}$ in the positive X-direction
d) Travelling with a velocity of $100\ ms^{-1}$ in the negative X-direction
342. The speed of sound in a gas
a) Does not depend upon density of the gas
b) Does not depend upon charges in pressure
c) Does not depend upon temperature
d) Depends upon density of the gas
343. Two stretched strings of same material are vibrating under same tension in fundamental mode. The ratio of their frequencies is 1 : 2 and ratio of the length of the vibrating segments is 1 : 4. Then the ratio of the radii of the strings is
a) 2 : 1 b) 4 : 1 c) 3 : 2 d) 8 : 1
344. A band playing music at a frequency f is moving towards a wall at a speedv_b. A motorist is following the band with a speedv_m. If v is speed of sound, the expression for the beat frequency heard by the motorist is
a) $\frac{(v+v_m)f}{v+v_b}$ b) $\frac{(v+v_m)f}{v-v_b}$ c) $\frac{2v_b(v+v_m)f}{v^2-v_b^2}$ d) $\frac{2v_m(v+v_b)f}{v^2-v_b^2}$
345. An empty vessel is partially filled with water, then the frequency of vibration of air column in the vessel
a) Remains same
b) Decreases
c) Increases
d) First increases then decreases
346. The wavelength of infrasonics in air is of the order of
a) 10^0m b) 10^1m c) 10^{-1}m d) 10^{-2}m
347. Two sound waves are represented by $y = a\sin(\omega t - kx)$ and$y = a\cos(\omega t - kx)$. The wavelength of wave I water are
a) $\pi/2$ b) $\pi/4$ c) π d) $3\pi/4$
348. The frequency of a whistle of an engine is 600 $cycles/sec$ is moving with the speed of 30 m/sec towards an observer. The apparent frequency will be (velocity of sound = 330 m/s)
a) 600 cps b) 660 cps c) 990 cps d) 330 cps
349. The tones that are separated by three octaves have a frequency ratio of
a) 3 b) 4 c) 8 d) 16
350. If the ratio of amplitude of two waves is 4 : 3. Then the ratio of maximum and minimum intensity will be
a) 16 : 18 b) 18 : 16 c) 49 : 1 d) 1 : 49
351. A source and an observer move away from each other with a velocity of 10 m/s with respect to ground. If the observer finds the frequency of sound coming from the source as 1950 Hz, then actual frequency of the source is (velocity of sound in air = 340 m/s)
a) 1950 Hz b) 2068 Hz c) 2132 Hz d) 2486 Hz
352. A wave is given by $y = 3\sin 2\pi\left(\frac{t}{0.04} - \frac{x}{0.01}\right)$, where y is in cm. Frequency of wave and maximum acceleration of particle will be
a) $100Hz, 4.7\times10^3 cm/s^2$
b) $500Hz, 7.5\times10^3 cm/s^2$
c) $25Hz, 4.7\times10^4 cm/s^2$
d) $25Hz, 7.4\times10^4 cm/s^2$
353. A sound wave of frequency v propagating through air with a velocity c, is reflected from a surface which is moving away from the source with a constant speed v. the frequency of the reflected wave, measured by the observed at the position of the source, is
a) $\frac{v(c-v)}{c+v}$ b) $\frac{v(C+v)}{c-v}$ c) $\frac{v(c+2v)}{c+v}$ d) $\frac{v(c-v)}{c-2v}$
354. If $y = 5\sin\left(30\pi t - \frac{\pi}{7} + 30°\right) y \to mm, t \to s, x \to m$.for given progressive wave equation, phase difference between two vibrating particle having path difference 3.5 m would be
a) $\pi/4$ b) π c) $\pi/3$ d) $\pi/2$
355. In question, the shape of the wave at time$t = 3s$,if O is a fixed end (not free) in is.

a) 

b) 

c) 

d) 

356. A man stands in front of a hillock and fires a gun. He hears an echo after 1.5 sec. The distance of the hillock from the man is (velocity of sound in air is 330 m/s)
a) 220 m b) 247.5 m c) 268.5 m d) 292.5 m

357. A cylindrical tube open at both the ends has a fundamental frequency of 390 Hz in air. If $\frac{1}{4}$of the tube is immersed vertically in water the fundamental frequency of air column is
a) 260 Hz b) 130 Hz c) 390 Hz d) 520 Hz

358. In a sinusoidal wave, the time required for a particular point to move from maximum displacement to zero displacement is 0.170 second. The frequency of the wave is
a) 1.47 Hz b) 0.36 Hz c) 0.73 Hz d) 2.94 Hz

359. A motor car is approaching towards a crossing with a velocity of 72 kmh^{-1}. The frequency of sound of its horn as heard by a policeman standing on the crossing is 260Hz. The frequency of horn is
a) 200 Hz b) 244 Hz c) 150 Hz d) 80 Hz

360. If V_m is the velocity of sound in moist air, $V_d$is the velocity of sound in dry air, under identical conditions of pressure and temperature
a) $V_m < V_d$ b) $V_m > V_d$ c) $V_m V_d = 1$ d) $V_m = V_d$

361. Given that $y = A\sin\left[\left(\frac{2\pi}{\lambda}(ct - x)\right)\right]$, where y and x are measured in metres. Which of the following statements is true
a) The unit of λ^{-1} is same as that of $\frac{2\pi}{\lambda}$
b) The unit of λ is same as that of x but not of A
c) The unit of c is same as that of $\frac{2\pi}{\lambda}$
d) The unit of $(ct - x)$ is same as that of $\frac{2\pi}{\lambda}$

362. A plane progressive wave is given by y=2cos 6.284 (30t-x).what is period of the wave?
a) $\frac{1}{330}s$ b) $2\pi \times 330s$ c) $(2\pi \times 330)^{-2}s$ d) $\frac{6.284}{330}s$

363. The amplitude of a wave is given by $A = \frac{c}{a+b+c}$. Resonance will occur when
a) $b = -\frac{c}{2}$ b) $b = -\frac{a}{2}$ c) $b = 0, a = c$ d) None of these

364. An observer standing near the sea shore observes 54 waves per minute. If the wavelength of the water wave is 10m then the velocity of water wave is
a) 540 ms^{-1} b) 5.4 ms^{-1} c) 0.184 ms^{-1} d) 9 ms^{-1}

365. A plane wave is described by the equation $y = 3\cos\left(\frac{x}{4} - 10t - \frac{\pi}{2}\right)$. The maximum velocity of the particles of the medium due to this wave is
a) 30 b) $\frac{3\pi}{2}$ c) 3/4 d) 40

366. Equation of motion in the same direction are given by
$y_1 = 2a\sin(\omega t - kx)$ and $y_2 = 2a\sin(\omega t - kx - \theta)$
The amplitude of the medium particle will be
a) $2a\cos\theta$ b) $\sqrt{2}a\cos\theta$ c) $4a\cos\theta/2$ d) $\sqrt{2}a\cos\theta/2$

367. The equation $\vec{\phi}(x,t) = \vec{j}\sin\left(\frac{2\pi}{\lambda}vt\right)\cos\left(\frac{2\pi}{\lambda}x\right)$ represents
a) Transverse progressive wave
b) Longitudinal progressive wave
c) Longitudinal stationary wave
d) Transverse stationary wave

368. What is the base frequency if a pipe gives notes of frequencies 425, 255 and 595 and decide whether it is closed at one end or open at both ends
a) 17, closed b) 85, closed c) 17, open d) 85, open

369. The phase difference between two waves represented by

$y_1 = 10^{-6} \sin[100t + (x/50) + 0.5]m$
$y_2 = 10^{-6} \cos[100t + (x/50)]m$
Where x is expressed in metres and t is expressed in second, is approximately
a) 1.5 rad b) 1.07 rad c) 2.07 rad d) 0.5 rad

370. Apparatus used to find out the velocity of sound in gas is
a) Melde's apparatus b) Kundt's tube c) Quincke's tube d) None of these

371. Ten tuning fork are arranged in increasing order of frequency in such a way that any two nearest tuning forks produce 4 beats s^{-1}. The highest frequency is twice that of the lowest. Possible highest and lowest frequencies are
a) 80 and 40 b) 100 and 50 c) 44 and 32 d) 72 and 36

372. If the phase difference between the two wave is 2π during superposition, then the resultant amplitude is
a) Maximum b) Minimum
c) Maximum or minimum d) None of the above

373. In stationary wave
a) Strain is maximum at nodes b) Strain is maximum at antinodes
c) Strain is minimum at nodes d) Amplitude is zero at all the points

374. The ratio of the sound in oxygen to that in hydrogen at same temperature and pressure is approximately
a) 16:1 b) 1:16 c) 4:1 d) 1:4

375. A source of sound S is moving with a velocity of $50 ms^{-1}$ towards a stationary observer. The observer measures the frequency of the source as 1000 Hz. What will be the apparent frequency of the source when it is moving away from the observer after crossing him? The velocity of the sound in medium is $350 m^{-1}$.
a) 750 Hz b) 857 Hz c) 1143 Hz d) 1333 Hz

376. At what speed should a source of sound move so that stationary observer finds the apparent frequency equal to half of the original frequency
a) $v/2$ b) $2v$ c) $v/4$ d) v

377. n waves are produced on a string in one second. When the radius of the string is doubled and the tension is maintained the same, the number of waves produced in one second for the same harmonic will be
a) $\frac{n}{2}$ b) $\frac{n}{3}$ c) $2n$ d) $\frac{n}{\sqrt{2}}$

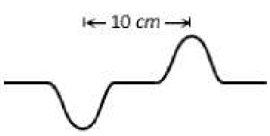
378. Two sound waves travel in the same direction in a medium. The amplitude of each wave is A and the phase difference between the two waves is $120°$. The resultant amplitude will
a) $\sqrt{2}A$ b) $2A$ c) $3A$ d) A

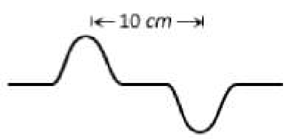
379. 25 tuning forks arranged in series in the order of decreasing frequency. Any two successive forks produce 3 beats/sec. If the frequency of the first tuning fork is the octave of the last fork, then the frequency of the 21^{st} fork is
a) 72 Hz b) 288 Hz c) 84 Hz d) 87 Hz

380. The ratio of intensities between two coherent sound sources is 4 : 1. The difference of loudness in decibels (dB) between maximum and minimum intensities, on their interference in space is
a) 20 log2 b) 10 log2 c) 20 log3 d) 10 log3

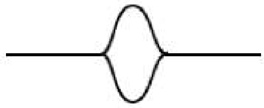
381. An organ pipe open at one end is vibrating in first overtone and is in resonance with another pipe open at both ends and vibrating in third harmonic. The ratio of length of two pipe is
a) 3:8 b) 8:3 c) 1:2 d) 4:1

382. Two pulses travel in mutually opposite directions in a string with a speed of 2.5 cm/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) 

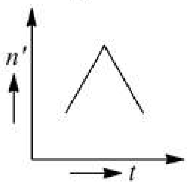
383. Two waves represented by the following equations are travelling in the same medium $y_1 = 5\sin 2\pi(75t - 0.25x)$, $y_2 = 10\sin 2\pi(150t - 0.50x)$
The intensity ratio I_1/I_2 of the two waves is
a) 1 : 2 b) 1 : 4 c) 1 : 8 d) 1 : 16

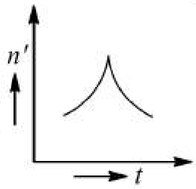
384. Two instruments having stretched strings are being played in union. When the tension of one of the instruments is increased by 1%, 3 beats are produced in 2s. the initial frequency of vibration of each wire is
a) 300 Hz b) 500 Hz c) 1000 Hz d) 400 Hz

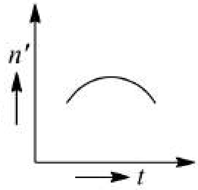
385. The time of reverberation of a room A is one second. What will be the time (in seconds) of reverberation of a room, having all the dimensions double of those of room A
a) $\frac{1}{2}$ b) 1 c) 2 d) 4

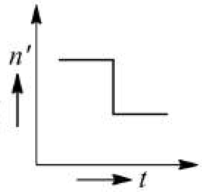
386. An organ pipe P_1 closed at one end vibrating in its first harmonic and another pipe P_2 open at both ends vibrating in its third harmonic are in resonance with a given tuning fork. The ratio of the length of P_1 to that P_2 is
a) 1/3 b) 1/6 c) 3/8 d) 8/3

387. A railway engine whistling at a constant frequency moves with a constant speed. It goes past a stationary observer standing beside the railway track. The frequency $(n')$of the sound heard by the observer is plotted against time (t), which of the following best represents the resulting curve

a) 

b) 

c) 

d) 

388. An observer is standing 500 m away from a vertically hill. Starting between the observer and the hill a police van having a siren of frequency 1000 Hz moves towards the hill with a uniform speed. If the frequency of the sound heard directly from the siren is 970 Hz, the frequency of the sound heard after reflection from the hill (in Hz) is about, (velocity of sound =330 ms^{-1})
a) 1042 b) 1032 c) 1022 d) 1012

389. A pulse of a wave train travels along a stretched string and reaches the fixed end of the string. It will be reflected with
a) A phase change of 180° with velocity reversed
b) The same phase as the incident pulse with no reversal of velocity
c) A phase change of 180° with no reversal of velocity
d) The same phase as the incident pulse but with velocity reversed

390. A wave travelling along the x-axis is described by the equation y(x, t) =0.005 cos (αx-βt). If the wavelength and the time period of the wave are 0.08m and 2.0s, respectively, than α and β in appropriate unit are
a) a=25.00π, β π b) $\alpha = \frac{0.08}{\pi}, \beta = \frac{2.0}{\pi}$ c) $\alpha = \frac{0.04}{\pi}, \beta = \frac{1.0}{\pi}$ d) $\alpha = 12.5\pi, \beta = \frac{\pi}{2.0}$

391. In the experiment to determine the speed of sound using a resonance column
a) Prongs of the tuning fork are kept in a vertical plane
b) Prongs of the tuning fork are kept in a horizontal plane
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) 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

392. In Melde's experiment, the string vibrates in 4 loops when a 50 g weight is placed in the pan of weight 15 g. To made the string vibrate in 6 loops, the weight that has to be removed from the pan in approximately

a) 7 g   b) 36 g   c) 21 g   d) 29 g

393. The equation of a cylindrical progressive wave is

a) $y = a\sin\omega t$ b) $y = a\sin(\omega t - kr)$

c) $y = \frac{a}{\sqrt{r}}\sin(\omega t - kr)$ d) $y = \frac{a}{r}\sin(\omega t - kr)$

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

a) 9:4   b) 2:3   c) 3:2   d) 4:9

395. The harmonics which are present in a pipe, open at one end are

a) Odd harmonics   b) Even harmonics

c) Even as well as odd harmonics   d) None of the above

396. A wave frequency us y=0.1 sin $[100\,\pi t - kx]$ and wave velocity is 100^{-1}, its wave number is equal to

a) 1m^{-1} b) 2m^{-1} c) πm^{-1} d) $2\pi\ \text{m}^{-1}$

397. A wave is represented by the equation

$y = 0.5\sin(10t - x)m$. It is a travelling wave propagating along the $+x$ direction with velocity

a) $10\ m/s$ b) $20\ m/s$ c) $5\ m/s$ d) None of these

398. The speed of a wave on string $150\ ms^{-1}$when the tension is 120 N. the percentage increase in the tension in order to raise the wave speed by 20% is

a) 44%   b) 40%   c) 20%   d) 10%

399. "Stationary waves" are so called because in them

a) The particles of the medium are not disturbed at all

b) The particles of the medium do not execute SHM

c) There occurs no flow of energy along the wave

d) The interference effect can't be observed

400. Two wires are in unison. If the tension in one of the wires is increased by 2%, 5 beats are produced per second. The initial frequency of each wire is

a) $200\ Hz$ b) $400\ Hz$ c) $500\ Hz$ d) $1000\ Hz$

401. A bus is moving with a velocity of 5 ms^{-1} towards a huge wall. The driver sounds a horn of frequency 165 Hz. If the speed of sound in air is 335ms^{-1}, the number of beats heard per second by the passengers in the bus will be

a) 3   b) 4   c) 5   d) 6

402. The minimum distance of reflector surface from the source for listening the echo of sound is

a) $28\ m$ b) $18\ m$ c) $19\ m$ d) $16.5\ m$

403. The relation between time and displacement for two particles is given by

$y_1 = 0.06\sin 2\pi(0.04t + \phi_1), y_2 = 0.03\sin 2\pi(1.04t + \phi_2)$

The ratio of the intensity of the waves produced by the vibrations of the two particles will be

a) 2 : 1   b) 1 : 2   c) 4 : 1   d) 1 : 4

404. The velocity of sound is v_s in air. If the density of air is increased to 4 times, then the new velocity of sound will be

a) $\frac{v_s}{2}$ b) $\frac{v_s}{12}$ c) $12v_s$ d) $\frac{3}{2}v_s^2$

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

a) $3A$ b) $\sqrt{5}A$ c) $\sqrt{2}A$ d) A

406. When a train approaches a stationary observer, the apparent frequency of the whistle is n' and when the same train recedes away from the observer, the apparent frequency isn''. Then the apparent frequency n when the observer moves with the train is

a) $n = \frac{n' + n}{2}$ b) $n = \sqrt{n'n''}$ c) $n = \frac{2n'n''}{n' + n''}$ d) $n = \frac{2n'n''}{n' - n''}$

407. If wavelength of a wave is $\lambda = 6000\text{Å}$. Then wave number will be

a) $166 \times 10^3 m^{-1}$ b) $16.6 \times 10^{-1} m^{-1}$ c) $1.66 \times 10^6 m^{-1}$ d) $1.66 \times 10^7 m^{-1}$

408. In a closed organ pipe, the 1st resonance occurs at 50 cm. At what length of pipe, the 2nd resonance will occur

a) 150 cm b) 50 cm c) 100 cm d) 200 cm

409. A student determines the velocity of sound with the help of a closed organ pipe. If the observed length for fundamental frequency is 24.7 m, the length for third harmonic will be

a) 74.1 cm b) 72.7 cm c) 75.4 cm d) 73.1 cm

410. Two radio station broadcast their programmes at the same amplitude A and at slightly different frequency ω_1 and ω_2 respectively where$\omega_2 - \omega_1 = 10^3$ Hz. A detector is receiving signals from the two stations simultaneously. It can only detect signals of intensity $>2A^2$. The time interval between successive maxima of the intensity of the signal received by the detector is

a) $10^3 s$ b) $10^{-3} s$ c) $10^{-4} s$ d) $10^4 s$

411. A car sounding its horn at 480 Hz moves towards a high wall at a speed of$20\ ms^{-1}$. If the speed of sound is $340 ms^{-1}$, the frequency of the reflected sound heard by the girl sitting in the car will be closed to

a) 540 Hz b) 524 Hz c) 568 Hz d) 480 Hz

412. The Doppler's effect is applicable for

a) Light waves b) Sound waves c) Space waves d) Both (a) and (b)

413. Two similar sonometer wires given fundamental frequencies of $500 Hz$. These have same tensions. By what amount the tension be increased in one wire so that the two wires produce $5 beats/sec$

a) 1% b) 2% c) 3% d) 4%

414. A tuning fork of frequency 200 Hz is in unison with a sonometer wire. The number of beats heard per second when the tension is increased by 1% is

a) 1 b) 2 c) 4 d) 1/2

415. A wave travelling along positive x-axis is given by $y = A\sin(\omega t - kx)$. If it is reflected from rigid boundary such that 80% amplitude is reflected, then equation of reflected wave is

a) $y = A\sin(\omega t + kx)$ b) $y = -0.8A\sin(\omega t + kx)$
c) $y = 0.8A\sin(\omega t + kx)$ d) $y = A\sin(\omega t + 0.8kx)$

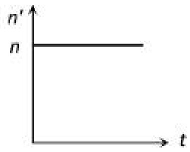
416. Three sound waves of equal amplitude have frequencies (v-1),v,(v+1). They superpose to give beat. The number of beats produced per second will be

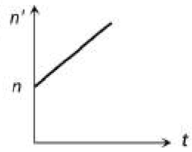
a) 4 b) 3 c) 2 d) 1

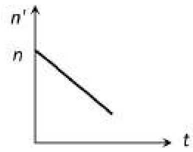
417. Beats are produced by two waves given by $y_1 = a\sin 2000\pi t\ and\ y_2 a\sin 2008\pi t$. The number of beats heard per second is

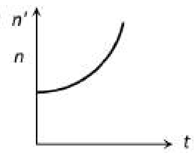
a) Zero b) One c) Four d) Eight

418. An observer starts moving with uniform acceleration a toward a stationary sound source emitting a whistle of frequency n. As the observer approaches source, the apparent frequency, heard by the observer varies with time as

a) 

b) 

c) 

d) 

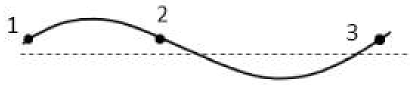
419. Two organ pipes, each closed at one end, give 5 beats s^{-1} when emitting their fundamental notes. If their lengths are in the ratio 50:51, their fundamental frequencies are

a) 250,255 b) 255,260 c) 260,265 d) 265,270

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

a) $1\ m$ b) $\frac{1}{2} m$ c) $5\ m$ d) $2\ \pi m$

421. The diagram below shows an instantaneous position of a string as a transverse progressive wave travels along it from left to right



Which one of the following correctly shows the direction of the velocity of the points 1, 2 and 3 on the string

1 2 3

a) → → → b) → ← → c) ↓ ↓ ↓ d) ↓ ↑ ↓

422. A transverse wave propagating on a stretched string of liner density 3×10^{-4} kg − m^{-1} is represented by the equation $y = 0.2\ \sin(1.5x + 60t)$ where x is in meter and t is in second. The tension in the string (in newton) is

a) 0.24 b) 0.48 c) 1.20 d) 1.80

423. Two sound waves having a phase difference of 60° have path difference of

a) 2λ b) $\lambda/2$ c) $\lambda/6$ d) $\lambda/3$

424. Two waves having sinusoidal waveforms have different wavelengths and different amplitude. They will be having

a) Same pitch and different intensity b) Same quality and different intensity

c) Different quality and different intensity d) Same quality and different pitch

425. A string is stretched between fixed points separated by 75.0 cm. it is observed to have resonant frequency of 420 Hz and 315 Hz. 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) 10.5 Hz

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

a) 0.0007 kg-wt b) 0.0021 kg-wt c) 0.036 kg-wt d) 0.0029 kg-wt

427. When an engine passes near to a stationary observer then its apparent frequencies occurs in the ratio 5/3. If the velocity of engine is (Velocity of sound is 340 m/s)

a) 540 m/s b) 270 m/s c) 85 m/s d) 52.5 m/s

428. Oxygen is 16 times heavier than hydrogen. Equal volumes of hydrogen and oxygen are mixed. The ratio of speed of sound in the mixture to that in hydrogen is

a) $\sqrt{8}$ b) $\sqrt{\frac{2}{17}}$ c) $\sqrt{\frac{1}{8}}$ d) $\sqrt{\frac{32}{17}}$

429. Ultrasonic signal sent from SONAR returns to it after reflection from a rock after a lapse of 1 sec. If the velocity of ultrasound in water is 1600 ms^{-1}, the depth of the rock in water is

a) 300 m b) 400 m c) 500 m d) 800 m

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

a) 1 b) 8 c) 4 d) 2

431. Two wires of the same material and radii r and $2r$ respectively are velded together end to end. The combination is used as a sonometer wire and kept under tension$T$. The welded point is midway between the two bridges. When stationary waves are set up in the composite wire, the joint is a node. Then the ratio of the number of loops formed in the thinner to thicker wire is

a) 2:3 b) 1:2 c) 2:1 d) 5:4

432. A string fixed at both ends oscillates in 5 segments, length 10m and velocity of wave is20 ms^{-1}. What is the frequency?

a) 5 Hz b) 15 Hz c) 10 Hz d) 2 Hz

433. A progressive wave in a medium is represented by the equation $y = 0.1\sin\left(10\pi t - \frac{5}{11}\pi x\right)$ where y and x are in cm and t in second. The wavelength and velocity of the wave is

a) $\frac{5}{11}$cm, 31.4 cms^{-1} b) 4.4cm, 22 cms^{-1} c) 2.2cm, 11 cms^{-1} d) $\frac{11}{5}$cm, 22 cms^{-1}

434. A tuning fork of frequency 512 Hz is used to produce vibrations in a sonometer wire of natural frequency 256 Hz. The wire will vibrate in

a) One segment b) Two segments c) Four segments d) Three segments

435. If the pressure amplitude in a sound wave is tripled, then the intensity of sound is increased by a factor of

a) 9 b) 3 c) 6 d) $\sqrt{3}$

436. The fractional change in wavelength of light coming from a star is 0.014% what is its velocity?

a) $42 \times 10^3 ms^{-1}$ b) $3.8 \times 10^8 ms^{-1}$ c) $3.5 \times 10^3 ms^{-1}$ d) $4.2 \times 10^4 ms^{-1}$

437. Velocity of sound in air is

a) Faster in dry air than in moist air
b) Directly proportional to pressure
c) Directly proportional to temperature
d) Independent of pressure of air

438. A man, standing between two cliffs, claps his hands and starts hearing a series of echoes at intervals of one second. If the speed of sound in air is 340 ms^{-1}, the distance between the cliffs is

a) 680 m b) 1700 m c) 340 m d) 1620 m

439. A particle on the trough of a wave at any instant will come to the mean position after a time(T=time period)

a) $\frac{T}{2}$ b) $\frac{T}{4}$ c) T d) 2T

440. In an experiment with sonameter a tuning fork of frequency 256 Hz resonates with a length of 25 cm and another tuning fork resonates with a length of 16 cm. tension of the string remaining constant the frequency of the second tuning fork is

a) 163.84 Hz b) 400 Hz c) 320 Hz d) 204.8 Hz

441. A sonometer wire 100 cm long has a fundamental frequency of 330 Hz. The velocity of propagation of transverse waves on the wire is

a) 330 ms^{-1} b) 660 ms^{-1} c) 990 ms^{-1} d) 115 ms^{-1}

442. When a tuning fork vibrates, the waves produced in the fork are

a) Longitudinal b) Transverse c) Progressive d) Stationary

443. The equation of a wave on a string of liner mass density 0.04 $kgm^{-1}$is given by

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

a) 4.0N b) 12.5N c) 0.5N d) 6.25N

444. Of the following, the equation of plane progressive wave is

a) $y = r\sin\omega t$ b) $y = r\sin(\omega t - kx)$ c) $y = \frac{a}{\sqrt{r}}\sin(\omega t - kx)$ d) $y = \frac{a}{r}\sin(\omega t - kx)$

445. Two closed organ pipes A and B, have the same length. A is wider than B. They resonate in the fundamental mode at frequencies n_A and n_B respectively, then

a) $n_A = n_B$
b) $n_A > n_B$
c) $n_A < n_B$
d) Either (b) or (c) depending on the ratio of their diameters

446. A person carrying a whistle emitting continuously a note of 272 Hz is running towards a reflecting surface with a speed of 18 $km/hour$. The speed of sound in air is 345ms^{-1}. The number of beats heard by him is

a) 4 b) 6 c) 8 d) 3

447. A pipe open at both the ends produce a note of fundamental frequency v_1 When the pipe is kept with $\frac{3}{4}$th of its length in water, it produces a note of fundamental frequency v_2. The ration of $\frac{v_1}{v_2}$ is

a) $\frac{4}{3}$ b) $\frac{3}{4}$ c) 2 d) $\frac{1}{2}$

448. The displacement of the interfering sound waves are $y_1 = 4\sin\omega t$ and $y_2 = 3\sin\left(\omega t + \frac{\pi}{2}\right)$. What is the amplitude of the resultant wave

a) 5 b) 7 c) 1 d) 0

449. A sound absorber the sound level by 20 dB. The intensity decreases by a factor of

a) 1000 b) 10000 c) 10 d) 100

450. The intensity of sound increases at night due to

a) Increase in density of air b) Decreases in density of air
c) Low temperature d) None of these

451. Stationary waves

a) Transport energy b) Does not transport energy
c) Have nodes and antinodes d) Both (b) and (c)

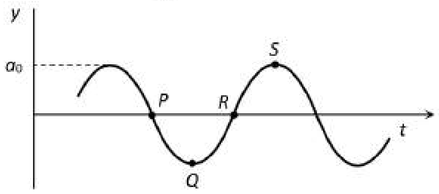
452. Air is blown at the mouth of a tube of length 25 cm and diameter equal to 2 cm open at both ends. If velocity of sound in air in 330ms^{-1}, the sound emitted will have all the frequency in the group

a) 330,990,1690 Hz b) 302,664,1320 Hz c) 660,1320,1980 Hz d) 660,100,3300 Hz

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

a) $0.2 \times 10^{-2}\mu W/m^2$ b) $1 \times 10^{-2}\mu W/m^2$ c) $4 \times 10^{-4}\mu W/m^2$ d) $5 \times 10^{-2}\mu W/m^2$

454. A wave motion has the function $y = a_0 \sin(\omega t - kx)$. The graph in figure shows how the displacement y at a fixed point varies with time t. Which one of the labelled points shows a displacement equal to that at the position $x = \frac{\pi}{2k}$ at time $t = 0$



a) P b) Q c) R d) S

455. The distance between two consecutive crests in a wave train produced in a string in 5 cm. If 2 complete waves pass through any point per second, the velocity of the wave is

a) 10 cm/sec b) 2.5 cm/sec c) 5 cm/sec d) 15 cm/sec

456. A steel rod 100 cm long is clamped at its mid-point. The funda-mental frequency of longitudinal vibrations of the rod is given to be 2.53 kHz. What is the speed of sound in steel

a) 5.06 km/s b) 6.06 km/s c) 7.06 km/s d) 8.06 km/s

457. The equation of a wave is given as $y = 0.07\sin(12\pi x - 3000\pi t)$where x is in metre and t in second, then the correct statement is

a) $\lambda = \dfrac{1}{6\text{m}}, \text{v} = 250\text{ms}^{-1}$ b) a=0.07m, $\text{v} = 300\text{ms}^{-1}$
c) N=1500, $\text{v} = 200\text{ ms}^{-1}$ d) None of the above

458. The frequency of a rod is 200 Hz. If the velocity of sound in air is 340 ms^{-1}, the wavelength of the sound produced is

a) 1.7 cm b) 6.8 cm c) 1.7 m d) 6.8 m

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

a) 5 b) 6 c) 2 d) 3/2

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

a) 24 Hz, 28 Hz b) 20 Hz, 24 Hz c) 16 Hz, 20 Hz d) 26 Hz, 30 Hz

461. 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

a) 500 b) 300 c) 330 d) 165

462. A source is moving towards a stationary observer, so that the apparent frequency increases by 50%. If velocity of sound is $330ms^{-1}$, then velocity of source is

a) $220ms^{-1}$ b) $180ms^{-1}$ c) $150ms^{-1}$ d) $110ms^{-1}$

463. A heavy uniform rope changes vertically from the ceiling, with its lower end free. A disturbance on the rope travelling upwards from the lower end has a velocity v at a distance x from the lower end such that

a) $v \propto x$ b) $v \propto \sqrt{x}$ c) $v \propto \frac{1}{x}$ d) $v \propto \frac{1}{\sqrt{x}}$

464. If in an experiment for determination of velocity of sound by resonance tube method using a tuning fork of 512 Hz, first resonance was observed at 30.7 cm and second was obtained at 63.2 cm, then maximum possible error in velocity of sound is (consider actual speed of sound in air is 332 m/s)

a) 204 cm/sec b) 110 cm/sec c) 58 cm/sec d) 80 cm/sec

465. A wave is represented by the equation $y = 0.5 \sin(10t + x)m$.It is a travelling wave propagating along $+X$ direction with velocity

a) 40ms^{-1} b) 20ms^{-1} c) 5ms^{-1} d) None of these

466. An iron load of 2 kg is suspended in air from the free end of a sonometer wire of length 1m. A tuning fork of frequency 256 Hz is in resonance with $1/\sqrt{7}$ time the length of the sonometer wire. If the load is immersed in metre that will be in resonance with the same tuning fork is (specified gravity of iron=8)

a) $\sqrt{8}$ b) $\sqrt{6}$ c) $\frac{1}{\sqrt{6}}$ d) $\frac{1}{\sqrt{8}}$

467. 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

468. Learned Indian classical vocalists do not like the accompaniment of a harmonium because

a) Intensity of the notes of the harmonium is too large
b) Notes of the harmonium are too shrill
c) Diatonic scale is used in the harmonium
d) Tempered scale is used in the harmonium

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

a) Zero b) 0.5% c) 5% d) 20%

470. A whistle of frequency 540 Hz rerates in a horizontal circle of radius 2m at an angular speed of 15rads^{-1}. The highest frequency heard by a listener at rest with respect to the center of circle (velocity of sound in air $=330ms^{-1}$)

a) 590 Hz b) 594 Hz c) 598 Hz d) 602 Hz

471. In an orchestra, the musical sounds of different instruments are distinguished from one another by which of the following characteristics

a) Pitch b) Loudness c) Quality d) Overtones

472. In the fundamental mode, time taken by the wave to reach the closed end of the air filled pipe is 0.01s. the fundamental frequency is

a) 25 b) 12.5 c) 20 d) 15

473. The second overtone of an open pipe is in resonance with the first overtone of a closed pipe of length 2m. length of the open pipe is

a) 4m b) 2m c) 8m d) 1m

474. 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) $\sqrt{2}A\cos\theta$

475. The angle between particle velocity and wave velocity in a transverse wave is

a) Zero b) $\pi/4$ c) $\pi/2$ d) π

476. A tuning fork of frequency 330 Hz resonates with an air column of length 120 cm in a cylindrical tube, in the fundamental mode. When water is slowly poured in it, the minimum height of water required for observing resonance once again is (velocity of sound $330 ms^{-1}$)

a) 75 cm b) 60 cm c) 50 cm d) 45 cm

477. Two closed organ pipe A and pipe B have the same length. A is wider than B. they resonate in the fundamental mode at frequencies $v_A and\ v_B$respectively, then

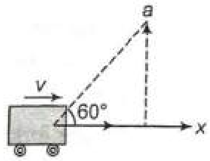
a) $v_A = v_B$

b) $v_A > v_B$

c) $v_A < v_B$

d) Either (b) or (c) depending on the ratio of their diameters

478. A car is moving along x-axis with a velocity v=20 m/s. it sounds a whistle of frequency 660 Hz. If the speed of sound is 340 m/s, the apparent frequency heard by the observer O (shown in the figure) is



a) 680 Hz b) 640 Hz c) 700 Hz d) 720 Hz

479. The extension in a string obeying Hook'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

480. If source and observer both are relatively at rest and if speed of sound is increased then frequency heard by observer will

a) Increases b) Decreases c) Can not be predicated d) Will not change

481. 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

a) 40 b) 30 c) 20 d) 10

482. 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) 1/2 sec b) 1/4 sec c) 1/8 sec d) 1/16 sec

483. The two interfering waves have intensities in the ratio 9 : 4. The ratio of intensities of maxima and minima in the interference pattern will be

a) 1 : 25 b) 25 : 1 c) 9 : 4 d) 4 : 9

484. When a string is divided into three segments of length ℓ_1, ℓ_2 and ℓ_3 the fundamental frequencies of these three segments are v_1, v_2 and v_3 respectively. The original fundamental frequency (v) of the string is

a) $\sqrt{v} = \sqrt{v_1} + \sqrt{v_2} + \sqrt{v_3}$ b) $v = v_1 + v_2 + v_3$

c) $\frac{1}{v} = \frac{1}{v_1} + \frac{1}{v_2} + \frac{1}{v_3}$ d) $\frac{1}{\sqrt{v}} = \frac{1}{\sqrt{v_1}} + \frac{1}{\sqrt{v_2}} + \frac{1}{\sqrt{v_3}}$

485. An organ pipe, open at both ends produces 5 beats/s when vibrates with a source of frequency 200 Hz. The second of the same pipe produces 10 beats/s with a source of frequency 420 Hz. The frequency of source is

a) 195 Hz b) 205 Hz c) 190 Hz d) 210 Hz

486. A source of sound is moving with constant velocity of 20 m/s emitting a note of frequency 1000 Hz. The ratio of frequencies observed by a stationary observer while the source is approaching him and after it crosses him will be

(Speed of sound $v = 340\ m/s$)

a) 9 : 8 b) 8 : 9 c) 1 : 1 d) 9 : 10

487. In the experiment for the determination of the speed of sound in air using the resonance column the resonates in the fundamental mode, with a tuning fork is 0.1m. When this length is changed to 0.35m, the same tuning fork resonates with the first overtone. Calculate the end correction.
a) 0.012 m b) 0.025 m c) 0.05 m d) 0.024 m

488. The speed of in air is 340 m/s. the speed with which a source of sound should move towards a stationary observer so that the apparent frequency becomes twice of the original is
a) 640 ms^{-1} b) 340 ms^{-1} c) 170 ms^{-1} d) 85 ms^{-1}

489. Stationary waves of frequency 300 Hz are formed in a medium in which the velocity of sound is 1200 $metre/sec$. The distance between a node and the neighbouring antinode is
a) 1 m b) 2 m c) 3 m d) 4 m

490. A wave is represented by the equation y=a cos (kx-ωt) is superposed with another wave to form a stationary wave such that the point x=0 is a node. The equation of the other wave is
a) a sin (kx+ωt) b) - a sin (kx-ωt) c) -a cos (kx+ωt) d) a cos (kx+ωt)

491. A source of sound of frequency 256 Hz is moving towards a wall with a velocity of $5ms^{-1}$. Velocity of sound is $330ms^{-1}$.The number of beats s^{-1} heard by an observer standing between the source and the wall is nearly
a) $\frac{256 \times 330}{325} - \frac{256 \times 330}{325}$ b) $256 - \frac{256 \times 330}{325}$
c) $\frac{256 \times 330}{325} \times \frac{256 \times 330}{335}$ d) $\frac{256 \times 330}{325} - 256$

492. A spherical source of power 4 W and frequency 800 Hz is emitting sound waves. The intensity of waves at a distance 200 m is
a) $8 \times 10^{-6} W/m^2$ b) $2 \times 10^{-4} W/m^2$ c) $1 \times 10^{-4} W/m^2$ d) $4\ W/m^2$

493. The frequency of a tuning fork is 384 per second and velocity of sound in air is 352 m/s. How far the sound has traversed while fork completes 36 vibration
a) 3 m b) 13 m c) 23 m d) 33 m

494. Two trains, one coming towards and another going away from an observer both at 4 m/s produce whistle simultaneously of frequency 300 Hz. Find the number of beats produced
a) 5 b) 6 c) 7 d) 12

495. The equation of wave is represented by $Y = 10^{-4} \sin \left[100t - \frac{x}{10}\right] m$, then the velocity of wave will be
a) $100ms^{-1}$ b) $4ms^{-1}$ c) $1000ms^{-1}$ d) zero

496. A string vibrates with a frequency of 200 Hz. When its length is doubled and tension is altered, it begins to vibrate with a frequency of 300 Hz. The ratio of the new tension to the original tension is
a) 9:1 b) 1:9 c) 3:1 d) 1:3

497. Two sources produce sound waves of equal amplitudes and travelling along the same direction producing 18 beats in 3 seconds. If one source has a frequency of 341 Hz, the frequency of the other source may be
a) 329 or 353 Hz b) 335 or 347 Hz c) 338 or 344 Hz d) 332 or 350 Hz

498. If the equation of transverse wave is y=sin (kx-2t), then the maximum particle velocity is
a) 4 unit b) 2 unit c) Zero d) 6 unit

499. a segment of wire vibrates with a fundamental frequency of 450 Hz under a tension of 9 kg-wt. then tension at which the fundamental frequency of the same wire becomes 900 Hz is
a) 36 kg-wt b) 27 kg-wt c) 18 kg-wt d) 72 kg-wt

500. Stationary waves are set up in air column. Velocity of sound in air is 330 m/s and frequency is 165 Hz. Then distance between the nodes is
a) 2 m b) 1 m c) 0.5 m d) 4 m

501. Two whistles A and B produce notes of frequencies 660 Hz and 596 Hz respectively. There is a listener at the mid-point of the line joining them. Now the whistle B and the listener start moving with speed 30 m/s away from the whistle A. If speed of sound be 330 m/s, how many beats will be heard by the listener
a) 2 b) 4 c) 6 d) 8

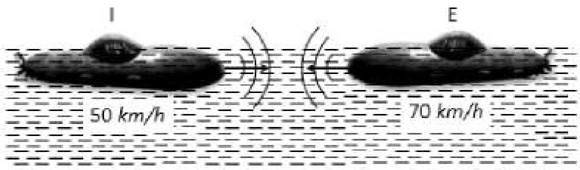
502. An open pipe is in resonance in 2nd harmonic with frequency v_1 Now one end of the tube is closed and frequency is increased to v_2 such that the resonance again occurs in nth harmonic. Choose the correct option.

a) $n = 3, v_2 = \frac{3}{4}v\_1$ b) $n = 3, v_2 - \frac{5}{4}v_1$ c) $n = 5, v_2 = \frac{5}{4}v_1$ d) $n = 5, v_2 = \frac{3}{4}v_1$

503. The superposing waves are represented by the following equations :
$y_1 = 5\sin 2\pi(10t - 0.1x)$, $y_2 = 10\sin 2\pi(20t - 0.2x)$
Ratio of intensities $\frac{I_{\max}}{I_{\min}}$ will be

a) 1 b) 9 c) 4 d) 16

504. An Indian submarine and an enemy submarine move towards each other during maneuvers in motionless water in the Indian ocean. The Indian submarine moves at 50 km/h, and the enemy submarine at 70 km/h. The Indian sub sends out a sonar signal (sound wave in water) at 1000 Hz. Sonar waves travel at 5500 km/h. What is the frequency detected by the Indian submarine



a) 1.04 kHz b) 2 kHz c) 2.5 kHz d) 4.7 kHz

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

a) 3 b) 4 c) 5 d) 7

506. A glass tube of length 1.0 m is completely filled with water. A vibrating tuning fork of frequency 500 Hz is kept over the mouth of the tube and water is drained out slowly at the bottom of tube. If velocity of sound in air is 330 ms^{-1}, then the total number of resonance that occur will be

a) 2 b) 3 c) 1 d) 5

507. Two Cu wires of radii R_1 and R_2such that $(R_1 > R_2)$. Then which of the following is true?

a) Transverse wave travels after in thicker wire
b) Transverse wave travels faster in thinner wire
c) Travels with the same speed in both the wires
d) Does not travel

508. The phase difference between two points separated by $1m$ in a wire of frequency 120 Hz is 90^0. The wave velocity is

a) 180 m/s b) 240 m/s c) 480 m/s d) 720 m/s

509. Suppose that the speed of sound in air at a given temperature is 400 m/sec. An engine blows a whistle at 1200 Hz frequency. It is approaching an observer at the speed of 100 m/sec. What is the apparent frequency as heard by the observer

a) 600 Hz b) 1200 Hz c) 1500 Hz d) 1600 Hz

510. If the velocity of sound in air is 350 m/s. Then the fundamental frequency of an open organ pipe of length 50 cm, will be

a) 350 Hz b) 1.75 Hz c) 900 Hz d) 750 Hz

511. The driver of a car travelling with speed 30 *metres per second* towards a hill sounds a horn of frequency 600 Hz. If the velocity of sound in air is 330 *metres per second*, the frequency of the reflected sound as heard by the driver is

a) 720 Hz b) 555.5 Hz c) 550 Hz d) 500 Hz

512. The distance between the nearest node and antinode in a stationary wave is

a) λ b) $\lambda/2$ c) $\lambda/4$ d) 2λ

513. If the wave equation $y = 0.08\sin\frac{2\pi}{\lambda}(200t - x)$ then the velocity of the wave will be

a) $400\sqrt{2}$ b) $200\sqrt{2}$ c) 400 d) 200

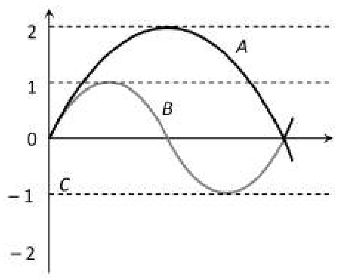
514. Two closed organ pipes of length 100 cm and 101 cm produce 16 beats in 20 sec. When each pipe is sounded in its fundamental mode calculate the velocity of sound

a) 303 ms^{-1} b) 332 ms^{-1} c) 323.2 ms^{-1} d) 300 ms^{-1}

515. Speed of sound in mercury at a certain temperature is 1450 m/s. Given the density of mercury as $13.6 \times 10^3 kg/m^3$, the bulk modulus for mercury is

a) $2.86 \times 10^{10} N/m^3$ b) $3.86 \times 10^{10} N/m^3$ c) $4.86 \times 10^{10} N/m^3$ d) $5.86 \times 10^{10} N/m^3$

516. The displacement-time graphs for two sound waves A and B are shown in the figure, then the ratio of their intensities I_A/I_B is equal to



a) 1 : 4 b) 1 : 16 c) 1 : 2 d) 1 : 1

517. Two sirens situated one kilometer apart are producing sound of frequency 330 Hz. An observer starts moving from one siren to the other with a speed of 2 m/s. If the speed of sound be 330 m/s, what will be the beat frequency heard by the observer

a) 8 b) 4 c) 6 d) 1

518. Sound waves travel at 350 m/s through a warm air and at 3500 m/s through brass. The wavelength of a 700 Hz acoustic wave as it enters brass from warm air

a) Decreases by a factor 20
b) Decreases by a factor 10
c) Increases by a factor 20
d) Increases by a factor 10

519. A source of sound of frequency 500 Hz is moving towards an observer with velocity 30ms^{-1}.The speed of sound is 330ms^{-1}.The frequency heard by the observer will be

a) 545 Hz b) 580 Hz c) 558.3 Hz d) 550 Hz

520. 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

a) 64 b) 256 c) 512 d) 1024

521. A tuning fork and a sonometer wire were sounded together and produce 4 beats per second. When the length of sonometer wire is 95 cm or 100 cm, the frequency of the tuning fork is

a) 156 Hz b) 152 Hz c) 148 Hz d) 160 Hz

522. The following equations represents 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

523. Sound waves in air always longitudinal because

a) Of the inherent characteristics of sound waves in air
b) Air does not have a modulus of rigidity
c) Air is a mixture of several gases
d) Density of air is very small

524. The tension of a stretched string is increased by 69%. In order to keep its frequency of vibration constant, its length must be increased by

a) 20% b) 30% c) $\sqrt{69}$% d) 69%

525. 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

526. Two passenger trains moving with a speed of 108 $km/hour$ cross each other. One of them blows a whistle whose frequency is 750 Hz. If sound speed is 330 m/s, then passengers sitting in the other train, after trains cross each other will hear sound whose frequency will be

a) 900 Hz b) 625 Hz c) 750 Hz d) 800 Hz

527. The velocity of sound I air is 330ms^{-1}. The rms velocity of air molecules ($\gamma = 1.4$) is approximately equal to

a) 400 ms^{-1} b) 471.4 ms^{-1} c) 231 ms^{-1} d) 462 ms^{-1}

528. A closed organ pipe and an open pipe of same length produce 2 beats s^{-1} when they are set into vibrations together in fundamental mode. The length of open pipe is now halved and that of closed pipe is doubled. The number of beats produced will be

a) 7 b) 4 c) 8 d) 2

529. A source of sound of frequency 256 Hz is moving rapidly towards a wall with a velocity of $5m/s$. The speed of sound is 330 m/s. If the observer is between the wall and the source, then beats per second heard will be

a) 7.8 Hz b) 7.7 Hz c) 3.9 Hz d) Zero

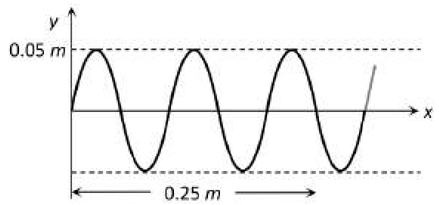
530. If the temperature is raised by 1 K from 300 K the percentage change in the speed of sound in the gaseous mixture is (R=8.31 J/mol-K)

a) 0.167% b) 0.334% c) 1% d) 2%

531. The frequency of the fundamental note in a wire stretched under tension T is v. if the tension is increased to 25T, then the frequency of the fundamental note will be

a) 25v b) 5v c) 10v d) V

532. If the speed of the wave shown in the figure is $330m/s$ in the given medium, then the equation of the wave propagating in the positive x-direction will be (all quantities are in M.K.S. units)



a) $y = 0.05 \sin 2\pi(4000\, t - 12.5\, x)$ b) $y = 0.05 \sin 2\pi(4000\, t - 122.5\, x)$

c) $y = 0.05 \sin 2\pi(3300\, t - 10\, x)$ d) $y = 0.05 \sin 2\pi(3300\, x - 10\, t)$

533. If two waves of the same frequency and amplitude respectively on superposition produce a resultant disturbance of the same amplitude, the waves differ in phase by

a) Π b) Zero c) Π/3 d) 2π/3

534. 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) 220 Hz b) 440 Hz c) 880 Hz d) 1760 Hz

535. Equations of a stationary wave and a travelling wave are $y_1 = a\ \sin kx\ \cos\omega t$ and $y_2 = a\ \sin(\omega t - kx)$. The phase difference between two points $x_1 = \frac{\pi}{3k}$ and $x_2 = \frac{3\pi}{2k}$ are ϕ_1 and ϕ_2 respectively for the two waves. The ratio ϕ_1/ϕ_2 is

a) 1 b) 5/6 c) 3/4 d) 6/7

536. 16 tuning forks are arranged in the order of increasing frequencies. Any two successive forks give 8 beats per sec when sounded together. If the frequency of the last fork is twice the first, then the frequency of the first fork is

a) 120 b) 160 c) 180 d) 220

537. An aeroplane be is above the head of an observer and the sound appears to be coming at an angle of 60^0 with the vertical. If velocity of sound is v, then the speed of aeroplane is

a) v b) $\frac{\sqrt{3}}{2}v$ c) $\frac{v}{2}$ d) 2

538. Two waves coming from two coherent sources, having different intensities interfere their ratio of maximum intensity to the minimum intensity is 25. The intensities of the sources are in the ratio

a) 25 : 1 b) 25 : 16 c) 9 : 4 d) 5 : 1

539. Quality of a musical note depends on

a) Harmonics present b) Amplitude of the wave c) Fundamental frequency d) Velocity of sound in the medium

540. The speed of a wave in a medium is 762 m/s. If 3600 waves are passing through a point, in the medium in 2 minutes, then its wavelength is

a) 13.8 m b) 25.3 m c) 41.5 m d) 57.2 m

541. The speed of sound oxygen (O_2) at a certain temperature is 460 ms^{-1}. The speed of sound in helium (He) at the same temperature will be (assume both gases to be ideal)

a) 500 ms^{-1} b) 650 ms^{-1} c) 330 ms^{-1} d) 1420 ms^{-1}

542. A vehicle with a horn of frequency $n$is moving with a velocity of 30ms^{-1} in a direction perpendicular to the straight line joining the observer and the vehicle. The observer perceives the sound to have a frequency $(n + n_1)$.If the sound velocity in air is 300ms^{-1}, then

a) $n_1 = 10n$ b) $n_1 = 0$ c) $n_1 = 0.1n$ d) $n_1 = -0.1n$

543. A whistle producing sound waves of frequency 9500 Hz above is approaching a stationary person with speedv ms^{-1}. The velocity of sound in air is 300 ms^{-1}. If the person can hear frequency up to a maximum of 10,000 Hz, the maximum value of v up to which he can hear the whistle is

a) $15\sqrt{2}\text{ms}^{-1}$ b) $15/\sqrt{2}\text{ms}^{-1}$ c) 15 ms^{-1} d) 30 ms^{-1}

544. The tension in a piano wire is 10N. What should be the tension in the wire to produce a note of double the frequency

a) 5 N b) 20 N c) 40 N d) 80 N

545. A source producing sound of frequency 170 Hz is approaching a stationary observer with a velocity 17 ms^{-1}. The apparent change in the wavelength of sound heard by the observer is (speed of sound in air = 340 ms^{-1})

a) 0.1m b) 0.2m c) 0.4m d) 0.5m

546. A resonance air column of length 20 cm resonated with a tuning fork of frequency 250 Hz. The speed of sound in air is

a) 300 m/s b) 200 m/s c) 150 m/s d) 75 m/s

547. The wavelength of a wave is 990 cm and that of other is 100 cm. speed of sound is 396 m/s. The number of beats heard is

a) 4 b) 5 c) 1 d) 8

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

a) 0 b) 1 c) 2 d) 3

549. With what velocity should an observer approach stationary sound source, so that apparent frequency of sound should appear double the actual frequency? (v is velocity of sound)

a) $\frac{v}{2}$ b) 3v c) 2v d) V

550. 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

551. The apparent frequency of a note is 200 Hz, when a listener is moving with a velocity of 40 ms^{-1} towards a stationary source. When he moves away from the same source with the same speed, the apparent frequency of the same notes is 160 Hz. The velocity of sound in air in $ms^{-1}$is

a) 340 b) 330 c) 360 d) 320

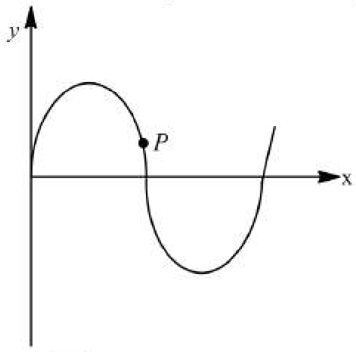
552. A fork of unknown frequency gives four beats s^{-1} when sounded with another of frequency 256. The fork is now loaded with a piece of wax and again four beats s^{-1} are heard. Then the frequency of the unknown fork is

a) 256 Hz b) 252 Hz c) 264 Hz d) 260 Hz

553. A tuning fork gives 5 beats with another tuning fork of frequency 100 Hz. When the first tuning fork is loaded with wax, then the number of beats remains unchanged, then what will be the frequency of the first tuning fork

a) 95 Hz b) 100 Hz c) 105 Hz d) 110 Hz

554. A transverse sinusoidal wave moves along a string in positive x-direction at a speed of 10cms^{-2}. The wavelength of the wave is 0.5 m and its amplitude is 10.cm at a particular time *t*, the snap-shot of the wave is shown in figure. The velocity of point P when its displacement is 5 cm is



a) $\frac{\sqrt{3}\pi}{50}\hat{j}ms^{-1}$ b) $-\frac{\sqrt{3}\pi}{50}\hat{j}ms^{-1}$ c) $\frac{\sqrt{3}\pi}{50}\hat{i}ms^{-1}$ d) $-\frac{\sqrt{3}\pi}{50}\hat{j}ms^{-1}$

555. Beats are produced with the help of two sound waves of amplitudes 3 and 5 *units*. The ratio of maximum to minimum intensity in the beats is

a) 2 : 1 b) 5 : 3 c) 4 : 1 d) 16 : 1

556. A tuning fork vibrates with 2 beats in 0.04 second. The frequency of the fork is

a) 50 Hz b) 100 Hz c) 80 Hz d) None of these

557. The wavelength of ultrasonic waves in air is of the order of

a) $5 \times 10^{-1} cm$ b) $5 \times 10^{-3} cm$ c) $5 \times 10^{1} cm$ d) $5 \times 10^{3} cm$

558. Frequency of a sonometer wire is n. Now its tension is increased 4 times and its length is doubled then new frequency will be

a) $n/2$ b) $4n$ c) $2n$ d) n

559. A motor cycle starts from rest and accelerates along a straight path at 2 ms^{-2}. At the starting point of the motor cycle gone when the driver hears the frequency of the siren at 94% of its value when the motor cycle was rest? (Speed =330 ms^{-1})

a) 49 m b) 98 m c) 147 m d) 196 m

560. An open organ pipe has fundamental frequency 100 Hz. What frequency will be produced if its one end is closed?

a) 100,200,300…… b) 50,150,250…… c) 50,100, 200,300…. d) 50,100,150,200……

561. The particles of a medium vibrate about their mean positions whenever a wave travels through that medium. The phase difference between the vibrations of two such particles

a) Varies with time b) Varies with distance separating them
c) Varies with time as well as distance d) Is always zero

562. Which of the following is not the transverse wave

a) X-rays b) γ-rays c) Visible light wave d) Sound wave in gas

563. In sine wave, minimum distance between 2 particles always having same speed is

a) $\frac{\lambda}{2}$ b) $\frac{\lambda}{4}$ c) $\frac{\lambda}{3}$ d) λ

564. In a sinusoidal wave, the time required for a particular point to move from maximum displacement to zero displacement is 0.14s. the frequency of the wave is

a) 0.42 Hz b) 2.75 Hz c) 1.79 Hz d) 0.56 Hz

565. The Speed of sound in a mixture of 1 mole of helium and 2 moles of oxygen at 27^0C is

a) 800ms^{-1} b) 400.8ms^{-1} c) 600ms^{-1} d) 1200ms^{-1}

566. For simple harmonic vibrations $y_1 = 8\ cos\omega t$

$y_2 = 4\cos(\omega t + \frac{\pi}{2})$

$y_3 = 2\cos(\omega t + \pi)$

$y_4 = \cos\left(\omega t + \frac{3\pi}{2}\right)$ are superimposed on one another. The resulting amplitude and phase are respectively

a) $\sqrt{45}$ and $\tan^{-1}(\frac{1}{2})$ b) $\sqrt{45}$ and $\tan^{-1}\left(\frac{1}{3}\right)$ c) $\sqrt{75}$ and $\tan^{-1}(2)$ d) $\sqrt{75}$ and $\tan^{-1}(\frac{1}{3})$

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

a) $\frac{20}{n}$ b) $\frac{10}{n}$ c) $\frac{5}{n}$ d) $\frac{n}{10}$

568. The electric field part of an electromagnetic wave in a medium is represented by $E_x = 0$;

$E_y = 2.5\frac{N}{C}\cos\left[\left(2\pi \times 10^6 \frac{rad}{m}\right)t - \left(\pi \times 10^{-2}\frac{rad}{s}\right)x\right]$;

$E_2 = 0$. The wave is

a) Moving along y direction with frequency $2\pi \times 10^6 Hz$ and wavelength 200 m

b) Moving along x direction with frequency $10^6 Hz$ and wavelength 100 m

c) Moving along x direction with frequency $10^6 Hz$ and wavelength 200 m

d) Moving along $-x$ direction with frequency $10^6 Hz$ and wavelength 200 m

569. Two wires are producing fundamental notes of the same frequency. Change in which of the following factors of one wire will not produce beats between them

a) Amplitude of the vibrations b) Material of the wire

c) Stretching force d) Diameter of the wires

570. The speed of sound in air is 340 m/s. The speed with which a source of sound should move towards a stationary observer so that the apparent frequency becomes twice of the original

a) $640m/s$ b) $340m/s$ c) $170m/s$ d) $85m/s$

571. Two open organ pipes of length 25 cm and 25.5 cm produce 10 $beat/sec$. The velocity of sound will be

a) 255 m/s b) 250 m/s c) 350 m/s d) None of these

572. 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) 3:4 c) 3:2 d) 1:3

573. The tension in a wire is decreased by 19%. The percentage decrease in frequency will be

a) 19% b) 10% c) 0.19% d) None of these

574. A sounding source of frequency 500 Hz moves towards a stationary observer with a velocity30 ms^{-1}. If the velocity of sound in air is 330 ms^{-1}, find frequency heard by the observer.

a) 500 Hz b) 550 Hz c) 355 Hz d) 55.5 Hz

575. The amplitude of wave disturbance propagating in positive direction of X–axis is given by $y = \frac{1}{1+x^2}$ at t=0 and by $y = \frac{1}{1+(x-1)^2}$ at t=2s where x and y are in meters. The shape of the wave disturbance does not change during propagation. The velocity of the wave is

a) 0.5ms^{-1} b) 2.0ms^{-1} c) 1.0ms^{-1} d) 4.0ms^{-1}

576. A plane EM wave of frequency 30 MHz travels in free space along the x-direction. The electric field component of the wave at a particular point of space and time $E = 6\,V/m$ along y-direction. Its magnetic field component B at this point would be

a) 2×10^{-8} T along z-direction
b) 6×10^{-6} T along x-direction
c) 2×10^{-8} T along y-direction
d) 6×10^{-8} T along z-direction

577. Two strings with masses per unit length of 25 gcm^{-1} and 9 gcm^{-1} are joined together in series. The reflection coefficient for the vibration waves is

a) $\frac{9}{25}$
b) $\frac{3}{5}$
c) $\frac{1}{16}$
d) $\frac{9}{16}$

578. The difference between the apparent frequency of a source of sound as perceived by the observer during its approach and recession is 2% of the frequency of the source. If the speed of sound in air is 300 ms^{-1}, the velocity of the source is

a) 1.5 ms^{-1}
b) 12 ms^{-1}
c) 6 ms^{-1}
d) 3 ms^{-1}

579. The temperature at which the speed of sound in air becomes double of its value at 0°C is

a) 273 K
b) 546 K
c) 1092 K
d) 0 K

580. Two tuning fork of frequency n_1 and n_2 produces n beats per second. If n_2 and n are known, n_1 may be given by

a) $\frac{\text{n}_2}{\text{n}} + \text{n}_2$
b) n_2n
c) $\text{n}_2 \pm \text{n}$
d) $\frac{\text{n}_2}{\text{n}} - \text{n}_2$

581. The displacement y of a wave travelling in the x -direction is given by $y = 10^{-4}\sin(600t - 2x + \frac{\pi}{3})$ meters, where x is expressed in meters and t is second. The speed of the wave-motion, in ms^{-1}, is

a) 200
b) 300
c) 600
d) 1200

582. An open pipe is in resonance in its 2nd harmonic with tuning fork of frequency f_1. Now it is closed at one end. If the frequency of the tuning fork is increased slowly from f_1 then again a resonance is obtained with a frequency f_2. If in this case the pipe vibrates n^{th} harmonics then

a) $n = 3, f_2 = \frac{3}{4}f_1$
b) $n = 3, f_2 = \frac{5}{4}f_1$
c) $n = 5, f_2 = \frac{5}{4}f_1$
d) $n = 5, f_2 = \frac{3}{4}f_1$

583. In 1 m long open pipe what is the harmonic of resonance obtain with a tuning fork of frequency 480 Hz?

a) First
b) Second
c) Third
d) Fourth

584. 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

585. Two sound waves of slightly different frequencies propagating in the same direction produce beats due to

a) Interference
b) Diffraction
c) Polarization
d) Refraction

586. Two waves having equations

$x_1 = a\sin(\omega t + \phi_1)$, $x_2 = a\sin(\omega t + \phi_2)$

If in the resultant wave the frequency and amplitude remain equal to those of superimposing waves. Then phase difference between them is

a) $\pi/6$
b) $2\pi/3$
c) $\pi/4$
d) $\pi/3$

587. A train approaches a stationary observer, the velocity of train being $\frac{1}{20}$ of the velocity of sound. A sharp blast is blown with the whistle of the engine at equal intervals of a second. The interval between the successive blasts as heard by the observer is

a) $\frac{1}{20}s$
b) $\frac{1}{20}$ min
c) $\frac{19}{20}s$
d) $\frac{10}{20}$ min

588. If the amplitude of sound is doubled and the frequency reduced to one-fourth, the intensity of sound at the same point will be

a) Increased by a factor of 2
b) Decreased by a factor of 2
c) Decreased by a factor of 4
d) Unchanged

589. Two tuning forks A and B vibrating simultaneously produce 5 beats. Frequency of B is 512. It is seen that if one arm of A is filed, then the number of beats increases. Frequency of A will be

a) 502
b) 507
c) 517
d) 522

590. The displacement of a particle executing periodic motion is given by $y = 4\cos^2(t/2)\sin(1000t)$. This expression may be considered to be a result of superposition of

a) Two waves b) Three waves c) Four waves d) Five waves

591. In order to double the frequency of the fundamental note emitted by a stretched string, the length is reduced to $3/4th$ of the original length and the tension is changed. The factor by which the tension is to be changed, is

a) 3/8 b) 2/3 c) 8/9 d) 9/4

592. Two waves of wavelengths 50 cm and 51 cm produced 12 beats per second. The velocity of sound is

a) 306 m/s b) 331 m/s c) 340 m/s d) 360 m/s

593. The equation of a stationary wave along a stretched string is given by $y = 4\sin\frac{2\pi x}{2}\cos 40\pi t$ where x and y are in cms and t is in sec. The separation between two adjacent nodes is

a) 3 cm b) 1.5 cm c) 6 cm d) 4 cm

594. The length of a sonometer wire AB is 110 cm. Where should the two bridges be placed from A to divide the wire in three segments whose fundamental frequencies are in the ratio of 1:2:3

a) 30 cm, 90 cm b) 60 cm, 90 cm c) 40 cm, 70 cm d) None of these

595. Two strings X and Y of a sitar produce a beat frequency $4Hz$. When the tension of the string Y is slightly increased the beat frequency is found to be 2 Hz. If the frequency of X is 300 Hz, then the original frequency of Y was

a) 296 Hz b) 298 Hz c) 302 Hz d) 304 Hz

596. The number of waves contained in unit length of the medium is called

a) Elastic wave b) Wave number

c) Wave pulse d) Electromagnetic wave

597. A train is moving at $30ms^{-1}$ in still air. The frequency of the locomotive whistle is 500 Hz and the speed of sound is $345ms^{-1}$. The apparent wavelength of sound in front of and behind the locomotive are respectively

a) $0.80m, 0.63m$ b) $0.63m, 0.80m$ c) $0.50m, 0.85m$ d) $0.63m, 0.75m$

598. Decibel is unit of

a) Intensity of light b) X-rays radiation capacity

c) Sound loudness d) Energy of radiation

599. The difference between the apparent frequency of a source of sound as perceived by the observer during its approach and recession is 2% of the natural frequency of the source. If the velocity of sound in air is 300ms^{-1}, the velocity of source is

a) 12ms^{-1} b) 1.5ms^{-1} c) 3ms^{-1} d) 6ms^{-1}

600. An object producing a pitch of 400 Hz flies past a stationary person. The object was moving in a straight line with a velocity200 ms^{-1}. What is the change in frequency noted by the person as the person as the object files past him?

a) 1440 Hz b) 240 Hz c) 1200 Hz d) 960 Hz

601. A racing car moving towards a cliff sounds its horn. The driver observes that the sound reflected from the actual sound of the horn. If v is velocity of sound, the velocity of the car is

a) $\frac{v}{\sqrt{2}}$ b) $\frac{v}{2}$ c) $\frac{v}{3}$ d) $\frac{v}{4}$

602. Which of the following is different from others

a) Velocity b) Wavelength c) Frequency d) Amplitude

603. The frequency of a tuning fork A is 2% more than the frequency of a standard tuning fork. The frequency of the same standard tuning fork. If 6 beats s^{-1} are heard when the two tuning fork A and B are excited, the frequency of A is

a) 120 Hz b) 122.4 Hz c) 116.4 Hz d) 130 Hz

604. The speed of sound in gas of density ρ at a pressure p is proportional to

a) $\left(\frac{p}{\rho}\right)^{2}$ b) $\left(\frac{p}{\rho}\right)^{\frac{3}{2}}$ c) $\sqrt{\frac{\rho}{p}}$ d) $\sqrt{\frac{p}{\rho}}$

605. 'SONAR' emits which of the following waves

a) Radio waves b) Ultrasonic waves c) Light waves d) Magnetic waves

606. A tuning fork of frequency 500 Cycles/s is sounded on a resonance tube. The first and second resonance is obtained at 17 cm and 52 cm. the velocity of sound in ms^{-1} is

a) 175 b) 350 c) 525 d) 700

607. 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 sec. If speed of sound in air is 330 m/s, the speed of engine is

a) 10 m/s b) 20 m/s c) 30 m/s d) 40 m/s

608. Fundamental frequency of a sonometer wire is n. if the length and diameter of the wire are doubled keeping the tension same, then the new fundamental frequency is

a) $\frac{2n}{\sqrt{2}}$ b) $\frac{n}{2\sqrt{2}}$ c) $\sqrt{2}n$ d) $\frac{n}{4}$

609. A hollow cylinder with both sides open generates a frequency v in air. When the cylinder vertically immersed into water by half its length the frequency will be

a) V b) 2v c) v/2 d) v/4

610. Two waves are given by $y_1 = a\sin(\omega t - kx)$ and $y_2 = a\cos(\omega t - kx)$

The phase difference between the two waves is

a) $\pi/4$ b) π c) $\pi/8$ d) $\pi/2$

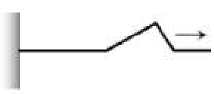
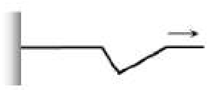
611. When the length of the vibrating segment of a sonometer wire is increased by 1% the percentage changes its frequency is

a) $\frac{100}{101}$ b) $\frac{99}{100}$ c) 1 d) 2

612. It is possible to distinguish between the transverse and longitudinal waves by studying the property of

a) Interference b) Diffraction c) Reflection d) Polarisation

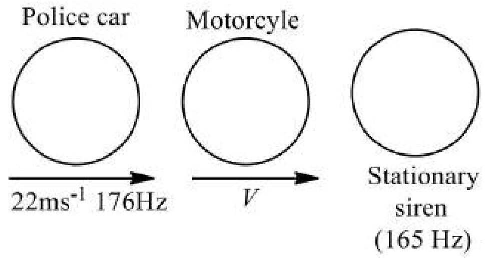
613. Figure here shown an incident pulse P reflected from a rigid support. Which one of A, B, C, D represents the reflected pulse correctly

a)  b)  c)  d) 

614. If $\lambda_1, \lambda_2, \lambda_3$ are the wavelengths of the waves giving resonance with the fundamental, first and second overtones respectively of a closed organ pipe, then the ratio of $\lambda_1, \lambda_2, \lambda_3$ is

a) 1:3:5 b) 1:2:3 c) 5:3:1 d) $1:\frac{1}{3}:\frac{1}{5}$

615. A police car moving at22 ms^{-1}, changes a motorcyclist. The police man sounds his horn at 176 Hz, while both of them move towards a stationary siren of frequency 165 Hz. Calculate the speed of the motorcycle, if it is given that he does not observe any beats.



a) $33ms^{-1}$ b) $22\ ms^{-1}$ c) Zero d) $11ms^{-1}$

616. The equation of a plane progressive waves is given by $y = 0.025 \sin(100t + 0.25x)$. The frequency of this wave would be

a) $\frac{50}{\pi} Hz$ b) $\frac{100}{\pi} Hz$ c) $100\ Hz$ d) $50\ Hz$

617. A transverse wave of amplitude $0.5\ m$ and wavelength $1\ m$ and frequency $2\ Hz$ is is propagating in a string in the negative x-direction. The expression for this wave is

a) $y(x,t) = 0.5 \sin(2\pi x - 4\pi t)$ b) $y(x,t) = 0.5 \cos(2\pi x + 4\pi t)$

c) $y(x,t) = 0.5 \sin(\pi x - 2\pi t)$ d) $y(x,t) = 0.5 \cos(2\pi x + 2\pi t)$

618. The minimum intensity of sound is zero at a point due to two sources of nearly equal frequencies, when

a) Two sources are vibrating in opposite phase

b) The amplitude of two sources are equal

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) Both the sources are in the same phase

619. A string is under tension so that its length is increased by $\frac{1}{n}$ times its original length. The ratio of fundamental frequency of longitudinal vibrations and transverse vibrations will be

a) $1:n$ b) $n^2:1$ c) $\sqrt{n}:1$ d) $n:1$

620. The equation of stationary wave along a stretched string is given by $y = 5 \sin\frac{\pi x}{3} \cos 40\pi t$, where x and y are in cm and t in second. The separation between two adjacent nodes is

a) $1.5\ cm$ b) $3\ cm$ c) $6\ cm$ d) $4\ cm$

621. The intensity of sound gets reduced by 10% on passing through a slab. The reduction in intensity on passing through three consecutive slab is

a) 30% b) 27.1% c) 20% d) 36%

622. v_1 and v_2 are the velocities of sound at the same temperature in two monoatomic gases of densities ρ_1 and ρ_2 respectively. If $\rho_1/\rho_2 = \frac{1}{4}$ then the ratio of velocities v_1 and v_2 will be

a) 1 : 2 b) 4 : 1 c) 2 : 1 d) 1 : 4

623. A source of sound emitting a tone of frequency 200 Hz moves towards an observer with a velocity v equal to the velocity of sound. If the observer also moves away from the source with the same velocity v, the apparent frequency heard by the observer is

a) 50Hz b) 100 Hz c) 150 Hz d) 200 Hz

624. The period of a wave is 360 ms^{-1} and frequency is 500 Hz. Phase difference between two consecutive particals is 60, then path different between them will be

a) 0.72 cm b) 120 cm c) 12 cm d) 7.2 cm

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

a) $\frac{2}{3}v$ b) v c) $\frac{3}{2}v$ d) $3v$

626. 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 8.0km/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

627. Two open organ pipes gives 4 $beats/sec$ when sounded together in their fundamental nodes. If the length of the pipe are 100 cm and 102.5 cm respectively, then the velocity of sound is :

a) 496 m/s b) 328 m/s c) 240 m/s d) 160 m/s

628. Intensity level of sound of intensity I is 30 dB. The ratio $\frac{I}{I_0}$ is (Where I_0 is the threshold of hearing)

a) 3000 b) 1000 c) 300 d) 30

629. The minimum audible wavelength at room temperature is about

a) 0.2 Å b) 5 Å c) 5 cm to 2 $metre$ d) 20 mm

630. The nature of sound waves in gases is

a) Transverse b) Longitudinal c) Stationary d) Electromagnetic

631. The ratio of densities of nitrogen and oxygen is 14: 16. The temperature at which the speed of sound in nitrogen will be same at that in oxygen at 55°C is

a) 35°C b) 48°C c) 65°C d) 14°C

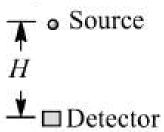
632. In a progressive wave, the distance between two consecutive crests is

a) $\frac{\lambda}{2}$ b) λ c) $2\,\lambda$ d) $\frac{2}{\lambda}$

633. Two speakers connected to the same source of fixed frequency are placed 2.0 m apart in a box. A sensitive microphone placed at a distance of 4.0m from their midpoint along the perpendicular bisector shows maximum response. The box is slowly rotated until the speakers are in line with the microphone. The distance between the midpoint of the speakers and the microphone remains unchanged. Exactly five maximum responses are observed in the microphone in doing this. The wavelength of the sound wave is

a) 0.2 m b) 0.4 m c) 0.6 m d) 0.8 m

634. A sound source is falling under gravity. At some time t=0, the detector lies vertically hallow sources at a depth H as shown in figure. If $v$is the velocity of sound and f_0 is frequency recorded after t=2s is



a) f_0 b) $\frac{f_0(v+2g)}{v}$ c) $\frac{f_0(v-2g)}{v}$ d) $f_0\left(\frac{v}{v-2g}\right)$

635. Two stretched strings have length $\boldsymbol{l}$ and 2$\boldsymbol{l}$ while tensions are T and 4T respectively. If they are made of same material the ratio of their frequencies is

a) 2:1 b) 1:2 c) 1:1 d) 1:4

636. A transverse wave is described by the equation

$y = yo \sin 2\ \pi \left(ft \frac{x}{\gamma}\right)$.The maximum particle velocity

is equal to four times the wave velocity, if

a) $\lambda = \frac{\pi y_0}{4}$ b) $\lambda = \frac{\pi y_0}{2}$ c) $\lambda = \pi y_0$ d) $\lambda = 2\pi y_0$

637. Doppler shift in frequency does not depend upon

a) The frequency of the wave produced b) The velocity of the source

c) The velocity of the observer d) Distance from the source to the listener

638. The magnetic field in the plane electromagnetic field is given by

$B_y = 2 \times 10^{-7} \sin(0.5 \times 10^3 z + 1.5 \times 10^{11} t)T$

The expression for the electric field may be given by

a) $E_y = 2 \times 10^{-7} \sin(0.5 \times 10^3 z + 1.5 \times 10^{11} t)\ V/m$

b) $E_x = 2 \times 10^{-7} \sin(0.5 \times 10^3 z + 1.5 \times 10^{11} t)\ V/m$

c) $E_y = 60 \sin(0.5 \times 10^3 z + 1.5 \times 10^{11} t) V/m$

d) $E_x = 60\sin(0.5 \times 10^3 z + 1.5 \times 10^{11} t) V/m$

639. A pipe 30 cm long is open at both ends. Which harmonic mode of the pipe is resonantly excited by a 1.1 kHz source? (Take speed of sound in air = 330 ms^{-1})

a) First b) Second c) Third d) Fourth

640. A wave of frequency 500 Hz has a velocity360ms^{-1}. The phase difference between two displacements at a certain point at a time 10^{-3} s apart will be

a) π rad b) π/2 rad c) π/4 rad d) 2π rad

641. Three waves of equal frequency having amplitudes 10 μm, 4μm and 7 μm 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

642. In a medium sound travels 2 km in 3 sec and in air, it travels 3 km in 10 sec. The ratio of the wavelengths of sound in the two media is

a) 1 : 8 b) 1 : 18 c) 8 : 1 d) 20 : 9

643. A stationary point source of sound emits sound uniformly in all directions in a non-absorbing medium. Two points $P$and $Q$are at a distance of 4m and 9m respectively from the source. The ratio of amplitudes of the waves at $P$and $Q$is

a) $\frac{3}{2}$ b) $\frac{4}{9}$ c) $\frac{2}{3}$ d) $\frac{9}{4}$

644. A siren emitting sound of frequency 800 Hz is going away from a static listener with a speed of 30 m/s, frequency of the sound to be heard by the listener is (take velocity of sound as 330 m/s)

a) 733.3 Hz b) 644.8 Hz c) 481.2 Hz d) 286.5 Hz

645. In the 3rd overtone of an open organ pipe, there are (N-stands for nodes and A-for antinodes)

a) $2N, 3A$ b) $3N, 4A$ c) $4N, 5A$ d) $5N, 4A$

646. Two progressive waves having equation $x_1 = 3\sin \omega t$ and $x_2 = 4\sin(\omega t - 90°)$ are superimposed. The amplitude of the resultant wave is

a) 5 unit b) 1 unit c) 3 unit d) 4 unit

647. Two trains, each moving with a velocity of 30 ms^{-1}, cross each other. One of the trains gives a whistle whose frequency is 600Hz. If the speed of sound is 330 ms^{-1} the apparent frequency for passengers sitting in the other train before crossing would be

a) 600 Hz b) 630 Hz c) 920 Hz d) 720 Hz

648. A boat at anchor is rocked by waves whose crests are 100m apart and velocity is 25ms^{-1}. The boat bounces up once in every

a) 2500 s b) 75 s c) 4 s d) 0.25 s

649. If you set up the seventh harmonic on a string fixed at both ends, how many nodes and antinodes are set up in it

a) 8,7 b) 7,7 c) 8,9 d) 9,8

650. If n_1, n_2 and n_3 are the fundamental frequencies of three segments into which a string is divided, then the original fundamental frequency n of the string is give by

a) $\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$ b) $\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{n_1}} + \frac{1}{\sqrt{n_2}} + \frac{1}{\sqrt{n_3}}$

c) $\sqrt{n} = \sqrt{n_1} + \sqrt{n_2} + \sqrt{n_3}$ d) $n = n_1 + n_2 + n_3$

651. A tube closed at one end and containing air is excited. It produces the fundamental note of frequency 512 Hz. If the same tube is open at both the ends the fundamental frequency that can be produced is

a) 1024 Hz b) 512 Hz c) 256 Hz d) 128 Hz

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

a) $a\omega$ b) $\frac{\omega}{k}$ c) $\frac{d\omega}{dk}$ d) $\frac{x}{l}$

653. If the temperature of the atmosphere is increased, the following character of the sound wave is effected

a) Amplitude b) Frequency c) Velocity d) Wavelength

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

a) 18 >x b) X >54 c) 54 > x >36 d) 36 > x > 18

655. A source of frequency n given 5 beats s^{-1}, when sounded with a source of frequency 200 s^{-1}. The second harmonic (2n) gives 10 beats s^{-1}, when sounded with a source of frequency 420 s^{-1}. n is equal to

a) 200 s^{-1} b) 205 s^{-1} c) 195 s^{-1} d) 210 s^{-1}

656. At which temperature the speed of sound in hydrogen will be same as that of speed of sound in oxygen at 100°C

a) −148°C b) −212.5°C c) −317.5°C d) −249.7°C

657. The equation of a wave travelling in a string can be written as $y = 3\cos\pi(100t - x)$. Its wavelength is

a) 100 cm b) 2 cm c) 5 cm d) None of the above

658. If n_1, n_2, n_3 .... are the frequencies of segments of a stretched string, the frequency n of the string is given by

a) $n = n_1 + n_2 + n_3 + \ ....$ b) $n = \sqrt{n_1 \times n_2 \times n_3 \times ...}$

c) $\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3} + \ ...$ d) None of these

659. A wave motion is described by $y(x,t) = a\sin(kx - wt)$. Then the ratio of the maximum particle velocity to the wave velocity is

a) ωa b) $\frac{1}{ka}$ c) $\frac{\omega}{k}$ d) ka

660. A source of sound of frequency 600 Hz is placed inside water. The speed of sound in water is 1500 ms^{-1} and in air it is300 ms^{-1}. The frequency of sound recorded by an observer who is standing in air is

a) 200 Hz b) 300 Hz c) 120 Hz d) 600 Hz

661. The fundamental frequency of a sonameter wire is v. if its radius is doubled and its tension becomes half, the material of the wire remains same, the new fundamental frequency will be

a) V b) $\frac{v}{\sqrt{2}}$ c) $\frac{v}{2}$ d) $\frac{v}{2\sqrt{2}}$

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

a) 100 b) 1000 c) 10000 d) 10

663. A wave is represented by the equation $y = 7\sin\{\pi(2t - 2x)\}$ where x is in $metres$ and t in seconds. The velocity of the wave is

a) 1 m/s b) 2 m/s c) 5 m/s d) 10 m/s

664. Sound waves of v=600Hz fall normally on a perfectly reflecting wall. The shortest distance from the wall at which all particles will have maximum amplitude of vibration will be (speed of sound=300ms^{-1})

a) $\frac{7}{8}m$ b) $\frac{3}{8}m$ c) $\frac{1}{8}m$ d) $\frac{1}{4}m$

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

a) 600 Hz b) 585 Hz c) 645 Hz d) 666 Hz

666. A bomb explodes on the moon. How long will it take for the sound to reach the earth?

a) 1000 s b) 1 day c) 10 s d) None of these

667. A string is hanging from a rigid support. A transverse pulse is excited at its free end. The speed at which the pulse travels a distance x is proportional to

a) x b) $\frac{1}{x}$ c) $\frac{1}{\sqrt{x}}$ d) $\sqrt{x}$

668. The harmonic which are present in a pipe open at one end are

a) Odd harmonics b) Even harmonics

c) Even as well as odd harmonics d) None of these

669. In open organ pipe, if fundamental frequency is n then the other frequencies are

a) $n, 2n, 3n, 4n$ b) $n, 3n, 5n$ c) $n, 2n, 4n, 8n$ d) None of these

670. If a source emitting waves a velocity $v/4$ and the observer moves away from the source with a velocity v/6, the apparent frequency as heard by the observer will be (v=velocity of sound)

a) $\frac{14}{15}v$ b) $\frac{14}{9}v$ c) $\frac{10}{9}v$ d) $\frac{2}{3}v$

671. On producing the waves of frequency 1000 Hz in a Kundt's tube, the total distance between 6 successive nodes is 85 cm. Speed of sound in the gas filled in the tube is

a) 330 m/s b) 340 m/s c) 350 m/s d) 300 m/s

672. A column of air of length 50 cm resonates with a stretched string of length 40 cm. The length of the same air column which will resonates with 60 cm of the same string at a the same tension is

a) 100 cm b) 75 cm c) 50 cm d) 25 cm

673. In the musical octave 'Sa', 'Re', 'Ga'

a) The frequency of the note 'Sa' is greater than that of 'Re', 'Ga'

b) The frequency of the note 'Sa' is smaller than that of 'Re', 'Ga'

c) The frequency of all the notes 'Sa', 'Re', 'Ga' is the same

d) The frequency decreases in the sequence 'Sa', 'Re', 'Ga'

674. A stone is dropped into a well. If the depth of water below the top be h and velocity of sound in air be v, the time after which splash of sound is heard is

a) $\sqrt{\frac{2h}{g}} + \frac{h}{v}$ b) $\sqrt{\frac{2h}{g}} - \frac{h}{v}$ c) $\sqrt{\frac{2h}{g}}$ d) $\sqrt{\frac{2h}{g}} \times \frac{h}{v}$

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

a) 2 : 1 b) 4 : 1 c) 9 : 1 d) 10 : 8

676. Calculate the frequency of the second harmonic formed on a string of length 0.5 m and mass $2 \times 10^{-4} kg$ when stretched with a tension of 20 N

a) 274.4 Hz b) 744.2 Hz c) 44.72 Hz d) 447.2 Hz

677. Velocity of sound measured in hydrogen and oxygen gas at a given temperature will be in the ratio

a) 1 : 4 b) 4 : 1 c) 2 : 1 d) 1 : 1

678. A closed Prgan pipe and an open organ pipe of same length produce 2 beats/second while vibrating in their fundamental modes. The length of the open organ pipe is halved and that of closed pipe is doubled. Then the number of beats produced per second while vibrating in the fundamental mode is

a) 2 b) 6 c) 8 d) 7

679. Two waves are represent by

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

and

$y_2 = A\cos(kx - \omega t)$. The amplitude of resultant wave is

a) 4A b) 2A c) $\sqrt{2}$A d) A

680. The sound wave was produced in a gas is always

a) Longitudinal b) Transverse c) Stationary d) Electromagnetic

681. Which two of the given transverse waves will give stationary waves when get superimposed

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

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

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

a) A and B b) A and C c) B and C d) Any two

682. The line of a sight of a jet plane makes an angle of 60^0 with the vertical, and the sound appears to be coming from over the head of the observer. The speed of jet plane is (taking speed of sound waves to be v)

a) v b) $v/\sqrt{3}$ c) $v\sqrt{3}$ d) $2v$

683. The path difference between two waves

$y_1 = a_1 \sin\left(\omega t - \frac{2\pi x}{\lambda}\right)$ and $y_2 = a_2 \cos\left(\omega t - \frac{2\pi x}{\lambda} + \phi\right)$is

a) $\frac{\lambda}{2\pi}(\phi)$ b) $\frac{\lambda}{2\pi}\left(\phi + \frac{\pi}{2}\right)$ c) $\frac{2\pi}{\lambda}\left(\phi - \frac{\pi}{2}\right)$ d) $\frac{2\pi}{\lambda}(\phi)$

684. A simple wave motion represented by $y = 5(\sin 4\pi t + \sqrt{3}\cos 4\pi t)$. Its amplitude is

a) 5 b) $5\sqrt{3}$ c) $10\sqrt{3}$ d) 10

685. A wave has velocity v in medium P and velocity 2v in medium Q. If the wave is incident in medium P at an angle of 30°, then the angle of refraction will be

a) 30° b) 45° c) 60° d) 90°

686. Two sources of sound placed to each other, are emitting progressive waves given by $y_1 = 4\sin 600\pi t$ and $y_2 = 5\sin 608\pi t$. An observer located near these two sources of sound will hear

a) 4 beats per second with intensity ratio 25 : 16 between waxing and waning
b) 8 beats per second with intensity ratio 25 : 16 between waxing and waning
c) 8 beats per second with intensity ratio 81 : 1 between waxing and waning
d) 4 beats per second with intensity ratio 81 : 1 between waxing and waning

687. Sound waves transfer

a) Only energy not momentum b) Energy
c) Momentum d) Both energy and momentum

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

a) Sinusoidal shape with amplitude $A/3$ b) Sinusoidal shape with amplitude $A/2$
c) Sinusoidal shape with amplitude A d) Straight line

689. When two wave of almost equal frequencies n_1 *and* $n_2$are produced simultaneously, then the time interval between successive maxima is

a) $\frac{1}{n_1 - n_2}$ b) $\frac{1}{n_1} - \frac{1}{n_2}$ c) $\frac{1}{n_1} + \frac{1}{n_2}$ d) $\frac{1}{n_1 + n_2}$

690. Three similar wire of frequency n_1, n_2 and n_3 are joined to make one wire. Its frequency will be

a) $n = n_1 + n_2 + n_3$ b) $\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$
c) $\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{n_1}} + \frac{1}{\sqrt{n_2}} + \frac{1}{\sqrt{n_3}}$ d) $\frac{1}{n^1} = \frac{1}{n_1^2} + \frac{1}{n_2^2} + \frac{1}{n_3^2}$

691. A string of length 2m 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 it with a velocity of

a) 125 ms^{-1} b) 250 ms^{-1} c) 500 ms^{-1} d) 1000 ms^{-1}

692. 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 at 100 Hz. The fundamental frequency of the open pipe is

a) 200 Hz b) 480 Hz c) 240 Hz d) 300 Hz

693. Two identical sound A and Breach a point in the same phase. The resultant sound is C. The loudness of C is n dB higher the loudness of A.

a) 2 b) 3 c) 4 d) 6

694. When two sound waves are superimposed, beats are produced when they have

a) Different amplitudes and phase b) Different velocities
c) Different phases d) Different frequencies

695. Beats are produced when two progressive waves of frequency 256 Hz ad 260 Hz superpose. Then the resultant amplitude changes periodically with frequency of

a) 256 Hz b) 260 Hz c) $\frac{256-260}{2}$ Hz d) 4 Hz

696. A particle moving along x-axis has acceleration f, at time t, given by $f = f_0\left(1-\frac{t}{T}\right)$, where f_0 and T are constants. The particle at $t = 0$ has zero velocity. In the time interval between $t = 0$ has zero velocity. In the time interval between $t = 0$ and the instant when $f = 0$, the particle's velocity (v_x) is

a) f_0T b) $\frac{1}{2}f_0T^2$ c) f_0T^2 d) $\frac{1}{2}f_0T$

697. 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 from the fixed end of the string. The speeds of incident (and reflected) waves are

a) 5ms^{-1} b) 10ms^{-1} c) 20ms^{-1} d) 40ms^{-1}

698. The extension in a string obeying Hooke's law is$x$. The speed of transverse waves in the stretched is$v$. If the extension in the string is increased to 1.5 x, the speed of transverse waves in it will be

a) 1.22 v b) 0.61 v c) 1.5 v d) 0.75 v

699. 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

a) 3.2 cm b) 4.2 m c) 4.2 cm d) 3.2 m

700. The fundamental frequency of a string stretched with a weight of 4 kg is 256 Hz. The weight required to produce its octave is

a) 16 kg-wt b) 12 kg-wt c) 24 kg-wt d) 4 kg-wt

701. In stationary waves all particles between two nodes pass through the mean position

a) At different times with different velocities

b) At different times with the same velocity

c) At the same time with equal velocity

d) At the same time with different velocities

702. A whistle of frequency 500 Hz, tie to the end of a string of length 1.2m, resolves at 400 rev/min. A listener standing some distance away in the plane of rotation of whistle hears frequency in the range of (speed of sound=340 ms^{-1})

a) 436 to 386 Hz b) 426 to 474 Hz c) 426 to 586 Hz d) 436 to 586 Hz

703. If the length of a closed organ pipe is 1.5 m and velocity of sound is 330 m/s, then the frequency for the second note is

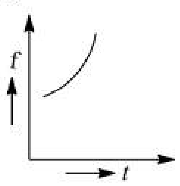
a) 220 Hz b) 165 Hz c) 110 Hz d) 55 Hz

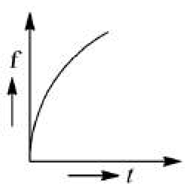
704. A travelling wave passes a point of observation. At this point, the time interval between successive crests is 0.2 seconds and

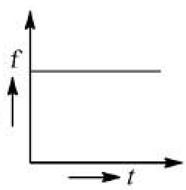
a) The wavelength is 5 m b) The frequency is 5 Hz

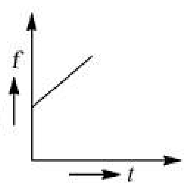
c) The velocity of propagation is 5 m/s d) The wavelength is 0.2 m

705. An observer starts moving with uniform acceleration$a$, towards a stationary sound source of frequencyf_0. As the observer approaches the source, the apparent frequency(f)heard by the observer varies with time (t)is

a) 

b) 

c) 

d) 

706. A metal wire of liner mass density of 9.8 $gm^{-1}$is stretched with a tension of kg-wt between two rigid supports 1 m 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 sources is

a) 50 Hz b) 100 Hz c) 200 Hz d) 25 Hz

707. A plane wave is represented by $x = 1.2\sin(314t + 12.56y)$. Where x and y are distances measured along in x and y direction in meters and t is time in seconds. This wave has

a) A wavelength of 0.25 m and travels in $+ve\ x$ direction
b) A wavelength of 0.25 m and travels in $+ve\ y$ direction
c) A wavelength of 0.5 m and travels in $-ve\ y$ direction
d) A wavelength of 0.5 m and travels in $-ve\ x$ direction

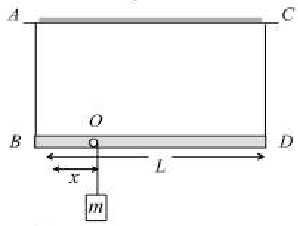
708. A hospital uses an ultrasonic scanner to locate tumours in a tissue. The operating frequency of the scanner is 4.0 MHz. The speed of should in a tissue is 1.7 $km-s^{-1}$. The wavelength of sound in the tissue is close to

a) $4\times10^{-4}m$ b) $8\times10^{-3}m$ c) $4\times10^{-3}m$ d) $8\times10^{-4}m$

709. A standing wave is represented by
$Y=A\sin(100t)\cos(0.01x)$
Where Y and A are in $millimetre$, t is in seconds and x is in $metre$. The velocity of wave is

a) $10^4 m/s$
b) $1\ m/s$
c) $10^{-4}m/s$
d) Not derivable from above data

710. A massless rod is suspended by two identical strings AB and CD of equal length. A block of mass m is suspended from point O such that BO is equal to $''x''$ Further, it is observed that the frequency of 1st harmonic (fundamental frequency) in AB is equal to 2nd harmonic frequency in CD. Then, length of BO is



a) $\frac{L}{5}$ b) $\frac{4L}{5}$ c) $\frac{3L}{4}$ d) $\frac{L}{4}$

711. A man standing between two parallel hills, claps his hand and hears successive echoes at regular intervals of 11s. If velocity of sound is $340ms^{-1}$, then the distance between the hills is

a) 100m b) 170 m c) 510 m d) 340 m

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

a) 1:1 b) 2:1 c) 1:4 d) 1:2

713. A string of density 7.5 gm cm^{-3} and area of cross-section $0.2mm^2$ is stretched under a tension of 20N. when it is plucked at the mid-point, the speed of the transverse wave on the wire is

a) $116ms^{-1}$ b) $40\ ms^{-1}$ c) $200\ ms^{-1}$ d) $80\ ms^{-1}$

714. A device used for investigating the vibration of a fixed string of wire is

a) Sonometer b) Barometer c) Hydrometer d) None of these

715. The wave length of light in visible part (λ_V) and for sound (λ_S) are related as

a) $\lambda_V>\lambda_S$ b) $\lambda_S>\lambda_V$ c) $\lambda_S=\lambda_V$ d) None of these

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

a) 240 Hz b) 230 Hz c) 220 Hz d) 200 Hz

717. Two waves of same frequency and intensity superimpose with each other in opposite phases, then after superposition the

a) Intensity increases by 4 times
b) Intensity increases by two times
c) Frequency increases by 4 times
d) None of these

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

a) Amplitude of sound
b) Intensity of sound
c) Wavelength of sound
d) Overtones present in the sound

719. If sound wave travel from air to water, which of the following remain unchanged?

a) Velocity b) Wavelength c) Frequency d) Intensity

720. Intensity level 200 cm from a source of sound is 80 dB. If there is no loss of acoustic power in air and intensity of threshold hearing is $10^{-12} Wm^{-2}$ then, what is the intensity level at a distance of 4000 cm from source

a) Aero b) 54 dB c) 64 dB d) 44 dB

721. Equation of progressive wave is

$y = a \sin\left[10\pi x + 11\pi t + \frac{\pi}{3}\right]$

a) Its wavelength is 0.2 units b) It is travelling in the positive x-direction

c) Wave velocity is 1.5 unit d) Time period of SHM is 1 s

722. The velocity of sound in air is $330 \mathrm{ms}^{-1}$ and the velocity of light in air is $3 \times 10^8 \mathrm{ms}^{-1}$. What frequency, in Hz does a BBC station which transmits at 1500m broadcast?

a) 2×10^5Hz b) 595×10^3Hz c) 0.22 Hz d) 5×10^{-6}Hz

723. A vehicle sounding a whistle of frequency 256 Hz is moving on a straight road, towards a hill with a velocity of10 ms^{-1}. The number of beats per second observed by a person travelling in the vehicle is (velocity of sound =330 ms^{-1})

a) Zero b) 10 c) 14 d) 16

724. A car moving with a velocity of 36 km^{-1} crosses a siren of frequency 500 Hz. The apparent frequency of siren after passing it will be

a) 520 Hz b) 485 Hz c) 540 Hz d) 460 Hz

725. A string of 7 m length has a mass of 0.035 kg. If tension in the string is 60.5 N, then speed of a wave on the string is

a) 77 m/s b) 102 m/s c) 110 m/s d) 165 m/s

726. A stone is dropped in a well which is 19.6m deep. Echo sound is heard after 2.06 sec (after dropping) then the velocity of sound is

a) 332.6 m/sec b) 326.7 m/sec c) 300.4 m/sec d) 290.5 m/sec

727. Fundamental frequency of an open pipe of length 0.5 m is equal to the frequency of the first overtone of a closed pipe of length l. The value of l_c is (m)

a) 1.5 b) 0.75 c) 2 d) 1

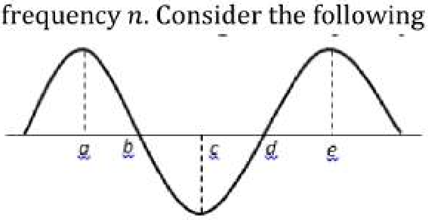
728. The frequency of fundamental tone in an open organ pipe of length 0.48 m is 320 Hz. Speed of sound is 320 m/sec. Frequency of fundamental tone in closed organ pipe will be

a) 153.8 Hz b) 160.0 Hz c) 320.0 Hz d) 143.2 Hz

729. The equation of a wave is 3cos π (50t-x). the wavelength of the wave is

a) 3 unit b) 2 unit c) 50 unit d) 47 unit

730. The rope shown at an instant is carrying a wave travelling towards right, created by a source vibrating at a frequency n. Consider the following statements



I. The speed of the wave is $4n \times ab$

II. The medium at a will be in the same phase as d after $\frac{4}{3n} s$

III. The phase difference between b and e is $\frac{3\pi}{2}$

Which of these statements are correct

a) I, II and III b) II only c) I and III d) III only

731. Two vibrating tuning forks produce progressive waves given by $y_1 = 4 \sin 500\pi t$ *and* $y_2 = \sin 50\pi t$. Number of beats produced per minute is

a) 360 b) 180 c) 3 d) 60

732. An organ pipe P closed at one end vibrates in its first harmonic. Another organ pipe Q open at both ends vibrates in its third harmonic. When both are in resonance with a tuning fork, the ratio of the length of P to that of Q is

a) 1/2 b) 1/4 c) 1/6 d) 1/8

733. A wave equation is given by $y = 4\sin\left[\pi\left(\frac{t}{5} - \frac{x}{9} + \frac{1}{6}\right)\right]$ where x is in cm and t is in second. Which of the following is true?

a) $\lambda = 18\ cm$ b) $v = 4ms^{-1}$ c) a=0.4 cm d) f= 50 Hz

734. A bat flies at a steady speed of 4 ms^{-1} emitting a sound of $f = 90 \times 10^3$ Hz. It is flying horizontally towards a vertical wall. The frequency of the reflected sound as defected by the bat will be (take velocity of sound in air as 330 ms^{-1})

a) 88.1×10^3Hz b) 87.1×10^3Hz c) 92.1×10^3Hz d) 89.1×10^3Hz

735. A wave travelling in positive X-direction with $A = 0.2m$ has a velocity of 360 m/sec. If $\lambda = 60m$, then correct expression for the wave is

a) $y = 0.2\sin\left[2\pi\left(6t + \frac{x}{60}\right)\right]$ b) $y = 0.2\sin\left[\pi\left(6t + \frac{x}{60}\right)\right]$

c) $y = 0.2\sin\left[2\pi\left(6t - \frac{x}{60}\right)\right]$ d) $y = 0.2\sin\left[\pi\left(6t - \frac{x}{60}\right)\right]$

736. A whistle sends out 256 waves in a second. If the whistle approaches the observer with velocity 1/3 of the velocity of sound in air, the number of waves per second the observer will receive

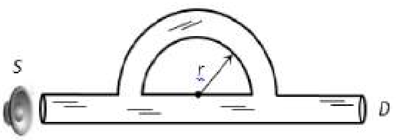
a) 384 b) 192 c) 300 d) 200

737. A is singing a note and at the same time B is singing a note with exactly one-eight the frequency of the note of A. The energies of two sounds are equal, the amplitude of the note of B is

a) Same that of A b) Twice as that of A

c) Four times as that of A d) Eight times as that of A

738. A sound wave of wavelength 32 cm enters the tube at S as shown in the figure. Then the smallest radius r so that a minimum of sound is heard at detector D is



a) 7 cm b) 14 cm c) 21 cm d) 28 cm

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

a) 9:4 b) 2:3 c) 3:2 d) 4:9

740. A plane progressive wave is represented by the equation $y = 0.1\sin\left(200\pi t - \frac{20\pi x}{17}\right)$ where y is displacement in m, t in second and x is distance from a fixed origin in $meter$. The frequency, wavelength and speed of the wave respectively are

a) 100 Hz, 1.7 m, 170 m/s b) 150 Hz, 2.4 m, 200 m/s

c) 80 Hz, 1.1 m, 90 m/s d) 120 Hz, 1.25 m, 207 m/s

741. Walls of auditorium should be

a) Good absorber b) Reflector c) Amplifier d) Modifier

742. A hollow cylinder with both sides open generates a frequency f in air. When the cylinder vertically immersed into water by half its length the frequency will be

a) f b) $2f$ c) $f/2$ d) $f/4$

743. 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

a) Zero b) $\pi/2$ c) π d) $3\pi/2$

744. An organ pipe open at one end is vibrating in first overtone and is in resonance with another pipe open at both ends and vibrating in third harmonic. The ratio of length of two pipe is

a) 1:2 b) 4:1 c) 8:3 d) 3:8

745. An observer is approaching a stationary source with a velocity 1/4 th of the velocity of sound. Then the ratio of the apparent frequency to actual frequency of source is

a) 4:5 b) 5:4 c) 2:3 d) 3:2

746. Two strings A and B of lengths, $L_A = 80\ cm$ and $L_B = x\ cm$respectively are used separately in a sonometer. The ratio of their densities (d_A/d_B) is 0.81. the diameter of B is one-half that of A. if the strings have the same tension and fundamental frequency the value of x is

a) 33 b) 102 c) 144 d) 130

747. When a sound wave of wavelength λ is propagating in a medium, the maximum velocity of the particle is equal to the velocity. The amplitude of wave is

a) λ b) $\frac{\lambda}{2}$ c) $\frac{\lambda}{2\pi}$ d) $\frac{\lambda}{4\pi}$

748. The equation of the propagating wave is $y = 25\sin(20t + 5x)$, where y is displacement. Which of the following statements is not true

a) The amplitude of the wave is 25 units

b) The wave is propagating in positive x-direction

c) The velocity of the wave is 4 units

d) The maximum velocity of the particles is 500 units

749. Angle between wave velocity and particle velocity of a longitudinal wave is

a) 90^o b) 60^o c) 0^o d) 120^o

750. The equation $y = 0.15\sin 5x \cos 300t$, describes a stationary wave. The wavelength of the stationary wave is

a) Zero b) 1.256 $metres$ c) 2.512 $metres$ d) 0.628 $metre$

751. The phase difference between two points is π/3. If the frequency of waves is 50 Hz, then what is the distance between two points? (Given v=330 ms^{-1})

a) 2.2 m b) 1.1 m c) 0.6 m d) 1.7 m

752. In open organ pipe, if fundamental frequency is v, then the other frequencies are

a) V,2v,3v,4v b) V,3v,5v c) V,2v,4v,8v d) None of these

753. A string fixed at both the ends is vibrating in two segments. The wavelength of the corresponding wave is

a) $\frac{l}{4}$ b) $\frac{l}{2}$ c) l d) $2l$

754. If vibrations of a string are to be increased by a factor of two, then tension in the string must be made

a) Half b) Twice c) Four times d) Eight times

755. The equation for spherical progressive wave is (where r is the distance from the source)

a) $y = a\sin(\omega t - kx)$ b) $y = \frac{a}{\sqrt{r}}\sin(\omega t - kx)$ c) $y = \frac{a}{2}\sin(\omega t - kx)$ d) $y = \frac{a}{r}\sin(\omega t - kx)$

756. An open pipe of length l vibrates in fundamental mode. The pressure variation is maximum at

a) 1/4 from ends b) The middle of pipe

c) The ends of pipe d) At 1/8 from ends of pipe

757. A source is moving towards an observer with a speed of 20 m/s and having frequency of 240 Hz. The observer is now moving towards the source with a speed of 20 m/s. Apparent frequency herad by observer, if velocity of sound is 340 m/s, is

a) 240 Hz b) 270 Hz c) 280 Hz d) 360 Hz

758. To raise the pitch of a stringed musical instrument the player can

a) Loosen the string b) Tighten the string c) Shorten the string d) Both (b) and (c)

759. Two organ pipes both closed at one end have length $l$and$(l + \Delta l)$. Neglect ed correction. If velocity of sound I air is v, the number of beats s^{-1} is

a) $v/4l$ b) $v/2l$ c) $\frac{v}{4l^2}(\Delta l)$ d) $\frac{v}{2l^2}(\Delta l)$

760. If v is the speed of sound in air then the shortest length of the closed pipe which resonates to a frequency n

a) $\frac{v}{4n}$ b) $\frac{v}{2n}$ c) $\frac{2n}{v}$ d) $\frac{4n}{v}$

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

a) 10 b) 0.5 c) 1 d) 0.117

762. Two vibrating strings of the same material but length L and 2L have radii 2r and r respectively. They are stretched under the same tension. Both the strings vibrate in their fundamental modes, the one of the length L with frequency v_1 and the other with frequency$v2$. the ratio $v/v_2$is

a) 2 b) 4 c) 8 d) 1

763. 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

a) $\frac{A}{\sqrt{2}}:\frac{\omega}{2}$ b) $\frac{A}{\sqrt{2}}:\omega$ c) $\sqrt{2}A:\frac{\omega}{2}$ d) $\sqrt{2}A:\omega$

764. A source of sound emits $400\pi W$ power which is uniformly distributed over a sphere of 10 m radius. What is the loudness of sound on the surface of a sphere

a) 200 dB b) 200 π dB c) 120 dB d) 120 π dB

765. A glass tube 1.5 m 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 330 m/sec is

a) 12 b) 6 c) 8 d) 4

766. A travelling wave represented by $y = a \sin(\omega t - kx)$ is superimposed on another wave represented by$y = a \sin(\omega t + kx)$. The resultant is

a) A standing wave having nodes at $x = \left(n + \frac{1}{2}\right)\frac{\lambda}{2}, n = 0,1,2$

b) A wave travelling along + x direction

c) A wave travelling along - x direction

d) A standing wave having nodes at $x = \frac{n\lambda}{2}; n = 0,1,2$

767. A wave in a string has an amplitude of 2 cm. The wave travels in the +ve direction of x axis with a speed of 128 m/sec and it is noted that 5 complete waves fit in 4 m length of the string. The equation describing the wave is

a) $y = (0.02)m \sin(7.85\, x + 1005t)$ b) $y = (0.02)m \sin(15.7\, x - 2010t)$

c) $y = (0.02)m \sin(15.7\, x + 2010t)$ d) $y = (0.02)m \sin(7.85\, x - 1005t)$

768. In a closed organ pipe the frequency of fundamental note is 50 Hz. The note of which of the following frequencies will not be emitted by it

a) 50 Hz b) 100 Hz c) 150 Hz d) None of the above

769. Which of the following is the longitudinal wave

a) Sound waves b) Waves on plucked string

c) Water waves d) Light waves

770. The equation of a spherical progressive wave is

a) $y = a\, sin\omega t$ b) $y = a\, sin(\omega t - kr)$ c) $y = \frac{a}{\sqrt{r}}\sin(\omega t - kr)$ d) $y = \frac{a}{r} sin(\omega t - kr)$

771. A tuning fork makes 256 vibrations per second in air. When the velocity of sound is 330 m/s, then wavelength of the tone emitted is

a) 0.56 m b) 0.89 m c) 1.11 m d) 1.29 m

772. A light pointer fixed to one prong of a tuning fork touches a vertical plate. The fork is set vibrating and the plate is allowed to fall freely. If eight oscillations are counted when the plate falls through 10 cm, the frequency of the tuning fork is

a) 360 Hz b) 280 Hz c) 560 Hz d) 56 Hz

773. A wave travels in a medium according to the equation of displacement given by
$y(x,t) = 0.03\sin(2t - 0.01x)$
Where y and x are in $metres$ and t in seconds. The wavelength of the wave is
a) $200\ m$ b) $100\ m$ c) $20\ m$ d) $10\ m$

774. A string of mass 0.2 kg m has length $l = 0.6$m. It I fixed at both ends and stretched such that it has a tension of 80 N. The string vibrates in three segments with amplitude=0.5 cm. The amplitude of transverse velocity is
a) 9.42ms^{-1} b) 3.14ms^{-1} c) 1.57ms^{-1} d) 6.28ms^{-1}

775. In a stationary wave all the particles
a) On either side of a node vibrate in same phase
b) In the region between two nodes vibrate in same phase
c) In the region between two antinodes vibrate in same phase
d) Of the medium vibrate in same phase

776. Distance between nodes on a string is 5 cm. velocity of transverse wave is2ms^{-1}. Then the frequency is
a) 5 Hz b) 10 Hz c) 20 Hz d) 15 Hz

777. If in a resonance tube a oil of density higher than that water is used then at the resonance frequency would
a) Increase b) Decrease c) Slightly increase d) Remain same

778. If the tension of sonometer's wire increases four times then the fundamental frequency of the wire will increase by
a) 2 times b) 4 times c) 1/2 times d) None of the above

779. The equation of a wave on a string of linear mass density $0.04\ kgm^{-1}$ is given by $y = 0.02(m)\sin\left[2\pi\left(\frac{t}{0.04(s)} - \frac{x}{0.50(m)}\right)\right]$. The tension in the string is
a) $6.25\ N$ b) $4.0\ N$ c) $12.5\ N$ d) $0.5\ N$

780. 50 tuning forks are arranged in increasing order of their frequencies such that each gives 4 beats/sec with its previous tuning fork. If the frequency of the last fork is octave of the first, then the frequency of the frequency of the first tuning fork is
a) $200\ Hz$ b) $204\ Hz$ c) $196\ Hz$ d) None of these

781. Maximum number of beats frequency heard by a human being is
a) 10 b) 4 c) 20 d) 6

782. Two tuning fork P and Q when set vibrating give 4 beats/s. if a prong of the fork P is filed the beats are reduced to$2s^{-1}$. What is frequency of P, if that of Q is 250 Hz?
a) 246 Hz b) 250 Hz c) 254 Hz d) 252 Hz

783. Out of the following, incorrect statement is
a) In Melde's experiment "P^2T" remain constant. (P=Loop, T=Tension)
b) In Kundt's experiment distance between two heaps of powder is $\lambda/2$
c) Quinckeey's tube experiment related with beats
d) Echo phenomena related with reflection of sound

784. The number of beats produced per second by two vibrations: $x_1 = x_0\sin 646\,\pi t$ and $x_2 = x_0\sin 652\,\pi t$ is
a) 2 b) 3 c) 4 d) 6

785. Which of the following equations represents a wave travelling along y-axis
a) $y = A\sin(kx - \omega t)$ b) $x = A\sin(ky - \omega t)$ c) $y = A\sin ky\cos\omega t$ d) $y = A\cos ky\sin\omega t$

786. What should be the velocity of a sound source moving towards a stationary observer so that apparent frequency is double the actual frequency (Velocity of sound is v)
a) v b) $2v$ c) $\frac{v}{2}$ d) $\frac{v}{4}$

787. A string of linear density 0.2 kgm^{-1} is stretched with a force of 500 N. A transverse wave of length 4.0 m and amplitude $(1/\lambda)$ metre is traveling along. Then the speed of the wave is
a) 50ms^{-1} b) 62.5ms^{-1} c) 2500ms^{-1} d) 12.5ms^{-1}

788. The amplitude of two waves are in ratio 5:2. If all other conditions for the two waves
Are same, then what is the ratio of their energy densities?

a) 5:2 b) 5:4 c) 4:5 d) 25:4

789. Quality depends on

a) Intensity b) Loudness c) Timbre d) Frequency

790. A standing wave is produced in a string fixed at both ends. In this case

a) All particles vibrate in phase
b) All antinodes vibrate in phase
c) All alternate antinodes vibrate in phase
d) All particles between two consecutive antinodes vibrate in phase

791. When sound is produced in an aeroplane moving with a velocity of 200 ms^{-1}horizontal its echo is heard after $10\sqrt{5}$s. if velocity of sound in air is 300 $ms^{-1}$the elevation of aircraft is

a) 250 m b) $250\ \sqrt{5}m$ c) 12.50 m d) 2500 m

792. **Statement I** Two longitudinal waves given by equation $y_1(x,t) = 2a\sin(\omega t - kx)$ and $y_2(x,t) = a\sin(2\omega t - 2kx)$ will have equal intensity.
Statement II Intensity of waves of given frequency in same medium is proportional to square of amplitude only

a) Statement I is false, Statement II is true
b) Statement I is true, Statement II is false
c) Statement I is true, Statement II is true, Statement II is the correct explanation of statement I
d) Statement I is true, Statement II is true, Statement II is not correct explanation of statement I

793. Velocity of sound is maximum in

a) Air b) Water c) Vacuum d) Steel

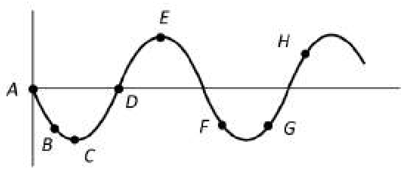
794. The sound carried by air from a sitar to a listener is a wave of the following type

a) Longitudinal stationary
b) Transverse progressive
c) Transverse stationary
d) Longitudinal progressive

795. The frequency of fundamental note in an organ pipe is 240 Hz. On blowing air, frequencies 720 Hz and 1200 Hz are heard. This indicates that organ pipe is

a) A pipe closed at one end
b) A pipe open at both ends
c) Closed at both ends
d) Having holes like flute

796. The diagram below shows the propagation of a wave. Which points are in same phase



a) F, G b) C and E c) B and G d) B and F

797. The frequency of transverse vibrations in a stretched string is 200 Hz. If the tension is increased four times and the length is reduced to one-fourth the original value, the frequency of vibration will be

a) 25 Hz b) 200 Hz c) 400 Hz d) 1600 Hz

798. A uniform wire of length L, diameter D and density S is stretched under a tension T. the correct relation between its fundamental frequency f, the length L and the diameter D is

a) $f \propto \frac{1}{LD}$ b) $f \propto \frac{1}{L\sqrt{D}}$ c) $f \propto \frac{1}{D^2}$ d) $f \propto \frac{1}{LD^2}$

799. The fundamental note produced by a closed organ pipe is of frequency f. The fundamental note produced by an open organ pipe of same length will be of frequency

a) $f/2$ b) f c) $2f$ d) $4f$

800. Two tuning forks have frequencies 450 Hz and 454 Hz respectively. On sounding these forks together, the time interval between successive maximum intensities will be

a) $1/4\ sec$ b) $1/2\ sec$ c) $1\ sec$ d) $2\ sec$

801. The following phenomenon cannot be observed for sound waves

a) Refraction b) Interference c) Diffraction d) Polarisation

802. Ultrasonic waves are produced by
a) Piezoelectric effect b) Pettiro's effect c) Doppler's effect d) Coulomb's law

803. A big explosion on the moon cannot be heard on the earth because
a) The explosion produces high frequency sound waves which are inaudible
b) Sound waves require a material medium for propagation
c) Sound waves are absorbed in the moon's atmosphere
d) Sound waves are absorbed in the earth's atmosphere

804. 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) Plucked at $\frac{l}{4}$ and touch at $\frac{l}{2}$ b) Plucked at $\frac{l}{4}$ and touch at $\frac{3l}{4}$
c) Plucked at $\frac{l}{2}$ and touched at $\frac{l}{4}$ d) Plucked at $\frac{l}{2}$ and touched at $\frac{3l}{4}$

805. Doppler phenomena is related with
a) Pitch (frequency) b) Loudness c) Quality d) Reflection

806. A tuning fork arrangement (pair) produces 4 $beats/sec$ with one fork of frequency 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) 286 cps b) 292 cps c) 294 cps d) 288 cps

807. A string on a musical instrument is 50 cm long and its fundamental frequency is 270 Hz. If the desired frequency of 1000 Hz is to be produced, the required length of the string is
a) 13.5 cm b) 2.7 cm c) 5.4 cm d) 10.3 cm

808. Find beat frequency? Motion of two particles is given by
$y_1 = 0.25\sin(310t)$
$y_2 = 0.25\sin(316t)$
a) 3 b) $\frac{3}{\pi}$ c) $\frac{6}{\pi}$ d) 6

809. The apparent frequency of a note, when a listener moves towards a stationary source, with velocity of 40 m/s is 200 Hz. When the moves away from the same source with the same speed, the apparent frequency of the same note is 160 Hz. The velocity of sound in air is (in m/s)
a) 360 b) 330 c) 320 d) 340

810. A police car with a siren of frequency 8 kHz is moving with uniform velocity 36 km/h towards a tall building which reflects the sound waves. The speed of sound in air is 320 m/s. the frequency of the siren heard by the car driver is
a) 8.5 kHz b) 8.25 kHz c) 7.25 kHz d) 7.5 kHz

WAVES

: ANSWER KEY :

1)	c	2)	b	3)	a	4)	a
5)	c	6)	d	7)	b	8)	b
9)	a	10)	a	11)	d	12)	a
13)	a	14)	c	15)	c	16)	b
17)	b	18)	b	19)	a	20)	a
21)	d	22)	d	23)	b	24)	b
25)	b	26)	c	27)	d	28)	c
29)	d	30)	d	31)	a	32)	d
33)	b	34)	c	35)	a	36)	d
37)	c	38)	a	39)	c	40)	c
41)	a	42)	b	43)	b	44)	d
45)	c	46)	c	47)	b	48)	b
49)	d	50)	c	51)	d	52)	a
53)	c	54)	c	55)	b	56)	c
57)	b	58)	b	59)	b	60)	d
61)	b	62)	a	63)	b	64)	d
65)	c	66)	b	67)	a	68)	a
69)	d	70)	a	71)	c	72)	b
73)	d	74)	b	75)	d	76)	c
77)	b	78)	a	79)	a	80)	c
81)	b	82)	d	83)	b	84)	a
85)	c	86)	c	87)	b	88)	c
89)	c	90)	c	91)	d	92)	b
93)	b	94)	c	95)	b	96)	d
97)	a	98)	d	99)	d	100)	b
101)	a	102)	a	103)	b	104)	b
105)	d	106)	d	107)	a	108)	c
109)	a	110)	b	111)	a	112)	a
113)	b	114)	d	115)	d	116)	c
117)	d	118)	b	119)	c	120)	a
121)	c	122)	c	123)	c	124)	b
125)	d	126)	a	127)	c	128)	a
129)	b	130)	c	131)	c	132)	d
133)	b	134)	c	135)	a	136)	a
137)	b	138)	a	139)	a	140)	c
141)	d	142)	a	143)	c	144)	d
145)	c	146)	a	147)	a	148)	d
149)	c	150)	d	151)	b	152)	c
153)	c	154)	b	155)	a	156)	b
157)	c	158)	b	159)	b	160)	c

161)	b	162)	c	163)	b	164)	d
165)	b	166)	b	167)	c	168)	c
169)	b	170)	b	171)	b	172)	d
173)	d	174)	c	175)	b	176)	b
177)	d	178)	a	179)	a	180)	c
181)	a	182)	c	183)	c	184)	b
185)	d	186)	d	187)	a	188)	b
189)	b	190)	d	191)	c	192)	c
193)	a	194)	a	195)	b	196)	d
197)	b	198)	d	199)	b	200)	a
201)	c	202)	d	203)	c	204)	c
205)	c	206)	c	207)	a	208)	b
209)	a	210)	a	211)	d	212)	b
213)	a	214)	d	215)	c	216)	c
217)	d	218)	a	219)	c	220)	d
221)	b	222)	b	223)	c	224)	c
225)	c	226)	d	227)	c	228)	a
229)	b	230)	a	231)	b	232)	b
233)	a	234)	a	235)	b	236)	a
237)	b	238)	a	239)	b	240)	d
241)	b	242)	a	243)	c	244)	b
245)	b	246)	c	247)	b	248)	d
249)	b	250)	b	251)	b	252)	b
253)	a	254)	c	255)	a	256)	a
257)	b	258)	c	259)	d	260)	a
261)	c	262)	d	263)	c	264)	a
265)	c	266)	a	267)	b	268)	b
269)	a	270)	c	271)	b	272)	a
273)	b	274)	b	275)	d	276)	b
277)	a	278)	c	279)	d	280)	c
281)	a	282)	a	283)	a	284)	b
285)	c	286)	b	287)	d	288)	d
289)	b	290)	b	291)	a	292)	b
293)	b	294)	d	295)	a	296)	a
297)	a	298)	b	299)	a	300)	c
301)	a	302)	c	303)	c	304)	a
305)	a	306)	d	307)	d	308)	a
309)	c	310)	c	311)	d	312)	b
313)	b	314)	d	315)	c	316)	c
317)	d	318)	b	319)	c	320)	b

321) b	322) a	323) c	324) d	521) a	522) a	523) b	524) b
325) b	326) c	327) a	328) a	525) c	526) b	527) b	528) a
329) a	330) b	331) a	332) c	529) d	530) a	531) b	532) c
333) a	334) c	335) b	336) d	533) d	534) c	535) d	536) a
337) b	338) a	339) a	340) c	537) b	538) c	539) a	540) b
341) d	342) d	343) d	344) c	541) d	542) b	543) c	544) c
345) c	346) b	347) a	348) b	545) a	546) b	547) a	548) c
349) c	350) c	351) b	352) d	549) d	550) c	551) c	552) d
353) c	354) d	355) a	356) b	553) c	554) a	555) d	556) a
357) a	358) a	359) b	360) b	557) a	558) d	559) b	560) b
361) a	362) a	363) c	364) d	561) b	562) d	563) a	564) c
365) a	366) c	367) d	368) b	565) b	566) a	567) b	568) c
369) b	370) b	371) d	372) a	569) a	570) c	571) a	572) d
373) a	374) d	375) a	376) d	573) b	574) b	575) a	576) a
377) a	378) d	379) c	380) c	577) c	578) d	579) c	580) c
381) c	382) c	383) b	384) a	581) b	582) c	583) c	584) a
385) c	386) b	387) d	388) b	585) a	586) b	587) c	588) c
389) c	390) a	391) a	392) b	589) c	590) b	591) d	592) a
393) c	394) a	395) a	396) c	593) b	594) b	595) a	596) b
397) a	398) a	399) c	400) c	597) d	598) c	599) c	600) c
401) c	402) d	403) c	404) a	601) c	602) d	603) a	604) d
405) a	406) c	407) c	408) a	605) b	606) b	607) c	608) d
409) a	410) b	411) a	412) d	609) a	610) d	611) c	612) d
413) b	414) a	415) b	416) c	613) d	614) d	615) b	616) a
417) c	418) b	419) a	420) b	617) b	618) c	619) c	620) b
421) d	422) b	423) c	424) c	621) b	622) c	623) d	624) c
425) a	426) c	427) c	428) b	625) a	626) c	627) b	628) b
429) d	430) d	431) b	432) a	629) d	630) b	631) d	632) b
433) b	434) b	435) a	436) d	633) b	634) d	635) c	636) b
437) d	438) c	439) b	440) b	637) d	638) d	639) b	640) a
441) b	442) a	443) d	444) b	641) c	642) d	643) d	644) a
445) c	446) c	447) d	448) a	645) c	646) a	647) d	648) c
449) d	450) a	451) d	452) c	649) a	650) a	651) a	652) a
453) c	454) b	455) a	456) a	653) c	654) b	655) b	656) d
457) a	458) c	459) a	460) b	657) b	658) c	659) d	660) d
461) a	462) d	463) b	464) d	661) d	662) a	663) a	664) c
465) d	466) d	467) d	468) d	665) d	666) d	667) d	668) a
469) d	470) b	471) c	472) a	669) a	670) c	671) b	672) b
473) a	474) a	475) c	476) d	673) b	674) a	675) b	676) d
477) c	478) a	479) a	480) d	677) b	678) d	679) c	680) a
481) c	482) c	483) b	484) c	681) a	682) c	683) b	684) d
485) b	486) a	487) b	488) c	685) d	686) d	687) d	688) d
489) a	490) c	491) a	492) a	689) a	690) b	691) c	692) a
493) d	494) c	495) a	496) a	693) d	694) d	695) d	696) d
497) b	498) a	499) a	500) b	697) c	698) a	699) b	700) a
501) b	502) c	503) b	504) a	701) d	702) d	703) b	704) b
505) c	506) b	507) b	508) c	705) d	706) a	707) c	708) a
509) d	510) a	511) a	512) c	709) a	710) a	711) c	712) d
513) d	514) c	515) a	516) d	713) a	714) a	715) b	716) a
517) b	518) d	519) d	520) d	717) d	718) d	719) c	720) b

721)	a	722)	a	723)	d	724)	b
725)	c	726)	b	727)	b	728)	b
729)	b	730)	c	731)	b	732)	c
733)	a	734)	c	735)	c	736)	a
737)	d	738)	b	739)	a	740)	a
741)	a	742)	a	743)	d	744)	a
745)	b	746)	c	747)	c	748)	b
749)	c	750)	b	751)	b	752)	a
753)	c	754)	c	755)	d	756)	b
757)	b	758)	d	759)	c	760)	a
761)	d	762)	d	763)	d	764)	c
765)	b	766)	a	767)	d	768)	b

769)	a	770)	d	771)	d	772)	d
773)	a	774)	c	775)	b	776)	c
777)	d	778)	a	779)	a	780)	c
781)	a	782)	a	783)	c	784)	b
785)	b	786)	c	787)	a	788)	d
789)	c	790)	c	791)	d	792)	b
793)	d	794)	d	795)	a	796)	d
797)	d	798)	a	799)	c	800)	a
801)	d	802)	a	803)	b	804)	a
805)	a	806)	b	807)	a	808)	b
809)	a	810)	a				

WAVES

: HINTS AND SOLUTIONS :

2 **(b)**

$$\frac{v}{4(\ell+e)}=f$$

$$\Rightarrow \ell+e=\frac{V}{4f}$$

$$\Rightarrow \ell=\frac{V}{4f}-e$$

Here $e=(0.6)r=(0.6)(2)=1.2\ cm$

So $\ell=\frac{336\times10^2}{4\times512}-1.2=15.2\ cm$

4 **(a)**

Frequency of wave is a function of the source of waves. Therefore, it remains unchanged.

5 **(c)**

The apparent change in the frequency of the source due to a relative motion between the source and observer is known as Doppler's effect. The perceived frequency is given by

$$v'=v\left(\frac{v-v_o}{v-v_s}\right)$$

Where v is original frequency, v the speed of sound, v_o speed of observer, $v_s$the speed of source. In the given case there is no relative motion between source and observer, since both are at rest, hence frequency of sound heard by the observer will remain unchanged.

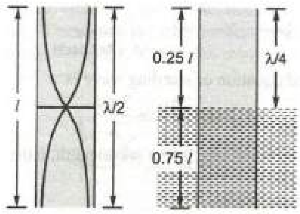
6 **(d)**

Light waves are electromagnetic waves. Light waves are transverse in nature and do not require a medium to travel, hence they can travel in vacuum. Sound waves are longitudinal waves and require a medium to travel. They do not travel in vacuum

7 **(b)**

When open tube is dipped in water, it becomes a tube closed at one end. Fundamental frequency for open tube is

$$v_0=\frac{v}{2l}$$



Length available for resonance of closed tube is $0.25\boldsymbol{l}$

$$\therefore\ v_c=\frac{v}{4(0.25l)}=\frac{v}{2l}\times2=2v_0$$

8 **(b)**

As we know that

$$\frac{n\lambda}{2}=I\ \ or\ \lambda=\frac{2l}{n}$$

9 **(a)**

Frequency of sonometer wire will be $(250+10)$ or $(250-10)$ on filling for k beat frequency decrease

$\therefore$ Frequency of sonometer wire $=260\ Hz$

Now using $v=\frac{v}{2l}$

$v=260\times2\times0.5$

$\Rightarrow v=260\ m/s$

10 **(a)**

$$v=2n(l_2-l_1)=2\times325(77.4-25.4)\text{cms}^{-1}$$

$$=\frac{650\times52}{100}\ \text{ms}^{-1}=338\ \text{ms}^{-1}$$

11 **(d)**

On reflection from fixed end (denser medium) a phase difference of π is introduced and velocity is reversed.

12 **(a)**

Frequency of second overtone (fifth harmonic) of close pipe

$$=\frac{5v}{fl}$$

Frequency of first overtone (second harmonic) of open pipe

$= \frac{2v}{2l}$

Accordingly,

$\frac{5v}{4l} - \frac{2v}{2l} = 100$

Or

$\frac{v}{4l} = 100$

Or

$v = 400\, l$

Fundamental frequency of open pipe

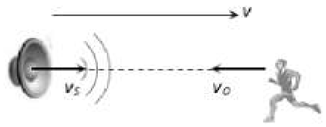
$= \frac{v}{2l} = \frac{400l}{2l} = 200 s^{-1}$

13 **(a)**

By using $n'' = n\left(\frac{v}{v - v_S}\right)$

$2n = n\left(\frac{v - v_O}{v - 0}\right) \Rightarrow v_O = -v = -$ (speed of sound)

Negative sign indicates that observer is moving opposite to the direction of velocity of sound, as shown



14 **(c)**

Let the frequency of tuning fork be N

As the frequency of vibration string $\propto \frac{1}{\text{length ofstring}}$

For sonometer wire of length 20 cm, frequency must be $(N + 5)$ and that for the sonometer wire of length $21cm$, the frequency must be $(N - 5)$ as in each case the tunning fork produces 5 beats/sec with sonometer wire

Hence $n_1 l_1 = n_2 l_2 \Rightarrow (N + 5) \times 20 = (N - 5) \times 21$

$\Rightarrow N = 205\ Hz$

15 **(c)**

Frequency of vib. in stretched string $n = \frac{1}{2(\text{Length})}\sqrt{\frac{T}{m}}$

When the stone is completely immersed in water, length changes but frequency doesn't ($\because$ unison re-established)

Hence length $\propto \sqrt{T} \Rightarrow \frac{L}{l} = \sqrt{\frac{T_{air}}{T_{water}}} = \sqrt{\frac{V\rho g}{V(\rho - 1)g}}$

[Density of stone $= \rho$ and density of water $= 1$]

$\Rightarrow \frac{L}{l} = \sqrt{\frac{\rho}{\rho - 1}} \Rightarrow \rho = \frac{L^2}{L^2 - l^2}$

16 **(b)**

Here , $n = 120\ Hz$,

$x = 0.8m, \phi = 0.5\pi$.

From $\phi = \frac{2\pi}{\lambda}x; \lambda = \frac{2\pi x}{\phi} = \frac{2\pi \times 0.8}{0.5\pi} = 3.2$ m

$v = n\lambda = 120 \times 3.2 = 384\ \text{ms}^{-1}$

18 **(b)**

From the formula for speed of sound in air

$\frac{v_1}{v_2} = \sqrt{\left(\frac{T_1}{T_2}\right)}$

Or

$\frac{2}{2v} = \sqrt{\left(\frac{273 + 27}{T_2}\right)}$

Or

$\frac{1}{2} = \sqrt{\left(\frac{300}{T_2}\right)}$

Squaring the Eq. (i), we get

$\frac{1}{4} = \frac{300}{T_2}$

Or $T_2 = 300 \times 4 = 1200K$

Or =1200-273=927°C

19 **(a)**

Observers in different inertial frames always measure different time intervals between a pair of events.

According to time dilation

$T_A > T_B$

20 **(a)**

Velocity of sound in air $\text{v} = 2\text{n}(\text{l}_2 - \text{l}_1)$

$= 2 \times 325(77.4 - 25.4)$

$= \frac{650/52}{100}$

=338 m/s

21 **(d)**

$y = 8 \sin 2\pi(0.1x - 2t)$

Compare it with the equation of wave motion

$y = r\ \sin 2\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right)$

$\frac{1}{\lambda} = 0.1, \lambda = 10$ cm

From $\phi = \frac{2\pi}{\lambda}x = \frac{2\pi}{10} \times 2 = 0.4 \times 180° = 72°$

22 **(d)**

Beat frequency$=v_1 \sim v_2$

Let the frequency of third note be n.
Then,
$$\frac{195v}{36} - v = 10 \quad ...(i)$$
And
$$v - \frac{193v}{36} = 10 \quad ...(ii)$$
Adding Eqs. (i) and (ii)
$$\frac{v}{18} = 20$$
$$\Rightarrow \quad v = 360\ ms^{-1}$$

23 **(b)**
After passing the 3 meter intensity is given by
$$I_3 = \frac{90}{100} \times \frac{90}{100} \times \frac{90}{100} \times I = 72.9\% \text{ of } I$$
So, the intensity is 72.9 decibel

24 **(b)**
n_A = Known frequency $= 256\ Hz, n_B = ?$
$x = 6\ bps$, which remains the same after loading.
Unknown tuning fork F_2 is loaded so $n_B \downarrow$
Hence $n_A - n_B \downarrow = x \quad \rightarrow$ Wrong ...(i)
$n_B \downarrow - n_A = x \quad \rightarrow$ ...(ii)
$\Rightarrow n_B = n_A + x = 256 + 6 = 262\ Hz$

25 **(b)**
For first pipe $n_1 = \frac{v}{4l_1}$ and for second pipe $n_2 = \frac{v}{4l_2}$
So, number of beats $= n_2 - n_1 = 4$
$$\Rightarrow 4 = \frac{v}{4}\left(\frac{1}{l_2} - \frac{1}{l_1}\right) \Rightarrow 16 = 300\left(\frac{1}{l_2} - \frac{1}{1}\right) \Rightarrow l_2 = 94.9\ cm$$

26 **(c)**
The frequency of fork 2
$= 200 \pm 4 = 196$ or 204 Hz
Since, on attaching the tape on the prong of fork 2, its frequency decreases, but now the number of beats per second is 6 i.e., the frequency difference now increases. It is possible only when before attaching the tape, the frequency of fork 2 is less than the frequency of tuning fork 1. Hence, the frequency of fork 2 is 196 Hz.

27 **(d)**
$n \propto \sqrt{T}$
$$\Rightarrow n_1 : n_2 : n_3 : n_4 = \sqrt{1} : \sqrt{4} : \sqrt{9} : \sqrt{16} = 1 : 2 : 3 : 4$$

28 **(c)**
$$n = \frac{v}{\lambda} = \frac{300}{0.6 \times 10^{-2}} Hz = \frac{3}{6} \times 10^4 Hz = 50{,}000 Hz$$
$\Rightarrow$ Wave is ultrasonic

29 **(d)**
fundamental frequency $\mathrm{f} = \frac{1}{2r\iota}\sqrt{\frac{T}{\pi\rho}}$
$$\therefore \frac{f_1}{f_2} = \frac{\iota_2}{\iota_1} \times \frac{r_2}{r_1}$$
$$\frac{600}{f_2} = \frac{2}{1} \times \frac{1}{2} \times \sqrt{\frac{T}{T/9}}$$
$$f_2 = 200 Hz$$

30 **(d)**
From $v = 2\,n(l_2 - l_1)$
$$n = \frac{v}{2(l_2 - l_1)} = \frac{340}{2(0.84 - 0.50)}$$
$$= \frac{340}{2 \times 0.34} = 500 \text{ Hz}$$

31 **(a)**
Here $p_1 = 3, T_1 = 8, p_2 = 2, T_2 = ?$
As $\frac{T_2}{T_1} = \frac{p_1^2}{p_2^2}$
$\therefore\ T_2 = \frac{p_1^2}{p_2^2} \times T_1 = \frac{9}{4} \times 8 = 18$ g

33 **(b)**
Transverse wave can propagate in solids but not in liquids and gases

34 **(c)**
Loudness depends upon intensity while pitch depends upon frequency

35 **(a)**
Comparing with standard equation we get
$$\frac{2\pi}{\lambda} = 10\pi$$
$$\therefore \lambda = \frac{2}{10} = 0.2m$$
$$\omega = 2\pi$$
$$\therefore n = 1\ Hz$$
And the wave is travelling along the positive direction

36 **(d)**
$\Delta\Phi_1$ due to path difference $= \pi/2$
$\Delta\Phi_2$ after time
$$\frac{T}{2} = \pi$$
$$\Rightarrow \Phi = \frac{\pi}{3} - \frac{\pi}{2} + \pi = \frac{5\pi}{6}$$

37 **(c)**
$$A = \sqrt{(a_1^2 + a_2^2 + 2a_1a_2\cos\phi)}$$
Putting $a_1 = a_2 = a$ and $\phi = \frac{\pi}{3}$, we get $A = \sqrt{3}a$

38 **(a)**

Phase difference between the two waves is

$\phi = (\omega t - \beta_2) - (\omega t - \beta_1) = (\beta_1 - \beta_2)$

$\therefore$ Resultant amplitude $A =$

$\sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos(\beta_1 - \beta_2)}$

40 **(c)**

The frequencies of tuning fork are the term of an AP whose common difference is 6.

∴ ι=a+(n-1)d

2a=a+(24-1)×6

a=23×6=138

∴ second frequency =135+6=144 Hz

41 **(a)**

Time taken for two syllables $t = \frac{2}{5}s$

$$x + x = v \times t = 330 \times \frac{2}{5}$$

$\therefore x = 66$m

42 **(b)**

In a closed pipe, resonance frequency $n = (2r-1)v = 4l = 135\ and\ 165$.

The lowest frequency must be highest common factor of 135 and 165, which is 15 Hz.

43 **(b)**

$n_A =$ Known frequency $= 256\ Hz, n_B = ?$

$x = 4\ bps$, which is decreasing after loading

$(i.e. x\downarrow)$ also known tuning fork is loaded so $n_A \downarrow$

Hence $n_A \downarrow - n_B = x \downarrow$ → correct ...(i)

$n_B - n_A \downarrow = x \downarrow$ → Wrong ...(ii)

$\Rightarrow n_B = n_A - x = 256 - 252\ Hz$

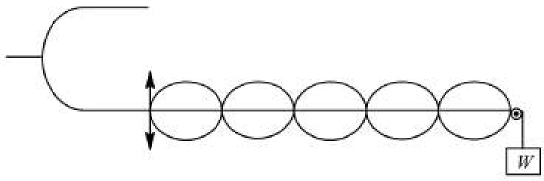
44 **(d)**

If d is the distance between man and reflecting surface of sound then for hearing echo

$$2d = v \times t \Rightarrow d = \frac{340 \times 1}{2} = 170\ m$$

45 **(c)**

In transverse arrangement the tuning fork is placed such that the vibration of the prongs is in direction perpendicular to the length of the string as shown in figure. As the tuning fork completes one vibration, the one vibration of wave on string is completed. Thus, in transverse mode, its frequency is the same as that of the fork. Hence, the required ratio is 1:1.



46 **(c)**

As $v = \frac{1}{2}\frac{\Delta v}{v}c$

$$\therefore 0.2c = \frac{1}{2}\frac{\Delta v}{(4 \times 10^7)}c$$

$\Delta v = 1.6 \times 10^7\ Hz$

As the rocket is receding away

$\therefore v' = v - \Delta v = 4 \times 10^7 - 1.6 \times 10^7$

$= 2.4 \times 10^7$ Hz

47 **(b)**

Comparing with $y = a\sin 2\pi\left[\frac{t}{T} - \frac{x}{\lambda}\right] \Rightarrow \lambda = 40\ cm$

48 **(b)**

$if\ L_1 and\ L_2$ are the first and second resonances, then we have

$$L_1 + e = \frac{\lambda}{4} and\ L_2 + e = \frac{3\lambda}{4}$$

$$\therefore\quad L - 2 - L_1 = \frac{\lambda}{2}$$

$\Rightarrow \lambda = 2(L_2 - L_1)$

49 **(d)**

Here, $v_{s_1} = 34\text{ms}^{-1}$,

$v = 340\text{ms}^{-1}$

$$f_1 = \frac{v \times n}{v - v_{s_1}} = \frac{340 \times n}{340 - 34} = \frac{340}{306}n$$

$$f_2 = \frac{v \times n}{v - v_{s_2}} = \frac{340 \times n}{(340 - 17)} = \frac{340n}{323}$$

$$\frac{f_1}{f_2} = \frac{323}{306} = \frac{19}{18}$$

50 **(c)**

$\lambda_1 = 2l, \lambda_2 = 2l + 2\Delta l \Rightarrow n_1 = \frac{v}{2l}$and $n_2 = \frac{v}{2l+2\Delta l}$

$$\Rightarrow \text{No. of beats} = n_1 - n_2 = \frac{v}{2}\left(\frac{1}{l} - \frac{1}{l + \Delta l}\right) = \frac{v\Delta l}{2l^2}$$

52 **(a)**

$Intensity\ \propto (amplitude)^2$

$\propto (2a\cos kx)^2$

Hence, intensity will be maximum when cos kx is maximum.

53 **(c)**

Let n be the frequency of fork C then

$n_A = n + \frac{3n}{100} = \frac{103n}{100}$ and $n_B = n - \frac{2n}{100} = \frac{98n}{100}$

But $n_A - n_B = 5 \Rightarrow \frac{5n}{100} = 5 \Rightarrow n = 100\ Hz$

$\therefore n_A = \dfrac{(103)(100)}{100} = 103\ Hz$

54 **(c)**

The frequency of reflected sound heard by the driver

$$n' = n\left(\frac{v - (-v_O)}{v - v_S}\right) = n\left(\frac{v + v_O}{v - v_S}\right)$$

$$= 124\left[\frac{330 + (72 \times 5/18)}{330 - (72 \times 5/18)}\right] = 140\ vibration/sec$$

55 **(b)**

Distance between two nodes $= \frac{\lambda}{2} = \frac{v}{2n} = \frac{16}{2n} = \frac{8}{n}$

56 **(c)**

$$v = \frac{\Delta\lambda}{\lambda} \times c = \frac{0.2}{100} \times 3 \times 10^8$$

$$= 6 \times 10^5\ \mathrm{ms^{-1}}$$

57 **(b)**

When the stone is suspended in air

$$n = \frac{1}{2L}\sqrt{\frac{W_a}{m}}$$

When the stone is suspended in water,

$$n = \frac{1}{2L'}\sqrt{\frac{W_w}{m}}$$

$$\therefore \frac{\sqrt{W_a}}{L} = \frac{\sqrt{W_w}}{L'}\ or\ \frac{W_a}{W_w} = \frac{L'^2}{L^2}$$

Specific gravity of stone

$$= \frac{W_a}{Wa - W_w} = \frac{1}{1 - \frac{W_w}{W_a}} = \frac{1}{1 - \frac{L'^2}{L^2}}$$

$$= \frac{L^2}{L^2 - L'^2} = \frac{(40)^2}{(40)^2 - (22)^2}$$

58 **(b)**

Fundamental frequency of open pipe

first harmonic $= \mathrm{n_1} = \dfrac{\mathrm{v}}{2l} = \dfrac{330}{2 \times 0.3} = 550\mathrm{Hz}$

second harmonic $= 2 \times \mathrm{n_1} = 1100\mathrm{Hz} = 1.1\ \mathrm{kHz}$

59 **(b)**

$\omega = 314, k = 1.57$ and $v = \frac{\omega}{k} = \frac{314}{1.57} = 200\ m/s$

60 **(d)**

$$v_L = \sqrt{\frac{Y}{\rho}}, v_T = \sqrt{\frac{T}{m}} = \sqrt{\frac{T}{\pi r^2 \rho}}$$

$$\frac{v_L}{V_T} = \sqrt{\frac{Y}{\rho} \times \frac{\pi r^2 \rho}{T}} = \sqrt{\frac{Y}{T/\pi r^2}} = \sqrt{\frac{Y}{\mathrm{stress}}}$$

$$\therefore \mathrm{stress} = \frac{Y}{(v_L/v_r)^2} = \frac{1 \times 10^{11}}{(100)^2} = 10^7\mathrm{Nm^{-2}}$$

61 **(b)**

Frequency remains the same *ie* 1000 Hz wavelength chances

$$\lambda_\omega = \frac{v_\omega}{V} = \frac{1500}{1000} = 1.5\ \mathrm{m}$$

62 **(a)**

$v = \sqrt{\frac{\gamma p}{\rho}}$. The speed (v) will be highest for the gas for which γ is highest, which is monoatomic gas .

63 **(b)**

For closed pipe $n_1 = \frac{v}{4l} = \frac{330}{4} Hz$

Second note $= 3n_1 = \frac{3 \times 330}{4} Hz$

64 **(d)**

Minimum time interval between two instants when the string is flat

$= T/2 = 0.5$ sec $\Rightarrow T = 1$ sec

Hence $\lambda = v \times T = 10 \times 1 = 10\ m$

65 **(c)**

Velocity of sound in a gas

$$v = \sqrt{\frac{\gamma p}{d}}$$

$$\therefore \quad \frac{v_{H_2}}{v_{H_2}} = \sqrt{\frac{\gamma_{H_2} \times d_{He}}{d_{H_2} \times \gamma_{He}}}$$

$$\frac{v_{H_2}}{v_{He}} = \sqrt{\frac{7 \times 3 \times 2}{5 \times 5}} \qquad \left[As\ \frac{d_{He}}{d_{H_2}} = 2\right]$$

$\therefore \frac{v_{H_2}}{v_{He}} = \frac{\sqrt{42}}{2}$

66 **(b)**

Given :$l = 4.9 \times 10^{-4} m$

From the formula

$Y = \frac{\text{stress}}{\text{strain}} = \frac{F/\pi r^2}{l/L}$

Or

$\frac{F}{\pi r^2} = Y \frac{l}{L}$

$=9 \times 10^{10} \times \frac{4.9 \times 10^{10^-}}{4}$

$=44.1 \times 10^6$

$V = \frac{1}{2L}\sqrt{\left(\frac{T}{m}\right)}$

$= \frac{1}{2L}\sqrt{\left(\frac{F}{\pi r^2 d}\right)} = \frac{1}{2}\sqrt{\left(\frac{F/\pi r^2}{d}\right)}$

$= \frac{1}{2} \times \sqrt{\left(\frac{44.1 \times 10^6}{9 \times 10^3}\right)}$

$= \frac{1}{2}\sqrt{(4.9 \times 10^3)} = \frac{1}{2}\sqrt{(49 \times 10^2)}$

$= \frac{7 \times 10}{2} = 35\ Hz$

67 **(a)**

Given, y=a sin (100 πt-3x)

The general equation,

$k = 3\ and\ k = \frac{2\pi}{\lambda}$

Or

$\lambda = \frac{2\pi}{k}$

$\lambda = \frac{2\pi}{3}$

Phase difference, $\phi = \frac{\pi}{3}$

$\frac{2\pi}{\lambda} . x = \frac{\pi}{3}$

$or \quad x = \frac{\pi}{3} \times \frac{\lambda}{2\pi}$

$x = \frac{\pi}{3} \times \frac{2\pi}{3 \times 2\pi}$

Distance,

$x = \frac{\pi}{9} m$

68 **(a)**

The given equation can be written as

$y = \frac{A}{2}\cos\left(4\pi nt - \frac{4\pi x}{\lambda}\right) + \frac{A}{2}\ \left[\because \cos^2\theta = \frac{1+\cos 2\theta}{2}\right]$

Hence amplitude $= \frac{A}{2}$ and frequency $= \frac{\omega}{2\pi} = \frac{4\pi n}{2\pi} = 2n$

And wave length $= \frac{2\pi}{k} = \frac{2\pi}{4\pi/\lambda} = \frac{\lambda}{2}$

69 **(d)**

On comparing the given equation with standard equation $y = a \sin\frac{2\pi}{\lambda}(vt - x)$. It is clear that wave speed $(v)_{wave} = v$ and maximum particle velocity $(v_{\max})_{particle} = a\omega = y_0 \times$ co-efficient of $t = y_0 \times \frac{2\pi v}{\lambda}$

$\because (v_{\max})_{particle} = 2(\omega)_{wave} \Rightarrow \frac{a \times 2\pi v}{\lambda} = 2v \Rightarrow \lambda = \pi y_0$

70 **(a)**

When the train is approaching the stationary observer frequency heard by the observer

$n' = \frac{v + v_0}{v} n$

When the train is moving away from the observer then frequency heard by the observer

$n'' = \frac{v - v_0}{v} n$

It is clear that n' and n'' are constant and independent of time. Also and $n' > n''$

71 **(c)**

$n_Q = 341 \pm 3 = 344Hz$ or $338Hz$

On waxing Q, the number of beats decreases hence

$n_Q = 344Hz$

72 **(b)**

Let x be distance of person from one cliff and y be distance of person from 2nd cliff. Let $y > x$.

$\therefore x + x = v \times t_1 = 340 \times 1 = 340$

$x = 170$ m

$y + y = v \times t_2 = 340 \times 2 = 680$

$y = 340$ m.

Distance between two cliffs

$= x + y = 170 + 340 = 510$m

73 **(d)**

Wave velocity $= n\lambda = \omega A \Rightarrow \lambda = \frac{\omega A}{\frac{\omega}{2\pi}} = 2\pi A$

74 **(b)**

$n_{\text{open}} = \frac{v}{2l_{\text{open}}}$

$$n_{\text{closed}} = \frac{v}{4l_{\text{closed}}} = \frac{v}{4l_{\text{open}/2}} = \frac{v}{2l_{\text{open}}}$$

$\left(As\ l_{closed} = \frac{l_{open}}{2}\right)$, $i.e.$ frequency remains unchanged

75 **(d)**

$$n = \frac{1}{2l}\sqrt{\frac{T}{\pi r^2 \rho}} \Rightarrow n \propto \frac{\sqrt{T}}{lr} \Rightarrow \frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}} \times \frac{l_2}{l_1} \times \frac{r_2}{r_1}$$

$$= \sqrt{\frac{T}{3T}} \times \frac{3l}{l} \times \frac{3r}{r} = 3\sqrt{3} \Rightarrow n_2 = \frac{n}{3\sqrt{3}}$$

76 **(c)**

$n_1 - n_2 = 10$ ...(i)

Using $n_1 = \frac{v}{4l_1}$ and $n_2 = \frac{v}{4l_2}$

$\Rightarrow \frac{n_1}{n_2} = \frac{l_2}{l_1} = \frac{26}{25}$ ...(ii)

After solving these equation $n_1 = 260\ Hz, n_2 = 250\ Hz$

77 **(b)**

Given : $y_1 = 4\sin 404\pi t, y_2 = 3\sin 400\pi t$

$\therefore \omega_1 = 404\pi, \omega_2 = 400\pi, A_1 = 4, A_2 = 3$

$\omega_1 = 2\pi v_1 \Rightarrow 404\pi = 2\pi v_1 \Rightarrow v_1 = 202\ Hz$

$\omega_2 = 2\pi v_2 \Rightarrow 400\pi = 2\pi v_2 \Rightarrow v_2 = 200\ Hz$

Beat frequency $= v_1 - v_2 = 202 - 200 = 2\ Hz$

$$\frac{I_{\max}}{I_{\min}} = \left(\frac{A_1 + A_2}{A_1 - A_2}\right)^2 = \left(\frac{4+3}{4-3}\right)^2 = \left(\frac{7}{1}\right)^2 = \frac{49}{1}$$

78 **(a)**

Given that y=15sin (660 πt—0.02πx)

Comparing with general equation of progressive wave, we get

$$y = (x,t) = a\sin\left(\frac{2\pi}{T}t - \frac{2\pi}{\lambda}x\right)$$

$$\therefore \frac{2\pi}{T} = 660\pi$$

$$or\ \ \frac{1}{T} = 330 \quad or \quad v = 330\ Hz$$

79 **(a)**

$$n' = n\left[\frac{v + v_O}{v - v_S}\right];$$

Here $v = 332 m/s$ and $v_O = v_s = 50\ m/s$

$$\Rightarrow 435 = n\left[\frac{332+50}{332-50}\right] \Rightarrow n = 321.12\ sec^{-1}$$

$$= 320\ sec^1$$

80 **(c)**

Given $v_c = v_o$(both first overtone)

Or

$$3\left(\frac{v_c}{4L}\right) = 2\left(\frac{v_o}{2l_o}\right)$$

$$\therefore l_o = \frac{4}{3}\left(\frac{v_o}{v_c}\right)L = \frac{4}{3}\sqrt{\frac{\rho_1}{\rho_2}}L$$

$$\left(as\ v \propto \frac{1}{\sqrt{\rho}}\right)$$

Therefore correct option is (c).

81 **(b)**

$n \propto \sqrt{T}$

82 **(d)**

Speed is maximum when y=a

$$\therefore \quad a = a\cos\left(\omega t + \frac{\pi}{4}\right)$$

$$\Rightarrow \quad \cos\left(\omega t + \frac{\pi}{4}\right) = 1$$

$$\Rightarrow \omega t + \frac{\pi}{4} = 0 \Rightarrow t = -\frac{\pi}{4\omega}$$

84 **(a)**

Fundamental frequency $n = \frac{v}{2l}$

$$\Rightarrow 350 = \frac{350}{2l} \Rightarrow l = \frac{1}{2}m = 50cm$$

85 **(c)**

After reflection from rigid support, a wave suffers a phase change of π

86 **(c)**

n_A=unknown frequency=450 Hz, $n_B = ?\ x = 5\ Hz$ which is decreasing after tension is increased (i.e., x↓)

Hence, $n_A \downarrow - n_B = x \downarrow$ .... (i)correct

$n_B - n_A \downarrow = x \downarrow$ ... . (ii)wrong

$\Longrightarrow n_B = n_A - x = 450 - 5 = 445\ Hz$

87 **(b)**

Here, $m = \frac{10^{-2}}{0.4}\text{kgm}^{-1} = \frac{1}{40}\text{kgm}^{-1}$,

$T = 1.6$

$$v = \sqrt{T/m} = \sqrt{\frac{1.6}{1/40}} = 8\text{ms}^{-1}$$

Time interval, $\Delta T = \frac{\lambda}{v} = \frac{2l}{v} = \frac{2\times 0.4}{8} = 0.1\text{s}$

88 **(c)**

The apparent frequency heard by the man is given by

$$v_{app} = v\left(\frac{v \pm v_o}{v \pm v_s}\right)$$

On our case,$v_o = 0$

$$\therefore v_{app} = v\left(\frac{v}{v \pm v_s}\right)$$

Given, $v = 300ms^{-1}, v_s = 4ms^{-1}, v = 240\ Hz$

In first case, train is approaching the man, so frequency heard

$$v_1 = v\left(\frac{v}{v \pm v_s}\right) = 240\left(\frac{300}{300-4}\right)$$

$= \frac{240 \times 300}{296} = 243.24\ Hz$

In second case, train is going away from the man, so frequency heard

$v_2 = v\left(\frac{v}{v + v_s}\right) = 240\ \left(\frac{300}{300 + 4}\right)$

$= \frac{240 \times 30}{304} = 236.84Hz$

Hence, number of beats heard by the man per second

$= v_1 - v_2$

$= 243.24 - 236.84 = 6.4 \approx 6$

89 **(c)**

(c) is the correct choice because its value is finite at all times.

90 **(c)**

Sonometer works on the principle of resonance. At resonance the wire of sonometer vibrate with maximum amplitude.

91 **(d)**

Observer hers two frequencies

(i) n_1 which is coming from the source directly

(ii) n_2 which is coming from the reflection image of source

So, $n_1 = 680\left(\frac{340}{340-1}\right)$ and $n_2 = 680\left(\frac{340}{340+1}\right)$

$\Rightarrow n_1 - n_2 = 4\ beats$

92 **(b)**

Both the ends will behave as nodes. In the nth mode of vibration,

$n\left(\frac{\lambda}{2}\right) = l\ \ \therefore\ \lambda = \frac{2l}{n}$

93 **(b)**

As the tube is open at both ends, therefore, next shortest length for resonance $= 2 \times 20 = 40$ cm.

94 **(c)**

$n' = n\left(\frac{v + v_o}{v}\right) \Rightarrow 2n = n\left(\frac{v + v_o}{v}\right) \Rightarrow \frac{v + v_o}{v} = 2$

$\Rightarrow v_o = v = 332\ m/sec$

95 **(b)**

Compare with $y = a\sin(\omega t - kx)$

We have $k = \frac{2\pi}{\lambda} = 62.4 \Rightarrow \lambda = \frac{2\pi}{62.4} = 0.1$

96 **(d)**

Given equation $y = y_0 \sin(\omega t - \phi)$

At $t = 0, y = -y_0 \sin\phi$

This is case with curve marked D

98 **(d)**

Waves travelling to the right can be given by

$y_1 = A\sin(\omega t - kx)$ ...(i)

When getting reflected from the fixed end of the string, there is an additional phase difference of π.

The reflected wave is

$y_2 = A\sin(\omega t + kx + \pi)$

$\Rightarrow y_2 = -A\sin(\omega t + kx)$ ...(ii)

Superposing, (i) + (ii) is the same as $y = \sin C - \sin D$

$y = 2A\cos\frac{C + D}{2}\sin\frac{C - D}{2}$

$y = 2A\cos\omega t\sin kx$

The stationary wave is given as

$y = 0.06\sin\frac{2\pi x}{3}\cos(120\pi t)$

Here $k = \frac{2\pi}{\lambda} = \frac{2\pi}{3}$ and $\omega = 120\pi$

$\therefore \lambda = 3m, v = \frac{120\pi}{2\pi} = 60Hz$

99 **(d)**

If two SHMs act in perpendicular direction, then their resultant motion is in the form of a straight line or a circle or a parabola etc, depending on the frequency ratio of the two SHMs and their phase difference. These figures are Lissajous figure.

100 **(b)**

$n_A = 258\ Hz$

$n_B = 262\ Hz$

Let n is the frequency of unknown tuning fork. It produces x beats with 258 and 2x with 262

262-(258-x)=2x

262-268+x=2x

X=4

N=254Hz

101 **(a)**

Beats period $= \frac{1}{30-20} = 0.1\ sec$

$\Delta\phi = \frac{2\pi}{T}\Delta t = \frac{2\pi}{0.1} \times 0.6 = 2\pi \times 6 = 12\pi$ or Zero

102 **(a)**

With reflection in tension, frequency of vibrating string will increase. Since number of beats are decreasing. Therefore, frequency of vibrating string or third harmonic frequency of closed pipe should be less than the frequency of tuning fork by 4.

$\therefore$ frequency of tuning fork

= Third harmonic frequency of closed pipe+4

$= 3\left(\frac{v}{4l}\right) + 4 = 3\left(\frac{340}{4 \times 0.75}\right) + 4 = 344\ Hz$

103 **(b)**

The minimum distance between compression and refraction of the wire $l = \frac{\lambda}{2}$ $\therefore$ Wave length $\lambda = 2l$

Now by $v = n\lambda \Rightarrow n = \frac{360}{2\times 1} = 180\text{sec}^{-1}$

104 **(b)**

In closed organ pipe. If $y_{incident} = a\sin(\omega t - kx)$ then $y_{reflected} = a\sin(\omega t + kx + \pi) = -a\sin(\omega t + kx)$

Superimposition of these two waves give the required stationary wave

105 **(d)**

Perceived frequency by observer in Ist case

$$v_1 = v\left(\frac{v}{v - v_s}\right)$$

$$\therefore \quad v_1 = v\left(\frac{340}{340 - 34}\right) = \frac{340v}{306}$$

Perceived frequency by observer in IInd case

$$v_2 = v\left(\frac{340}{340 - 17}\right) = \frac{340v}{323}$$

Therefore,

$$\frac{v_1}{v_2} = \frac{340v}{306} \times \frac{323}{340v} = \frac{323}{306} = \frac{19}{18}$$

106 **(d)**

Compare the given equation with the standard form

$$y = r\cos\left[\frac{2\pi t}{T} - \frac{2\pi x}{\lambda}\right]$$

Coefficient of $t = \frac{2\pi}{T} = 2\pi n = 4\pi, n = 2$ Hz

107 **(a)**

By Doppler's formula $n' = \frac{nv}{(v - v_S)}$

Since, source is moving towards the listener so $n' > n$.

If $n = 100$ then $n' = 102.5$

$$\Rightarrow 102.5 = \frac{100 \times 320}{(320 - v_S)} \Rightarrow v_s = 8\ m/sec$$

108 **(c)**

In an open organ pipe, number of nodes in third harmonic = 3.

109 **(a)**

Both waves are moving opposite to each other

110 **(b)**

At point A, source is moving away from observer so apparent frequency $n_1 < n$ (actual frequency)
At point B source is coming towards observer so apparent frequency $n_2 > n$ and point C source is moving perpendicular to observer so $n_3 = n$

Hence $n_2 > n_3 > n_1$

111 **(a)**

Here $\omega = 2\pi n = 2\pi \Rightarrow n = 1$

113 **(b)**

$$\text{Time} = \frac{\text{Distance}}{\text{Velocity}} = \frac{1000}{330} = 3.03 \text{ sec}$$

Sound will be heard after 3.03 sec. So his watch is set $3sec$, slower

114 **(d)**

Distance between two consecutive nodes is $\frac{\lambda}{2}$

$$\therefore \frac{\lambda}{2} = \frac{2m}{2} = 1m$$

So the distance of another node from the surface will be

$$3 + \frac{\lambda}{2} = 3 + 1 = 4m$$

115 **(d)**

Compare the given equation with $y = a\cos(\omega t + k\phi)$

$$\Rightarrow \omega = 2\pi n = 2000 \Rightarrow n = \frac{1000}{\pi} Hz$$

116 **(c)**

As phase difference between waves of amplitudes 10 mm and 7 mm is π, therefore, their resultant amplitude $= 10 - 7 = 3$ mm. Now amplitudes 3 mm and 4 mm have a phase difference $= \frac{\pi}{2}$.

$\therefore$ Resultant amplitude $= \sqrt{3^2 + 4^2} = 5$ mm

117 **(d)**

$$I \propto \frac{1}{r^2} \Rightarrow \frac{\Delta I}{I} = -2\frac{\Delta r}{r} = -2 \times 2 = -4\%$$

Hence intensity is decreased by 4%

119 **(c)**

$$n \propto \frac{1}{l} \Rightarrow \frac{\Delta n}{n} = -\frac{\Delta l}{l}$$

If length is decreased by 2% then frequency increases by 2%

$$i.e., \frac{n_2 - n_1}{n_1} = \frac{2}{100}$$

$$\Rightarrow n_2 - n_1 = \frac{2}{100} \times n_1 = \frac{2}{100} \times 392 = 7.8 \approx 8$$

123 **(c)**

We know frequency

$$n = \frac{p}{2l}\sqrt{\frac{T}{\pi r^2 \rho}} \Rightarrow n \propto \frac{1}{\sqrt{\rho}}$$

$i.e.$, graph between n and $\sqrt{\rho}$ will be hyperbola

124 **(b)**

For open tube, $n_0 = \frac{v}{2l}$

For closed tube length available for resonance is

$l' = l \times \frac{25}{100} = \frac{l}{4}$ ∴ Fundamental frequency of water filled tube

$$n = \frac{v}{4l'} = \frac{v}{4 \times (l/4)} = \frac{v}{l} = 2n_0 \Rightarrow \frac{n}{n_0} = 2$$

126 **(a)**

The maximum particle velocity are twice the wave velocity

$$a\omega = 2\left(\frac{\omega}{k}\right)$$

Or ak=2

Given y=a sin 2π(b+-cx)

Or y=a sin (2πbt-2πcx)

The general wave can

Y=a sin (ωt-x)

Then k=2πc

So, $a_2\pi c = 2$

$c = 1/\pi a$

127 **(c)**

$y = A\sin(st - b\,x + c)$Represents a wave, when a may correspond to ω *and* b may correspond to$k$.

128 **(a)**

$$n \propto \sqrt{T} \Rightarrow \frac{\Delta n}{n} = \frac{1}{2}\frac{\Delta T}{T}$$

Beat frequency

$$= \Delta n = \left(\frac{1}{2}\frac{\Delta T}{T}\right)n = \frac{1}{2} \times \frac{2}{100} \times 400 = 4$$

129 **(b)**

Intensity ∝ $(\text{amplitude})^2$

$$\therefore \frac{I_1}{I_2} = \frac{a_1^2}{a_2^2}$$

$$\frac{1}{9} = \frac{a_1^2}{a_2^2}$$

$$\Longrightarrow \frac{a^1}{a^2} = \frac{1}{3}$$

130 **(c)**

$v_1 = 256$ Hz

For tuning for $v_1 - v_1 = \pm 5$,

v_2 = frequency of piano

$v_2 = (256 + 5)$Hz or $(256 - 5)$Hz

When tension is increased, the bear frequency decreases to 2 beats/s.

If we assume that the frequency of piano string is 261 Hz, then on increasing tension, frequency, more than 261 Hz. But it is given that beat frequency decreases to 2, therefore, 261 is not possible.

Hence, 251 Hz i.e., 256-5 was the frequency of piano string before increasing tension.

131 **(c)**

Beats are the periodic and repeating functions heard in the intensity of sound, when two sound waves of very similar frequency interface with ine another.

Beats = defference in frequencies.

Maximum number of beats =402-400=2

133 **(b)**

The distance between two points *i.e.* path difference

Between them $\Delta = \frac{\lambda}{2\pi} \times \phi = \frac{\lambda}{2\pi} \times \frac{\pi}{3} = \frac{\lambda}{6} = \frac{v}{6n}$

$$(\because v = n\lambda) \Rightarrow \Delta = \frac{360}{6 \times 500} = 0.12m = 12\ cm$$

134 **(c)**

According to the law of length

$$n_1 l_1 = n_2 l_2$$

$$l_2 = \frac{n_1 l_1}{n_2} = \frac{800 \times 50}{1000} = 40\ \text{cm}$$

135 **(a)**

$$n' = n\left(\frac{v - v_O}{v}\right) = \left(\frac{330 - 33}{330}\right) \times 100 = 90\ Hz$$

136 **(a)**

Frequency of string $= 440 \pm 5$

As frequency of tuning fork decreases beat frequency also increases, therefore, frequency of string $= 445\ Hz$

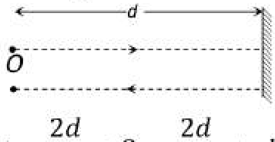
137 **(b)**

Frequency of first overtone or second harmonic $(n_2) = 320\ Hz$. So, frequency of first harmonic

$$n_1 = \frac{n_2}{2} = \frac{320}{2} = 160Hz$$

138 **(a)**

Suppose the distance between shooter and reflecting surface is d. Hence time interval for hearing echo is



$$t = \frac{2d}{v} \Rightarrow 8 = \frac{2d}{350} \Rightarrow d = 1400\ m$$

139 **(a)**

The frequency, when a sonometer wire of vibrating length is 48 cm.

$$v_1 = \frac{c}{2 \times l_1} = \frac{c}{2 \times 0.48} = \frac{c}{0.96}$$

The frequency, when a sonometer wire of vibrating length is 50 cm.

$$v_2 = \frac{c}{2 \times l_2} = \frac{c}{2 \times 0.50} = \frac{c}{1.00}$$

$v_1 - v_2 = 8$ $\qquad v_1$

v_2	4
v_3	4

$\therefore \frac{v_1}{v_2} = \frac{1.00}{096} \Rightarrow \delta$

$v_1 = \frac{1.00}{0.96} v_2$

$\because v_2 + 8v_2 \times \frac{100}{96}$

$v_2 = 192\ Hz.$

The frequency of the tuning fork.

$v = v_2 + 4 = 192 + 4 = 196\ Hz$

140 **(c)**

Using the relation for Doppler's shift

$\Delta\lambda = \frac{0.05}{100}\lambda \quad (Given)$

Since,

$\Delta\lambda = \frac{v}{c}\lambda$

$\therefore \frac{0.05}{100}\lambda = \frac{v}{c}\lambda$ or $v = 5 \times 10^{-4} c$

$\Rightarrow v = 5 \times 10^{-4} \times 3 \times 10^8 = 1.5 \times 10^5 ms^{-1}$

Since, λ decreases, the star is approaching the observer.

141 **(d)**

A series of notes arranged, such that their fundamental frequencies have definite ratios is called a musical scale. In 1588, Zarlino constructed a musical scale by introducing sis notes between an Octave. These eight notes constitute major diatonic scale. The first one note or the note of the lowest frequencies is called keynote and ratio of the frequencies of the two notes is called interval between them. It means two octaves higher means four times the given frequency.

∴ Required frequency=4×128=512 Hz

142 **(a)**

Here, $\quad y = A\sin(kx - \omega t)$

$\frac{dy}{dt} = A\cos(kx - \omega t) \times (-\omega)$

$\left(\frac{dy}{dt}\right)_{\max} = A(-1)(-\omega) = A\omega$

143 **(c)**

$n' = n\left(\frac{v}{v - v_S}\right) = 90\left(\frac{v}{v - \frac{v}{10}}\right)$

$= 100$ vibration/sec

144 **(d)**

As is clear from figure, at $t = 0, x = 0$, displacement $y = 0$. Therefore, option (a) or (d) may be correct.

In case of (d); $y = A\sin(kx - \omega t)$

$\frac{dy}{dt} = A\cos(kx - \omega t)[-\omega]$

$\frac{dy}{dx} = A\cos(kx - \omega t)[k]$

$\frac{\frac{dy}{dt}}{dy/dx} = \frac{-\omega A\cos(kx - \omega t)}{kA\cos(kx - \omega t)} = -\frac{\omega}{k} = -v$

$\frac{dy}{dt} = -v\left(\frac{dy}{dx}\right)$

ie particle velocity = −(wave speed) × slope.

And slope at $x = 0$ and $t = 0$ is positive, in figure. Therefore, particle velocity is in negative y-direction.

145 **(c)**

According to Laplace, the speed of sound in a gas is

$v = \sqrt{\frac{\gamma p}{d}} = \sqrt{\frac{\gamma RT}{M}}$

Where R is gas constant, T the temperature and M the molecular weight.

For monatomic gas helium, $\gamma_1 = \frac{5}{3}, M_1 = 4$

For diatomic gas nitrogen, $\gamma_2 = \frac{7}{5}, M_2 = 28$

$\therefore \frac{v_{N_2}}{v_{H_e}} = \sqrt{\frac{\gamma_1 M_2}{\gamma_2 M_1}}$

$= \sqrt{\frac{5/3}{7/5} \times \frac{28}{4}} = \sqrt{\frac{5 \times 5}{3}} = \frac{5}{\sqrt{3}}$

Hence,

$\frac{v_{h_2}}{v_{He}} = \frac{\sqrt{3}}{5}$

146 **(a)**

The given equation is

$y = 5\sin\frac{\pi}{2}(100t - x) \quad \dots(i)$

Comparing Eq. (i) with standard wave equation, given by

Y=a sin (ωt-kx) ...(ii)

We have

$\omega = \frac{100\pi}{2} = 50\pi$

$\Rightarrow \dfrac{2\pi}{T} = 50\pi$

$\Rightarrow T = \dfrac{2\pi}{50\pi} = 0.04\ s$

147 **(a)**

If $y_{incident} = a\sin(\omega t - kx)$ and $y_{stationary} = a\sin(\omega t)\cos kx$ then it is clear that frequency of both is same (ω)

148 **(d)**

For closed pipe $n_1 = \frac{v}{4l} \Rightarrow l = \frac{v}{4n} = \frac{332}{4\times 166} = 0.5m$

149 **(c)**

Comparing with the standard equation,

$y = A\sin\frac{2\pi}{\lambda}(vt - x)$, we have

$v = 200\ cm/\text{sec}, \lambda = 200\ cm; \therefore n = \dfrac{v}{\lambda} = 1\ \text{sec}^{-1}$

150 **(d)**

The time-interval between two successive beats

$\mathrm{T} = \dfrac{1}{\text{beat freaquency}} = \dfrac{1}{\mathrm{v}_1 - \mathrm{v}_2}$

151 **(b)**

Let the equation of wave be $y = A\sin(\omega t - kx)$

Where $\omega = 2\,\pi\, n\ and\ k = \frac{2\pi}{\lambda}$

Wave velocity, $V = n\lambda = \frac{\omega}{2\pi}\times\frac{2\pi}{k} = \frac{\omega}{k}$

Maximum particle velocity $v = A\omega$

For $V = v; \frac{\omega}{k} = A\omega\ or\ A = \frac{1}{k} = \frac{\lambda}{2\pi}$

152 **(c)**

For interference, two waves must have a constant phase relationship. Equation '1' and '3' and '2' and '4' have a constant phase relationship of $\frac{\pi}{2}$ out of two choices.

Only one S_2 emitting '2' and S_4 emitting '4' is given so only (c) option is correct

153 **(c)**

Here , $\frac{T_1}{T_2} = \frac{8}{1}, \frac{l_1}{l_2} = \frac{36}{35}, \frac{D_1}{D_2} = \frac{4}{1}$

and $\frac{\rho_1}{\rho_2} = \frac{1}{2}$

$n_1 = 360\ \text{Hz}, n_2 = ?$

Now, $\frac{n_2}{n_1} = \frac{l_1 D_1}{l_2 D_2}\sqrt{\frac{T_2\rho_1}{\rho_2 T_1}}$

$\dfrac{n_2}{n_1} = \dfrac{36}{35}\times\dfrac{4}{1}\sqrt{\dfrac{1}{8}\times\dfrac{1}{2}} = \dfrac{36}{35}$

Clearly $n_2 > n_1$. When $n_2 = 360$ Hz; $n_1 = 350$ Hz

Number of beats $s^{-1} = n_2 - n_1 = 360 - 350 = 10$

154 **(b)**

Given,

$v_s = \dfrac{v}{10}$

Apparent frequency

$v' = v\left(\dfrac{v}{v - v_s}\right)$

Where

v=real frequency of source

v=velocity of sound

v_s=velocity of source

So,

$\dfrac{v'}{v'} = \dfrac{v}{v - \frac{v}{10}} = \dfrac{10}{9}$

155 **(a)**

Two possible frequencies of source are $= 100 \pm 5 = 105\ or\ 95$

Frequency of 2nd harmonic $= 210\ or\ 190$

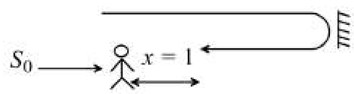
5 beats with source of frequency 205 are possible only when 2nd harmonic has frequency= 210

$\therefore$ Frequency of source = 105 Hz

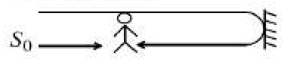
156 **(b)**

$v = n\lambda \Rightarrow \lambda = \dfrac{v}{n} = \dfrac{340}{170} \Rightarrow \lambda = 2$

First case



Second case



$x = \dfrac{\lambda}{2} = 1\ m$

157 **(c)**

Comparing with $y = a\sin(\omega t - kx) \Rightarrow a = \frac{10}{\pi}, \omega = 2000\pi$

$\therefore v_{\max} = a\omega = \dfrac{10}{\pi}\times 2000\pi = 2000m/sec$

and $\omega = \frac{2\pi}{T} \Rightarrow 200\pi = \frac{2\pi}{T} \Rightarrow T = 10^{-3} sec$

158 **(b)**

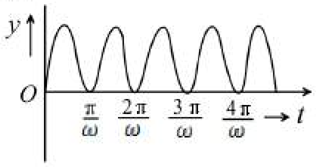
Comparing the given equation with $y = a\cos(\omega t - kx)$

$a = 25, \omega = 2\pi n = 2\pi \Rightarrow n = 1Hz$

159 **(b)**

Here, $y = \sin^2 \omega t$

$\frac{dy}{dt} = 2\omega \sin \omega t \cos \omega t = \omega \sin 2\omega t$



$\frac{d^2y}{dt^2} = 2\omega^2 \cos 2\omega t$

For SHM, $\frac{d^2y}{dt^2} \propto -y$

Hence, function is not SHM, but periodic, From the $y - t$ graph, time period is

$t = \frac{\pi}{\omega}$

160 **(c)**

Any two particles on different sides of a node have phase difference of 180°

161 **(b)**

Given,

$y = 4\cos^2 \frac{t}{2} \sin(1000t)$

$= 2(1 + \cos t) \sin(1000t) \left(\because 1 + \cos\theta = 2\cos^2 \frac{\theta}{2}\right)$

$= 2 \sin 1000t + 2 \cos t \sin 1000t$

$= 2 \sin 1000t + \sin(1001)t + \sin(999)t$

Therefore, it consists of 3 SHM's

162 **(c)**

The speed of the car is 72kmh^{-1}

$= 72 \times \frac{5}{18} = 20\text{ms}^{-1}$

The distance travelled by sound in reaching the hill and coming back to the moving driver

=1800+(1800-200)=3400m

So, the speed of sound=

$\frac{3400}{10} = 340ms^{-1}$

163 **(b)**

Here $n_1 = 480, \text{m} = 10$

$n_2 = n_1 \pm m = 480 \pm 10 = 490 \text{ or } 470$

When tension is increased, n_2 will increase

$(\therefore n_2 \propto \sqrt{T})$.

As number of beats s^{-1} decrease, $n_2 = 470$ Hz

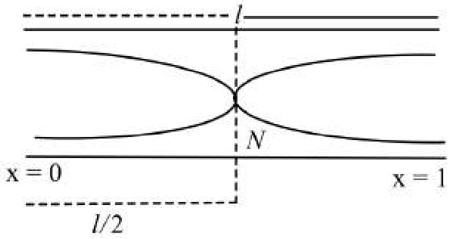
164 **(d)**

$n = \frac{1}{2l}\sqrt{\frac{T}{\pi r^2 \rho}} \Rightarrow n \propto \frac{\sqrt{T}}{r}$

$\Rightarrow \frac{n_2}{n_1} = \frac{r_1}{r_2}\sqrt{\frac{T_2}{T_1}} = \frac{1}{2} \times \sqrt{\frac{1}{2}} = \frac{1}{2\sqrt{2}}$

165 **(b)**

The first normal mode of vibration is called fundamental mode.



For first normal mode of vibration

$\iota = \frac{\lambda_1}{2}$

Since, the pressure vibration is maximum at node, i.e., $at\ 1/2$,

Hence, the pressure variation is maximum at the

$x = \frac{1}{2}$

166 **(b)**

The speed of sound (longitudinal waves) in water is given by

$v = \sqrt{\frac{B}{d}}$

Where B is bulk modulus of water and d is density

Given, $B = 2 \times 10^9 Nm^{-2}$, $d = 10^3 kgm^{-3}$

$v = \sqrt{\frac{2 \times 10^9}{10^3}} = 1.414 \times 10^3$

$= 1414 \text{ ms}^{-1}$

When sound travels back to the observer, it cover's twice the distance. So, time of echo.

$t = \frac{2d}{v}$

$\therefore \frac{tv}{2} = \frac{1414 \times 2}{2} = 1414\ m$

167 **(c)**

The explanation of the statements are given below

(i) In meled's experiment $\text{p}\sqrt{T}$=constant.

$\Rightarrow p^2T$=constant

Hence, this statement is correct.

(ii) In Kundt's experiment distance between two heaps of powder is$\lambda/2$.

Hence, this statement is correct

(iii) Quink's tube experiment is related with interface.

So, this statement is correct

(iv) Echo phenomena are related with reflection of sound.

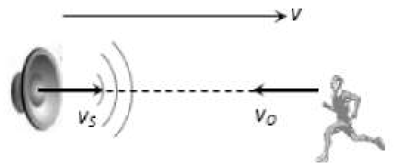
So, this statement is correct

168 **(c)**

Water waves are transverse as well as longitudinal in nature

169 **(b)**

When source and listener both are moving towards each other then, the frequency heard



$$n''n = \left(\frac{v+v_O}{v-v_S}\right) \Rightarrow n'' = f\left(\frac{v+v/10}{v-v/10}\right) = 1.22\,f$$

171 **(b)**

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

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

According to superposition principle, the resultant displacement is

$y = y_1 + y_2$

$= 0.05[\sin(3\pi t - 2x) + \sin(3\pi t + 2x)]$

$y = 0.05 \times 2\sin 3\pi t\cos 2x$

$y = (0.01\cos 2x)\sin 2\pi t = R\sin 3\pi t$

Where $R = 0.1\ \cos 2\,x =$ amplitude of the resultant standing wave.

At $\quad x = 0.5$ m

$R = 0.1\cos 2x = 0.1\cos 2 \times 0.5$

$= 0.1\cos 1(\text{radian}) = 0.1\cos\frac{180°}{\pi}$

$= 0.1\cos 57.3°$

$R = 0.1 \times 0.54\text{m} = 0.054\text{m} = 5.4\text{cm}.$

172 **(d)**

Resultant intensity of two periodic wave is given by

$I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\delta$

Where δ is the phase difference between the waves.

For maximum intensity, δ=2nπ; n=0,1,2,.... Etc.

Therefore, for zero order maxima, cos δ=1

$I_{\max} = I_1 + I_2 + 2\sqrt{I_1 I_2}$

$= \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

For minimum intensity, δ=(2n-1)π;

N=1,2,...etc

Therefore, for Ist order minima, cos δ=-1

$I_{\max} = I_1 + I_2 - 2\sqrt{I_1 I_2}$

$= \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$

Therefore, $I_{\max} + I_{\min}$

$$= \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 + \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$$

$= 2(I_1 + I_2)$

173 **(d)**

$$n' = n\left(\frac{v+v_o}{v-v_s}\right) = n\left(\frac{v+v/2}{v-v/2}\right) = 3n$$

174 **(c)**

Energy density $(E) = \frac{I}{v} = 2\pi^2\rho n^2 A^2$

$v_{\max} = \omega A = 2\pi n A \Rightarrow E \propto (v_{\max})^2$

$i.e.$, graph between E and $v_{\max}$ will be parabola symmetrical about E axis

175 **(b)**

Initially number of beats per second = 5

∴ Frequency of pipe = $200 \pm 5 = 195\ Hz$ or $205\ Hz$ ...(i)

Frequency of second harmonics of the pipe = $2n$ and number of beats in this case = 10

∴ $2n = 420 \pm 10 \Rightarrow 410\ Hz$ or $430\ Hz$

$\Rightarrow n = 205\ Hz$ or $215\ Hz$ ...(ii)

From equation (i) and (ii) it is clear that $n = 205\ Hz$

176 **(b)**

$\mathrm{f_{open}} = \frac{\mathrm{v}}{2\iota_{\mathrm{open}}}$

$\mathrm{f_{closed}} = \frac{\mathrm{v}}{4\iota_{\mathrm{closed}}} = \frac{\mathrm{v}}{\frac{4\iota_{\mathrm{open}}}{2}}$

$\left(\text{As } \iota_{\mathrm{closed}} = \frac{\iota_{\mathrm{open}}}{2}\right)$

$= \frac{\mathrm{v}}{2\mathrm{f_{open}}} = \mathrm{f_{open}}$ i. e.,

Frequency remains unchanged.

177 **(d)**

$$v = \frac{\omega}{k} = \frac{\text{Co} - \text{efficient of } t}{\text{Co} - \text{efficient of } x} = \frac{2}{0.01} = 200\ cm/sec$$

178 **(a)**

$m = \frac{0.035}{5.5}\text{kg m}^{-1}, T = 77N$

$$v=\sqrt{T/m}=\sqrt{\frac{77\times 5.5}{0.035}}=110\text{ms}^{-1}$$

179 **(a)**

According to problem

$\frac{1}{2L}\sqrt{\frac{T}{m}}=\frac{v}{4L}$ ...(i)

And $\frac{1}{2L}\sqrt{\frac{T+8}{m}}=\frac{3v}{4L}$ ...(ii)

Dividing equation (i) and (ii),

$$\sqrt{\frac{T}{T+8}}=\frac{1}{3}\Rightarrow T=1N$$

180 **(c)**

Large vertical plane acts as listener moving towards source with a velocity v.

$$\therefore n'=\frac{(c+v)n}{c}$$

This is the number of waves striking the surface per second.

182 **(c)**

The frequency of a wave is $\text{v}=\frac{\text{v}}{\lambda}$ where v is velocity and λ is wavelength.

For first wave, $\text{v}_1=396\text{ ms}^{-1}$

$\lambda_1=99\text{cm}=99\times 10^{-2}\text{m}$

$\therefore \text{v}_1=\frac{396}{99}\times 100=400\text{Hz}$

For second wavw, $\text{v}_2=396\text{ ms}^{-1}$

$\lambda_2=100\text{ cm}=100\times 10^{-2}\text{m}$

$\therefore \text{v}_2=\frac{396}{100}\times 100\text{ Hz}$

Number of beats = difference in frequencies.

$=\text{v}1-\text{v}_{=400}-396=4$

183 **(c)**

For closed organ pipe $n_1,:n_2:n_3\ldots.=1:3:5:\ldots.$

184 **(b)**

The given equation of a progressive wave is

$$y=3\sin\pi\left(\frac{t}{2}-\frac{x}{4}\right)=3\sin 2\pi\left(\frac{t}{4}-\frac{x}{8}\right)$$

The standard equation of a progressive wave is

$$y=y_0\sin 2\pi\left(\frac{t}{T}-\frac{x}{\lambda}\right)$$

Comparing these two equation, we get

T=4s, λ=8m

∴ velocity of wave,

$$v=\frac{\lambda}{T}=\frac{8}{4}=2ms^{-1}$$

Distance travelled by wave in time t is

S=vt

Or s=2×5=10m

185 **(d)**

$v=n\lambda\Rightarrow\lambda=10\ cm$

Phase difference $=\frac{2\pi}{\lambda}\times$ Path difference $=\frac{2\pi}{10}\times 2.5=\frac{\pi}{2}$

186 **(d)**

Path difference $(\Delta x)=50\ cm=\frac{1}{2}m$

$\therefore$ Phase difference $\Delta\phi=\frac{2\pi}{\lambda}\times\Delta x\Rightarrow\phi=\frac{2\pi}{1}\times\frac{1}{2}=\pi$

Total phase difference $=\pi-\frac{\pi}{3}=\frac{2\pi}{3}$

$\Rightarrow A=\sqrt{a^2+a^2+2a^2\cos(2\pi/3)}=a$

187 **(a)**

From Doppler's effect in sound, the perceived frequency (v') is given by

$$v'=\left(\frac{v+v_o}{v}\right)v$$

Where v_o is velocity of observer, v of sound and v the original frequency.

Give, v=240 Hz, $v=300ms^{-1}$, $v_o=11ms^{-1}$

$$v'=240\left(\frac{330+11}{330}\right)$$

$v'\approx 248Hz$

188 **(b)**

$l_1+l_2+l_3=110\ cm$ and $n_1l_1=n_2l_2=n_3l_3$

$n_1:n_2:n_3::1:2:3$

$\because\frac{n_1}{n_2}=\frac{1}{2}=\frac{l_2}{l_1}\Rightarrow l_2=\frac{l_1}{2}$ and $\frac{n_1}{n_3}=\frac{1}{3}=\frac{l_3}{l_1}\Rightarrow l_3=\frac{l_1}{3}$

$$\because l_1+\frac{l_1}{2}+\frac{l_1}{3}=110\text{ so }l_1=60cm, l_2=30cm, l_3=20cm$$

189 **(b)**

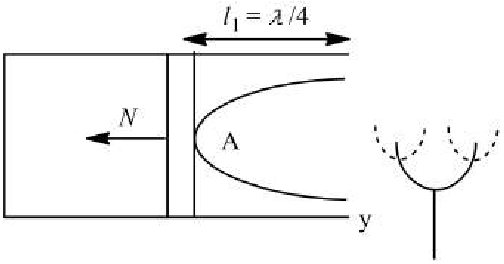
In a closed organ pipe in which length of air-column can be increased or decreased, the first resonance occurs at $\lambda/4$ and second resonance occurs at $3\lambda/4$.

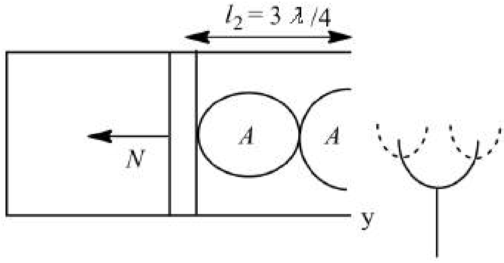
Thus, at first resonance

$\frac{\lambda}{4}=13$ ... (i)

And a second resonance

$\frac{3\lambda}{4}=41$ ... (ii)





Subtracting Eq.(i) from Eq.(ii), we have

$$\frac{3\lambda}{4} - \frac{\lambda}{4} = 41 - 13$$

$$\Rightarrow \frac{\lambda}{2} = 28$$

$$\therefore \quad \lambda = 56\ cm$$

Hence, frequency of tuning fork

$$v = \frac{v}{\lambda} = \frac{350}{56 \times 10^{-2}} = 365 \text{ Hz}$$

190 **(d)**

Time lost in covering the distance of 2 km by the sound waves $t = \frac{d}{v} = \frac{2000}{330} = 6.06\ sec \approx 6\ sec$

191 **(c)**

Real frequency v=400 Hz

Apparent frequency v'=390Hz

V'<v

So, the distance between the source and listener increases or the listener is going away from source.

192 **(c)**

Given, a=0.2m

$v = 360\ ms^{-1}, \lambda = 60m$

Equations of transverse wave travelling along positive x-axis

$$y = a \sin 2\pi \left[\frac{t}{T} - \frac{x}{\lambda}\right]$$

Or

$$y = a \sin 2\pi \left[\frac{v}{\lambda} t - \frac{x}{\lambda}\right]$$

$$y = 0.2 \sin 2\pi \left[6t - \frac{x}{60}\right]$$

193 **(a)**

When other end of pipe is opened, its fundamental frequency becomes 200 Hz. The overtone have frequencies 400,600,800 Hz…….

194 **(a)**

$v_0 = 332\ m/s$. Velocity sound at t°C is $v_t = (v_0 + 0.61\ t)$

$$\Rightarrow v_{20} = v_0 + 0.61 \times 20 = 344.2\ m/s$$

$$\Rightarrow \Delta n = v_{20}\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right) = 344.2\left(\frac{100}{50} - \frac{100}{51}\right) = 14$$

195 **(b)**

Minimum frequency will be heard, when whistle moves away from the listener.

$n_{\min} = n\left(\frac{v}{v+v_s}\right)$ where $v = r\omega = 0.5 \times 20 = 10\ m/s$

$$\Rightarrow n_{\min} = 385\left(\frac{340}{340+10}\right) = 374Hz$$

196 **(d)**

From the given equation k=0.2π

$$\Rightarrow \quad \frac{2\pi}{\lambda} = 0.2\pi$$

$$\Rightarrow \lambda = 10\ mm$$

$$\Delta\Phi = \frac{2\pi}{\lambda} \times \Delta x$$

$$= \frac{2\pi}{10} \times 2 = \frac{2\pi}{5} = 72°$$

197 **(b)**

Musical interval is the ratio of frequencies $= \frac{320}{240} = \frac{4}{3}$

199 **(b)**

Ultrasonic waves are those of higher frequencies than maximum audible range frequencies (audible range of frequencies is 20 Hz to 20000 Hz)

200 **(a)**

Velocity of sound is independent of frequency. Therefore it is same (v) for frequency n and $4n$

201 **(c)**

Resultant amplitude $= \sqrt{a_1^2 + a_2^2 + 2a_1a_2 \cos\phi}$

$$= \sqrt{0.3^2 + 0.4^2 + 2 \times 0.3 \times 0.4 \times \cos\frac{\pi}{2}} = 0.5\ cm$$

202 **(d)**

Infrasonic waves have frequency less than (20 Hz) audible sound and wavelength more than audible sound

203 **(c)**

Apparent frequency

$$v' = v\left(\frac{v - v_L}{v - v_S}\right)$$

$$= 165\left(\frac{355+5}{355-5}\right)$$

$(\because v_L = -5ms^{-1}, v_s = 5ms^{-1})$

$$= 165 \times \frac{340}{330} = 170\ Hz$$

Therefore, the number of beats heard
=170-165=5

204 **(c)**

Maximum velocity $v_{\max}$ $fa = 2 \times 300 \times 0.1$
$= 60\pi\ \mathrm{cms}^{-1}$

205 **(c)**

String vibrates in five segment so $\frac{5}{2}\lambda = l \Rightarrow \lambda = \frac{2l}{5}$

Hence $n = \frac{v}{\lambda} = 5 \times \frac{v}{2l} = 5 \times \frac{20}{2\times10} = 5\ Hz$

207 **(a)**

Energy is not carried by stationary waves

208 **(b)**

By using $v = \sqrt{\frac{\gamma RT}{M}} \Rightarrow v \propto \sqrt{T}$

$$\frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{T+600}{T}} = \sqrt{3} \Rightarrow T = 300\ K = 27°\mathrm{C}$$

209 **(a)**

For closed pipe $n = \frac{v}{4l} \Rightarrow n = \frac{332}{4\times42} = 2Hz$

210 **(a)**

Here$n_1 = 200$ Hz.

Number of beats s^{-1}; $\mathrm{m} = 4$

$\therefore\ n_2 = 200 \pm 4 = 204\ or\ 196$ Hz

On loading fork 2, its frequency decreases. And number of beats s^{-1} increases to 6. Therefore m is negative.

$n_2 = 200 - 4 = 196$ Hz

211 **(d)**

It a is amplitude of each wave,

$I_0 = k(a+a)^2 = 4ka^2$

Let ϕ be the phase difference to obtain the intensity$I_0/2$.

$$\therefore \frac{I_0}{2} = ka_r^2 = k(a^2 + a^2 + 2aa\cos\phi)$$

$$= k2a^2(1+cos\,\phi) = k4a^2\cos^2\frac{\phi}{2}$$

$$= I_0\cos^2\phi/2$$

$\cos\frac{\phi}{\sqrt{2}} = \frac{1}{\sqrt{2}} = \cos 45° \therefore \phi = 90°.$

If Δx is path difference between the two waves, then

$$\Delta x = \frac{\lambda}{2\pi}\phi = \frac{\lambda}{2\pi}\left(\frac{\pi}{2}\right) = \frac{\lambda}{4}$$

Therefore, displacement of sliding tube $\frac{1}{2}(\Delta x) = \lambda/8$

212 **(b)**

Given that, two waves
$y = a\sin(\omega t - ka)$
And y = a cos (ωt-kx)
Here, the phase difference between the two waves is $\frac{\pi}{2}$.
So, the resultant amplitude

$$A = \sqrt{a_1^2 + a_2^2 + 2a_1a_2\cos\Phi}$$

$$\left(Here\ a_1 = a, a_2 = a, \Phi = \frac{\pi}{2}\right)$$

$$\therefore \mathrm{A} = \sqrt{\mathrm{a}^2 + \mathrm{a}^2 + 2\mathrm{a}\,\mathrm{a}\cos\frac{\pi}{2}}$$

or $\mathrm{A} = \sqrt{\mathrm{a}^2 + \mathrm{a}^2 + 0}$

$\Longrightarrow \mathrm{A} = \sqrt{2}\mathrm{a}$

213 **(a)**

For the end correction x,

$$\frac{l_2 + x}{l_1 + x} = \frac{3\lambda/4}{\lambda/4} = 3$$

$$\Rightarrow \quad x = \frac{l_2 - 3l_1}{2}$$

$$= \frac{70.2 - 3\times22.7}{2} = 1.05\mathrm{cm}$$

214 **(d)**

$$\frac{dy}{dt} = y_0\cos 2\pi\left[ft - \frac{x}{\lambda}\right] \times 2\pi f$$

$\therefore$ maximum particle velocity $= \left(\frac{dy}{dt}\right)_{max} = 2\pi f y_0 \times 1$

Wave velocity $= f\lambda$

As $2\pi f y_0 = 4f\lambda, \therefore\ \lambda = \frac{2\pi y_0}{4} = \frac{\pi y_0}{2}$

215 **(c)**

If the temperature changes then velocity of wave and its wavelength changes. Frequency amplitude and time period remain constant

216 **(c)**

Intensity=energy/sec/area=power/area.

From a point source, energy spreads over the surface of a sphere of radius$r$.

Intensity $=\frac{P}{A}=\frac{P}{4\pi r^2}\propto\frac{1}{r^2}$

But Intensity = $(\text{Amplitude})^2$

$\therefore (\text{Amplitude})^2 \propto \frac{1}{r^2}$ or Amplitude $\propto \frac{1}{r}$

At distance $2r$,amplitude becomes $A/2$

217 **(d)**

Reverberation time $T=\frac{kV}{\alpha S}\Rightarrow T\propto V$

218 **(a)**

As the string vibrates in n loops, therefore,

$l=\frac{n\lambda}{2}$

Therefore, v would become $\frac{1}{2}$ times.

As $v\propto\sqrt{T}$

Therefore, to make v half time, T must be made $\frac{1}{4}$time *ie* M/4.

219 **(c)**

Both listeners, hears the same frequencies

220 **(d)**

Speed of sound, doesn't depend upon pressure and density medium at constant temperature

222 **(b)**

With temperature rise frequency of tuning fork decreases. Because, the elastic properties are modified when temperature is changed

Also, $n_1=n_0(1-0.00011t)$

Where n_t = frequency at t°C, n_0 = frequency at 0°C

223 **(c)**

Since solid has both the properties (rigidly and elasticity)

224 **(c)**

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

Comparing with $y=2a\cos\frac{2\pi vt}{\lambda}\sin\frac{2\pi x}{\lambda}\Rightarrow\lambda=6\ cm$

$\therefore$ The separation between adjacent nodes $=\frac{\pi}{2}=3\ cm$

225 **(c)**

For open pipe $f_1=\frac{v}{2l}$ and for closed pipe

$$f_2=\frac{v}{4\times\left(\frac{l}{4}\right)}=\frac{v}{l}=2f_1\Rightarrow\frac{f_1}{f_2}=\frac{1}{2}$$

226 **(d)**

From Doppler's effect in sound,

$$v'=v_o\left(\frac{v\pm v_o}{v\pm v_s}\right)$$

In the given case, $v_s=0.5v, v_o=0, v_o-3kHz$

$$\therefore v'=3\times\frac{v}{v-0.5v}=6kHz$$

227 **(c)**

When piston moves a distancex_1, path difference change by 2 xs.

∴the path difference between maxima and consecutive minima=$\lambda/2$

$\therefore 2x=\lambda/2$

Or

λ=4x=4×9 cm=36cm=0.36m

$$n=\frac{v}{\lambda}=\frac{360}{0.36}=1000\ Hz$$

228 **(a)**

Frequency of closed pipe

$$n_1=\frac{v}{4\iota_1}\Longrightarrow\iota_1=\frac{v}{4n_1}$$

Frequency of open pipe,

$$n_2=\frac{v}{2\iota_1}\Longrightarrow\iota_2=\frac{v}{2n_2}$$

When both pipes are joined then length of closed pipe

$$\iota=\iota_1+\iota_2$$

$$\frac{v}{4n}=\frac{v}{4n_1}+\frac{v}{2n_2}$$

Or

$$\frac{1}{2n}=\frac{1}{2n_1}+\frac{1}{2n_2}$$

Or

$$\frac{1}{2n}=\frac{n_2+2n_1}{2n_1n_2}$$

Or

$$n=\frac{n_1n_2}{n_2+2n_1}$$

229 **(b)**

$$n_1=\frac{\omega_1}{2\pi}=\frac{400\pi}{2\pi}=200\ Hz$$

$$n_2=\frac{\omega_2}{2\pi}=\frac{400\pi}{2\pi}=202\ Hz$$

$\therefore$ Number of beats per sec $n=n_2-n_1=2$

Again, $A_1=4$ *and* $A_2=3$

$$\frac{I_{\max}}{I_{\min}}=\frac{(A_1+A_2)^2}{(A_1-A_2)^2}=\left(\frac{4+3}{4-3}\right)^2=\frac{49}{1}$$

230 **(a)**

Here ,$T_1=16\ N, T_2=?$

As per the choice given, $T_2 > T_1$

$\therefore n_2 > n_1, (n_2 - n_1) = 3 \qquad ...(i)$

As $\quad n \propto \sqrt{T}$

$$\therefore \frac{n_2}{n_1} = \sqrt{\frac{T}{16}} = \sqrt{\frac{T}{4}}$$

If n_1 corresponds to 4: n_2 corresponds to $3 + 4 = 7$, which is $\sqrt{T}$. Therefore, $T = 49$ N

231 **(b)**

Apparent frequency in this case $n' = \frac{n(v+v_o)}{v}$

$\because \frac{v + v_o}{v} > 1 \Rightarrow \frac{n'}{n} > i.e. n' > n$

232 **(b)**

Speed =360 revolutions per min

=360/60 revolutions per sec=6

$\therefore$ frequency =6×60=360

233 **(a)**

Sending wave mode arises from the combination of reflection and impedance such that the reflected wave interfere and impedance such that the reflected waves interfere constructively with the incident wave.

Wave $z_1 = A\sin(kx - \omega t)$ is travelling along positive x-direction, $z_2 = A\sin(kx + \omega t)$ is travelling along positive y-direction. Hence, $z_1 + z_2$ produce standing wave because they travel along same axis but in opposite direction.

234 **(a)**

From doppler's effect, perceived frequency

$v' = v\left(\frac{v - v_o}{v - v_s}\right)$

$\frac{9}{8} = \frac{340}{340 - v_s}$

$\Longrightarrow 9(340 - v_s) = 8 \times 340$

$\Longrightarrow v_s = 37.7 ms^{-1} = 40 ms^{-1}$

235 **(b)**

From the given equation amplitude $a = 0.04m$

Frequency $= \frac{\text{Co-efficient of t}}{2\pi} = \frac{\pi/5}{2\pi} = \frac{1}{10} Hz$

Wave length $\lambda = \frac{2\pi}{\text{Co-efficient of } x} = \frac{2\pi}{\pi/9} = 18m$

Wave speed $v = \frac{\text{Co-efficient of } t}{\text{Co-efficient of } x} = \frac{\pi/5}{\pi/9} = 1.8 m/s$

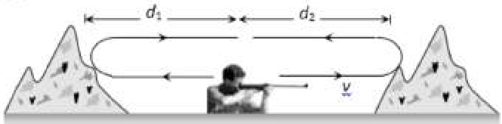
236 **(a)**

Frequency of waves remains same, $i.e.$ 60 kHz and wavelength $\lambda = \frac{v}{n} = \frac{330}{60\times10^3} = 5.5\ mm$

238 **(a)**

Speed of sound $v = \sqrt{\frac{\gamma P}{d}} \Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{d_2}{d_1}}$ [$\because P$-constant]

239 **(b)**

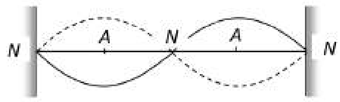


$2(d_1 + d_2) = v(t_1 + t_2) \Rightarrow d_1 + d_2$

$$= \frac{330 \times (3 + 5)}{2} = 1320\ m$$

240 **(d)**

When plucked at one fourth it gives two loops, and hence 2nd harmonic is produced.



241 **(b)**

Here $\rho_1 = \rho_2; \frac{r_1}{r_2} = \frac{1}{2}, T_1 = T_2$

$$n_1 = \frac{1}{2lr_1}\sqrt{\frac{T_1}{\pi\rho_1}}; n_2 = \frac{1}{2lr_2}\sqrt{\frac{T_2}{\pi\rho_2}}$$

$$\frac{n_1}{n_2} = \frac{r_2}{r_1} = 2$$

242 **(a)**

Velocity of wave (v)=360 m/s

Frequency, n= 600Hz

Phase difference, $\Delta\Phi = 60o$

If the minimum distance between two points is Δx, then

$\Delta x = \frac{\lambda}{2\pi} \times \Delta\Phi$

$\Delta x = \frac{v}{2\pi n} \times \Delta\Phi$

Or

$\Delta x = \frac{360}{2\pi \times 600} \times 60$

$\Delta x = \frac{360}{2\pi \times 600} \times \frac{\pi}{3}$

$\Delta x = \frac{1}{10} m$

$\Delta x = 10$ cm

243 **(c)**

Intensity ∝ (amplitude)^2

As $A_{\max} = 2a_o$(a_o = amplitude of one source) so $I_{\max} = 4I_o$

244 **(b)**

EM waves do not require medium for their propagation

245 **(b)**

Velocity of sound increases if the temperature increases. So with $v = n\lambda$, if v increases n will increase

At 27°C, $v_1 = n\lambda$, at 31°C, $v_2 = (n+x)\lambda$

Now using $v \propto \sqrt{T}$ $\quad \left[\because v = \sqrt{\frac{\gamma RT}{M}}\right]$

$$\frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} = \frac{n+x}{n}$$

$$\Rightarrow \frac{300+x}{300} = \sqrt{\frac{(273+31)}{(273+27)}} = \sqrt{\frac{304}{300}} = \sqrt{\frac{300+4}{300}}$$

$$\Rightarrow 1 + \frac{x}{300} = \left(1 + \frac{4}{300}\right)^{1/2} = \left(1 + \frac{1}{2} \times \frac{4}{300}\right) \Rightarrow x = 2$$

$[\because (1+x)^n = 1 + nx]$

246 **(c)**

We know that intensity $I \propto a^2$, where a is amplitude of the wave. The maximum amplitude is the sum of two amplitudes i.e., $(a + a = 2a)$

Hence, maximum intensity $\propto 4\,a^2$

Therefore the required ratio $i.e.$, ratio of maximum intensity (loudness) and intensity (loudness)of one wave is given by n,

$$n = \frac{4a^2}{a^2} = 4$$

247 **(b)**

As given,

$$y = 10^{-6} \sin\left(100t + 20x + \frac{\pi}{4}\right) \quad \dots \text{(i)}$$

Comparing it with

$$y = a\sin(\omega t + kx + \phi) \quad \dots \text{(ii)}$$

We find,

$\omega = 100\, rads^{-1}, k = 20/m$

$$\therefore \quad v = \frac{\omega}{k} = \frac{100}{20} = 5ms^{-1}$$

248 **(d)**

As source is moving towards observer,

$$\therefore v' = \frac{uv}{u - v_1} = \frac{333 \times 450}{333 - 30} = 499.5 = 500$$

249 **(b)**

When the piston is moved through a distance of $8.75cm$, the path difference produced is $2 \times 8.75cm = 17.5cm$.

This must be equal to $\frac{\lambda}{2}$ for maximum to change to minimum.

$$\therefore \frac{\lambda}{2} = 17.5\ cm \Rightarrow \lambda = 35cm = 0.35m$$

So, $v = n\lambda \Rightarrow n = \frac{v}{\lambda} = \frac{350}{0.35} = 1000Hz$

250 **(b)**

$$n_1 l_1 = n_2 l_2 \Rightarrow 250 \times 0.6 = n_2 \times 0.4 \Rightarrow n_2 = 375Hz$$

251 **(b)**

$$v = \sqrt{\frac{T}{m}} = \sqrt{\frac{T}{\pi r^2 \rho}}$$

$$v \propto \frac{\sqrt{T}}{r} \Rightarrow \frac{v_A}{v_B} = \sqrt{\frac{T_A}{T_B}} . \frac{r_B}{r_A} = \sqrt{\frac{1}{2}} . \frac{1}{2} = \frac{1}{2\sqrt{2}}$$

252 **(b)**

Phase difference $= \frac{2\pi}{\lambda} \times$ path difference

$$\Rightarrow \frac{\pi}{2} = \frac{2\pi}{\pi} \times 0.8 \Rightarrow \lambda = 4 \times 0.8 = 3.2m$$

Velocity $v = n\lambda = 120 \times 3.2 = 384\ m/s$

253 **(a)**

Since there is no relative motion between the source and listener, so apparent frequency equals original frequency

254 **(c)**

Since there is no relative motion between the listener and source, hence actual frequency will be heard by listener

256 **(a)**

$l_1 + x = \frac{\lambda}{4} = 22.7;$

$l_2 + x = \frac{3\lambda}{4} = 70.2; l_3 + x = \frac{5\lambda}{4}$

$$x = \frac{l_2 - 3l_1}{2} = \frac{70.2 - 68.1}{2} = \frac{2.1}{2} = 1.05 \text{ cm}$$

$$\frac{l_3 + x}{l_1 + x} = 5$$

$$l_3 = 5l_1 + 4x = 5 \times 22.7 + 4 \times 1.05 = 117.7 \text{ cm}$$

257 **(b)**

$$\therefore \frac{v}{v_c} = \frac{c/2\lambda}{v/4\lambda} = \frac{2}{1}$$

258 **(c)**

Comparing with $y = a\cos(\omega t + kx - \phi)$,

We get $k = \frac{2\pi}{\lambda} = 0.02\pi \Rightarrow \lambda = 100\ cm$

Also, it is given that phase difference between particles $\Delta\phi = \frac{\pi}{2}$. Hence path difference between them

$$\Delta = \frac{\lambda}{2\pi} \times \Delta\phi = \frac{\lambda}{2\pi} \times \frac{\pi}{2} = \frac{\lambda}{4} = \frac{100}{4} = 25\ cm$$

259 **(d)**

Beat frequency of heart $= 1.25\ Hz$

$\therefore$ Number of beats in 1 minute $= 1.25 \times 60 = 75$

260 **(a)**

$n_A = ?, n_B =$ Known frequency $= 320\ Hz$

$x = 4\ bps$, which remains same after filing.

Unknown fork A if filed so $n_A \uparrow$

Hence $n_A \uparrow - n_B = x\ \rightarrow$ Wrong

$n_B - n_A \uparrow = x\ \rightarrow$ Correct

$\Rightarrow\ n_A = n_B - x = 320 - 4 = 316\ Hz.$

This is the frequency before filing.

But in question after filing is asked which must be greater than 316 Hz, such that it produces 4 $beats\ per\ sec$. Hence it is 324 Hz

261 **(c)**

Let I_r and I_i represent the intensities of reflected and incident waves respectively, then

$$\frac{I_r}{I_i} = \left(\frac{\mu - 1}{\mu + 1}\right)^2$$

Where $\mu = \frac{v_1}{v_2}$

$$\text{Or}\quad v = \frac{\sqrt{\frac{T}{m_1}}}{\sqrt{\frac{T}{m_2}}} = \sqrt{\frac{m_2}{m_1}} = \sqrt{\frac{25}{9}} = \frac{5}{3}$$

$$\therefore \frac{I_r}{I_i} = \left[\frac{\left(\frac{5}{3}\right) - 1}{\left(\frac{5}{3}\right) + 1}\right]^2 = \frac{1}{16}$$

262 **(d)**

For two coherent sources, $I_1 = I_2$

$$I_{\max} = (A_1 + A_2)^2 = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$$

This is given as I_0 for maximum and zero for minimum. If there are two noncoherent sources, there will be no maximum and minimum intensities. Instead of all the intensity I_0 at maximum and zero foe minimum, it will be just $I_0/2$

263 **(c)**

$$v_s = r\omega = r \times 2\pi v$$

$$= \frac{70}{100} \times 2 \times \frac{22}{7} \times 5 = 22ms^{-1}$$

Frequency is minimum when source is moving away from listener.

$$v' = \frac{u \times v}{u + u_s} = \frac{352 \times 1000}{352 + 22} = 941\ \text{Hz}$$

264 **(a)**

Since, train (source) is moving towards pedestrian (observer), the perceived frequency will be higher than the original.

$$v' = v\left(\frac{v + v_o}{v - v_s}\right)$$

Here, $v_o = o$(as observer is stationary)

$v_s = 25ms^{-1}$(velocity of source)

$v = 350\ ms^{-1}$ (velocity of sound)

And v=1kHz (original frequency)

Hence,

$$v' = 1000\left(\frac{350 + 0}{350 - 25}\right)$$

$$= 1000 \times \frac{350}{325} = 1077\ Hz$$

265 **(c)**

The reflection sound appears to propagate in a direction opposite to that of moving engine. Thus, the source and the observer can be presumed to approach each other with same velocity.

$$v' = \frac{v(v + v_o)}{(v - v_s)}$$

$$= v\left(\frac{v + v_s}{v - v_s}\right) \qquad (\because v_o = v_s)$$

$$\Rightarrow v' = 1.2\left(\frac{350 + 50}{350 - 50}\right)$$

$$= \frac{1.2 \times 400}{300} = 1.6\ kHz$$

266 **(a)**

Using relation v=vλ

Or

$$\lambda = \frac{v}{v} = \frac{340}{340} - 1m$$

If length of resonance columns are l_1, l_2 and l_3, then

$l_1 = \frac{\lambda}{4} = \frac{1}{4}m = 25$ cm (for first resonance)

$l_2 = \frac{3\lambda}{4} = 75$cm (for second resonance)

$l_3 = \frac{5\lambda}{4} = 125$ cm for third resonance

This case of third resonance is impossible because total length of the tube is 120 cm

So, minimum height of water =120-75=45cm

268 **(b)**

As is known, frequency of vibration of a stretched string

$$n \propto \sqrt{T} \propto \sqrt{mg} \propto \sqrt{g}$$

As $n_\omega = \frac{80}{100} n_a = 0.8 n_a$

$$\therefore \frac{g'}{g} = \left(\frac{n_\omega}{n_a}\right)^2 = (0.8)^2 = 0.64$$

If ρ_ω = relative density of water(=1)

ρ_m =relative density of mass

ρ_r = relative density of liquid, then

$$\frac{g'}{g} = \left(1 - \frac{\rho_\omega}{\rho_m}\right) = 0.64$$

$\frac{\rho_\omega}{\rho_m} = 1 - 0.64 = .36$ (i)

Similarly, in the liquid

$$\frac{g'}{g} = \left(\frac{n_L}{n_a}\right)^2 = (0.6)^2 = 0.36$$

$$\frac{g'}{g} = \left(1 - \frac{\rho_L}{\rho_m}\right) = 0.36$$

$\frac{\rho_L}{\rho_m} = 1 - 0.36 = 0.64$ (ii)

Dividing Eq. (i) by Eq. (ii), we get

$$\frac{\rho_L}{\rho_m} = \frac{0.64}{0.34} = 1.77$$

Hence specific gravity of liquid=1.77

269 **(a)**

The time taken by the stone to reach the lake

$$t_1 = \sqrt{\left(\frac{2h}{g}\right)} = \sqrt{\left(\frac{2 \times 500}{10}\right)}$$

$$= 10 \text{ sec (Using } h = ut + \frac{1}{2}gt^2)$$

Now time taken by sound from lake to the man

$$t_2 = \frac{h}{v} = \frac{500}{340} \approx 1.5 \text{ sec}$$

$\Rightarrow$ Total time $= t_1 + t_2 = 10 + 1.5 = 11.5$ sec

270 **(c)**

Let n be the actual frequency of sound of horn.

If v_s is velocity of car, then frequency of sound striking the cliff (source moving towards listener)

$$n' = \frac{(v + v_s)n'}{v} = \frac{(v + v_s)}{v} \times \frac{v \times n}{(v - v_s)}$$

Or $\frac{n'}{n} = \frac{v+v_s}{v-v_s} = 2$

$$v + v_s = 2v - 2v_s$$

$$3v_s = v, v_s = \frac{v}{3}$$

271 **(b)**

$$2\left(\frac{v_1}{2l_1}\right) = \frac{v_2}{4l_2}$$

$$\therefore \frac{\sqrt{T/\mu}}{l_1} = \frac{320}{4l_2}$$

(μ=mass per unit length of wire)

$$Or \ \frac{\sqrt{50/\mu}}{0.5} = \frac{320}{4 \times 0.8}$$

Solving we get μ=0.02 kg/m=20 g/m

$\therefore$ Mass of string=20 g/m $\times$0.5 m=10 g

272 **(a)**

In transverse waves medium particles vibrate perpendicular to the direction of propagation of wave

273 **(b)**

As v=nλ

$$\therefore \quad \lambda = \frac{v}{n} = \frac{300}{500} = \frac{3}{5} m$$

Now, phase difference

$$= \frac{2\pi}{\lambda} \times \text{path difference}$$

$$\therefore \quad 60° = \frac{2\pi}{\lambda} \times \text{path difference}$$

$$\text{or} \quad \frac{60° \times \pi}{180°} = \frac{2\pi \times 5}{3} \times \text{path difference}$$

$$\text{path difference} = \frac{3 \times 60 \times \pi}{2\pi \times 5 \times 180} = 0.1$$

274 **(b)**

Beat frequency=number of beats s^{-1}

$= n_1 - n_2$

And maximum loudness $= (a + a)^2 = 4a^2 = 4I_1 \ or \ 4I_2 = 4I$

275 **(d)**

$$\text{speed v} = \frac{\omega}{k} = \frac{2\pi \times \lambda}{T \times 2\pi} = \frac{\lambda}{T}$$

276 **(b)**

Let L is the original length of the wire and k is force constant of wire.

Final length = initial length + elongation

$L' = L + \frac{F}{k}$

For the condition

$a = L + \frac{4}{k}$ ... (i)

For the second condition

$b = L + \frac{5}{k}$ ... (ii)

By solving Eqs. (i) and (ii), we get

$L = 5a - 4b$ and $k = \frac{1}{b-a}$

Now, when the longitudinal tension is 9N, length of the string

$= L + \frac{9}{k} = 5a - 4b + 9(b-a)$

=5b-4a

277 **(a)**

Let m be the total mass of the rope of length$l$.

Tension in the rope at a height h from lower end= weight of rope of length h is $T = \frac{mg}{l}(h)$

As $v = \sqrt{\frac{T}{(m/l)}}$

$v = \sqrt{\frac{mg(h)}{l(m/l)}} = \sqrt{gh}$

$v^2 = gh$

Which is a parabola. Therefore, h versus v graph is a parabola option (a) is correct.

278 **(c)**

The fundamental frequency of a wire is given by

$v = \frac{1}{2l}\sqrt{\frac{T}{m}}$

Where $l$is length of wire, T the tension and m the mass per unit length.

$\mathrm{m} = \frac{\text{mass of wire}}{\text{length of wire}}$

$= \frac{\pi r^2 L \times \text{density}}{L} = \pi r^2 d$

$v = \frac{1}{2l}\sqrt{\frac{T}{\pi r^2 d}}$

$\Rightarrow v = \frac{1}{2rl}\sqrt{\frac{T}{\pi d}}$

$\therefore \frac{v_1}{v_2} = \frac{r_2}{r_1} = \frac{2}{1}$

279 **(d)**

The speed of sound in a gas of density ρ at pressure P is

$v = \sqrt{\frac{\gamma P}{\rho}}$

280 **(c)**

$\mathrm{v}_1 = \frac{\mathrm{v}}{\lambda_1} = \frac{\mathrm{v}}{1.00}$ and $\mathrm{v}_2 = \frac{\mathrm{v}}{\lambda_2} = \frac{\mathrm{v}}{1.01}$

$\therefore \Delta\mathrm{v} = \mathrm{v}_1 - \mathrm{v}_2 = \mathrm{v}\left[\frac{1}{1.00} - \frac{0}{1.01}\right] = 10$

or $\mathrm{v} = \frac{10 \times 1 \times 1.01}{0.01} = 1010$ for 3s

$\therefore \mathrm{v} = 336.6\ \mathrm{ms}^{-1}$

281 **(a)**

Loudness, $L = 10\log_{10}\frac{I}{I_0}$

$60 = 10\log_{10}\frac{I_1}{I_0}$

$\Rightarrow \frac{I_1}{I_0} = 10^6$ ... (i)

$similarly,$ $30 = 10\, lig_{10}\frac{I_2}{I_0}$

$\frac{I_2}{I_0} = 10^3$ ... (ii)

Dividing Eq. (i) by Eq. (ii), we get

$\frac{I_1}{I_2} = 1000$

282 **(a)**

Path difference for a given phase difference δ is given by

$\Delta x = \frac{\lambda}{2\pi}\delta$

Given that $\delta = 60° = \frac{\pi}{3}$

$\Delta x = \frac{\lambda}{2\pi} \times \frac{\pi}{3}$ $\therefore \Delta x = \frac{\lambda}{6}$

283 **(a)**

Velocity of propagation

$\mathrm{x} = \frac{\text{Coefficient of t}}{\text{coefficient of x}} = \frac{2\pi\ /0.01}{2\pi/0.3} = 30ms^{-1}$

284 **(b)**

If $\rho_{\mathrm{H}} = 1$, then $\rho_{\mathrm{mix}} = \frac{4\times1+1\times16}{(4+1)} = 4$

$\frac{\mathrm{v}_{\mathrm{mix}}}{\mathrm{v}_{\mathrm{H}}} = \sqrt{\frac{\rho_{\mathrm{H}}}{\rho_{\mathrm{mix}}}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$

$v_{mix} = \frac{\mathrm{v}_{\mathrm{H}}}{2} = \frac{1224}{2} = 612\mathrm{ms}^{-1}$

286 **(b)**

$$\text{Frequency} = \frac{\text{velocity}}{\text{Wavelength}}$$

$\therefore f_1 = \frac{v}{\lambda_1} = \frac{330}{5} = 66Hz$

And $f_2 = \frac{v}{\lambda_2} = \frac{330}{5.5} = 60Hz$

Number of beats per second

$= f_1 - f_2 = 66 - 60 = 6$

287 **(d)**

Given,

Progressive wave y=a sin (kx-ωt)

When reflected by right wall

Progressive wave y'= a sin [k(-x)-wt)]

Or y' = a sin [-(kx+ωt)]

Or y' = a sin (kx+ωt)

289 **(b)**

For hearing beats, difference of frequencies should be less than 10 Hz

290 **(b)**

In close organ pipe

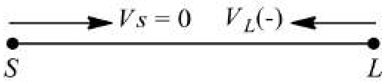
$v = \frac{v}{4l}$

So,

$l = \frac{v}{4v}$

291 **(a)**

Here, $v_s = 0$ and v_L is negative where $v_s$is velocity of source and $v_L$is velocity of listener (aeroplane)



If apparent frequency is v' and v is actual frequency, then

$v' = \frac{v-(-v_L)}{v} v = \frac{v+v_L}{v} L$

$i.e.$, v'>v

So, apparent frequency will increase, it means apparent wavelength will decrease.

292 **(b)**

As is clear from figure of question

$l = \frac{\lambda_p}{4}, \lambda = 4l, n_p = \frac{v}{\lambda_p} = \frac{v}{4l}$

$l = \frac{\lambda_q}{2}, \lambda_q = 2l, n_q = \frac{v}{\lambda_q} = \frac{v}{2l}$

$l = \lambda_r, \lambda_r = l, n_r = \frac{v}{\lambda_r} = \frac{v}{l}$

$l = \frac{3\lambda_s}{4}, \lambda_s = \frac{4l}{3}, n_s = \frac{v}{\lambda_s} = \frac{3v}{4l}$

$\therefore n_p : n_q : n_r : n_s = \frac{v}{4l} : \frac{v}{2l} : \frac{v}{l} : \frac{3v}{4l} = 1:2:3:4$

293 **(b)**

At t=0 and t=2s, the shape of y-x graphs are same.

294 **(d)**

$Y = 10 \sin\left[\frac{2\pi}{45} t + a\right]$

If t=0, y=5 cm

5=10(sin a)

$\sin a = \frac{1}{2}$

$a = \frac{\pi}{6}$

If t=7.5 g

Then total phase =

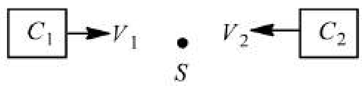
$\frac{2\pi}{45} \times \frac{15}{2} + \frac{\pi}{6} = \frac{\pi}{3} + \frac{\pi}{6} = \frac{\pi}{2}$

295 **(a)**

$n = \frac{v}{\lambda} \propto v \Rightarrow \frac{n_{MW}}{n_{US}} \approx \frac{3 \times 10^8}{3 \times 10^2} \approx 10^6 : 1$

296 **(a)**

Firstly, car will be treated as an observer which is approaching the source. Then, it will be treated as a source, which is moving in the direction of sound.



Hence,

$f_1 = f_o\left(\frac{v+v_1}{v-v_1}\right)$

$f_2 = f_o\left(\frac{v+v_2}{v-v_2}\right)$

$\therefore\ f_1 - f_2 = \left(\frac{1.2}{100}\right) f_o$

$= f_o\left[\frac{v+v}{v+v_1} - \frac{v+v_2}{v-v_2}\right]$

Or

$\left(\frac{1.2}{100}\right) f_o = \frac{2v(v_1-v_2)}{(v-v_1)(v-v_2)}, f_o$

$as\ v_1 and\ v_2$ Are very very less than v.

We can write, $(v-v_1) or\ (v-v_2) \approx v$.

$\therefore \left(\frac{1.2}{100}\right) f_o = \frac{2(v_1-v_2)}{v} f_o$

$Or\ \ (v_1 - v_2) = \frac{v \times 1.2}{200}$

$= \frac{300 \times 1.2}{200} = 1.98 ms^{-1}$

$=7.128 \text{km} \boldsymbol{h}^{-1}$

$\therefore$ the nearest integer is 7.

297 **(a)**

$y = y_1 + y_2 = a\sin(\omega t - kx) = a\sin(\omega t - kx)$

$y = 2a\sin\omega t\cos kx$

Clearly it is equation of standing wave for position of nodes y=0.

$i.e., x = (2n+1)\dfrac{\lambda}{4}$

$\Rightarrow \left(n+\dfrac{1}{2}\right)\lambda = 0,1,2,3$

298 **(b)**

In case of interference of two waves resultant intensity

$I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$

If ϕ varies randomly with time, so $(\cos\phi)_{av} = 0$

$\Rightarrow I = I_1 + I_2$

For n identical waves, $I = I_0 + I_0 + \ \ldots. = nI_0$

Here $I = 10I_0$

299 **(a)**

According to Doppler's effect, whenever there is a relative motion between a source of sound and listener, the apparent frequency of sound heard by the listener is different from the actual frequency of sound emitted by the source. Let S be source of sound and L the listener of sound. Let v be the actual frequency of sound emitted by the source and λbe the actual wavelength of the sound emitted.

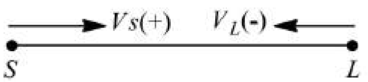
If v is velocity of sound in still air, then

$\lambda = \dfrac{v}{V}$

If velocity of listener is $v_L$and velocity of source is v_s, then apparent frequency of sound waves heard by the listener is

$v' = \dfrac{v - v_L}{v - s_s} \times V$

Here, both source and listener are approaching each other.



Then v_s is positive and v_L is negative.

$\therefore v' = \dfrac{v - (-v_L)}{v - v_s} v = \left(\dfrac{v + v_L}{v - v_s}\right) v$

$i.e., \quad v' > v$

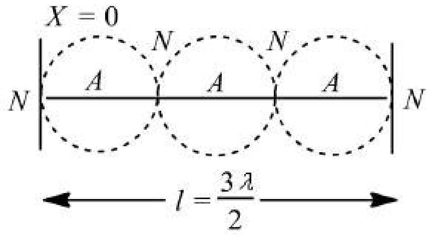
Also,

$\lambda' < \lambda$

So, listener listens more frequency and observes less wavelength.

300 **(c)**

Third mode of vibration or second overtone has three loops.



It consist of 4 nodes and 3 antinodes.

301 **(a)**

$y(x,t) = e^{-(ax^2 + bt^2 + 2\sqrt{ab}tx)}$

$= e^{-(\sqrt{a}x + \sqrt{b}t)^2}$

It is a function of type

$\therefore$ y(x,t) represents wave travelling along –x direction.

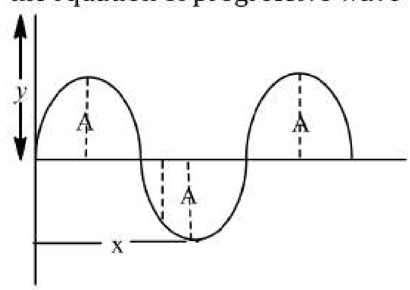
$Speed\ of\ wave\ = \dfrac{\omega}{k} = \dfrac{\sqrt{b}}{\sqrt{a}} = \sqrt{\dfrac{b}{a}}$

302 **(c)**

Total energy is conserved

303 **(c)**

If after t time, displacement of particle is y, then the rquation of progressive wave



Y=A cos (ax+bt)

304 **(a)**

$y = 5\ \sin\dfrac{\pi}{2}(100t - x)$

$y = 5\ \sin\left(\dfrac{100\pi}{2}t - \dfrac{\pi}{2}x\right)$

$y = 5\ \sin\left(50\pi t - \dfrac{\pi}{2}x\right)$

The general equation

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

$\therefore \omega = 50\pi$

$T = \dfrac{2\pi}{\omega} = \dfrac{2\pi}{50\pi} = \dfrac{1}{25}$

Or $T = 0.04$ s

305 **(a)**

$n \propto \frac{1}{l} \Rightarrow n_1 l_1 = n_2 l_2 \Rightarrow (n+4)49 = (n-4)50$

$\Rightarrow n = 396$

306 **(d)**

Beats are the periodic and repeating function heard in the intensity of sound when two sound waves of very similar frequency interface with one another.

308 **(a)**

No of beats, $x = \Delta n = \frac{30}{3} = 10\ Hz$

$\Rightarrow$ Also $\Delta n = v\left[\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right] = v\left[\frac{1}{5} - \frac{1}{6}\right] = 10 \Rightarrow v = 300\ m/s$

309 **(c)**

Relation of path difference and phase difference is given by

$\Delta\Phi = \frac{2\pi}{\gamma} \times \Delta x$

Where Δx is path difference.

But path difference between two crests Δx=λ

Hence, $\Delta\Phi = \frac{2\pi}{\lambda} \times \lambda = 2\pi$

310 **(c)**

Here, $v = 330\ \text{ms}^{-1}$

Phase difference of $1.6\pi = 40$ cm

Phase difference of $2\pi = \frac{40}{1.6\pi} \times 2\pi$ cm $= 50$ cm

ie, $\lambda = 50$ cm $= 0.5$ cm

$n = \frac{v}{\lambda} = \frac{330}{0.5} = 660$ Hz

311 **(d)**

Speed of sound $v \propto \sqrt{T}$ and it is independent of pressure

312 **(b)**

Position of first node=16cm

$\frac{\lambda}{2} + e = 16cm$

Where e =end correction

Position of second node=46cm

$\frac{\lambda}{2} + \frac{\lambda}{2} + e = 46cm$

Dividing Eq. (ii) by Eq.(i)

$\frac{\lambda}{2} = 30\ cm$

$\lambda = 60\ cm = \frac{60}{100} m$

$\therefore$ speed of sound v=vλ

$= 500 \times \frac{60}{100} = 300 ms^{-1}$

313 **(b)**

Using $n = \frac{1}{2l}\sqrt{\frac{T}{m}}$

Number of beats $= \frac{1}{2}\sqrt{\frac{T}{m}}\left[\frac{1}{l_2} - \frac{1}{l_1}\right]$

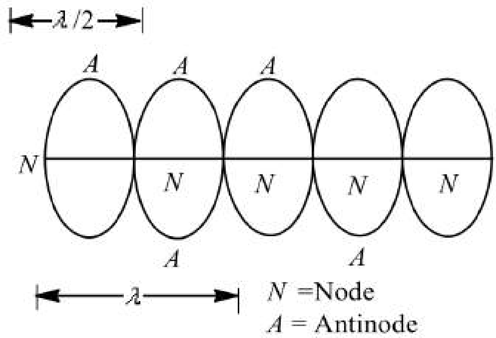
$= \frac{1}{2}\sqrt{\frac{20}{1 \times 10^{-3}}}\left[\frac{1}{49.1 \times 10^{-2}} - \frac{1}{51.6 \times 10^{-2}}\right] = 7$

314 **(d)**

By using $n' = n\frac{v}{v - v_S} \Rightarrow \frac{n'}{n} = \left(\frac{V}{V-S}\right)$

317 **(d)**

The nodes and antinodes are formed in a standing wave pattern as a result of the interface of two waves. Distance between two nodes is half wavelength (λ)



Standerd equation of standing wave is

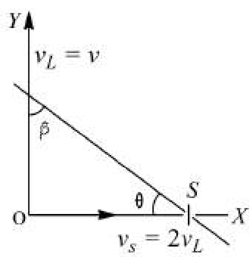
$y = 2_a \sin\frac{2\pi x}{\gamma}\cos\frac{2\pi vt}{\gamma}$

Where a is amplitude, the wavwlength

318 **(b)**

Let speed of observer be $v_L = v$ along Y-axis and speed of source the $v_s = 2v_L = 2v$ along X-axis

$\therefore PS = 2(OL)$



$\cos\alpha = \frac{2}{\sqrt{5}}$ *and* $\cos\beta = \frac{2}{\sqrt{5}}$

Now , apparent frequency n' is given by

$$n' = \frac{(v - v_L \cos\beta)n}{(v + v_L \cos\alpha)}$$

Where v is velocity of sound.

$$n' = \frac{(v - v\sqrt{5})n}{(v + 4v\sqrt{5})}$$

Clearly, n' is constant, but $n' < n$. This is shown in curve (b).

319 **(c)**

Frequency of sonometer wire is given by

$$v = \frac{1}{2l}\sqrt{\frac{T}{m}} = \frac{1}{2l}\sqrt{\frac{T}{\pi r^2 p}}$$

$$v_1 = \frac{1}{2l_1}\sqrt{\frac{T_1}{\pi r_1^2 \rho_1}}$$

$$v_2 = \frac{1}{2l_2}\sqrt{\frac{T_2}{\pi r_2^2 \rho_2}}$$

$$\therefore \frac{v_1}{v_2} = \frac{l_2}{l_1}\sqrt{\frac{T_1}{T_2} \times \frac{r_2^2}{r_1^2} \times \frac{\rho_2}{\rho_1}}$$

$$\frac{v_1}{v_2} = \frac{35}{36}\sqrt{\frac{8}{1} \times \frac{1}{16} \times \frac{2}{1}}$$

$\because v_1 < v_2$ and $v_2 = 360\text{Hz}$

Therefore,

$$v = 360 \times \frac{35}{36}$$

v_1=350 Hz

So, number of beats produced $= v_1 - v_2$

=360-350=10

320 **(b)**

$$v = \frac{\text{Co}-\text{efficient of } t}{\text{Co}-\text{efficient } of\ x} = \frac{1/2}{1/4} = 2m/s$$

Hence $d = vt = 2 \times 8 = 16m$

321 **(b)**

Speed of sound in gases is given by

$$v = \sqrt{\frac{\gamma RT}{M}} \Rightarrow v \propto \frac{1}{\sqrt{M}} \Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{M_2}{M_1}}$$

322 **(a)**

From the given equation $k = \frac{2\pi}{k}$ = Co-efficient of $x = \frac{\pi}{4} \Rightarrow \lambda = 8m$

323 **(c)**

When train is approaching frequency heard by the observer is

$n_a = n\left(\frac{v}{v - v_S}\right) \Rightarrow 219 = n\left(\frac{340}{340 - v_S}\right)$ ...(i)

When train is receding (goes away), frequency heard by the observer is

$n_r = n\left(\frac{v}{v + v_S}\right) \Rightarrow 184 = n\left(\frac{340}{340 + v_S}\right)$ ...(ii)

On solving equation (i) and (ii) we get $n = 200Hz$ and $v_S = 29.5m/s$

324 **(d)**

First overtone for closed pipe $= \frac{3v}{4l}$

Fundamental frequency for open pipe $= \frac{v}{2l}$

First overtone for open pipe $= \frac{2v}{2l}$

326 **(c)**

Frequency of 2^{nd} overtone $n_3 = 5n_1 = 5 \times 50 = 250Hz$

327 **(a)**

Number of extra waves received $\text{s}^{-1} = \pm u/\lambda$

$\therefore$ Number of beats $\text{s}^{-1} = \frac{u}{\lambda} - (-u/\lambda) = \frac{2u}{\lambda}$

328 **(a)**

Maximum pressure at closed end will be atmosphere pressure adding with acoustic wave pressure

So $\rho_{\max} = \rho_A + \rho_0$ and $\rho_{\min} = \rho_A - \rho_0$

Thus $\frac{\rho_{\max}}{\rho_{\min}} = \frac{\rho_A + \rho_0}{\rho_A - \rho_0}$

329 **(a)**

$v = \sqrt{\frac{\gamma RT}{M}} \Rightarrow v \propto \sqrt{\frac{\gamma}{M}}$. Since $\frac{\gamma}{M}$ is maximum for H_2 so sound velocity is maximum in H_2

330 **(b)**

Path difference between the wave reaching at D

$$\Delta x = L_2P - L_1P = \sqrt{40^2 + 9^2} - 40 = 41 - 40 = 1m$$

For maximum $\Delta x = (2n)\frac{\lambda}{2}$

For first maximum $(n = 1) \Rightarrow 1 = 2(1)\frac{\lambda}{2} \Rightarrow \lambda = 1m$

$$\Rightarrow n = \frac{v}{\lambda} = 330Hz$$

331 **(a)**

Velocity of sound $v \propto \sqrt{T}$

Time

$$t \propto \frac{1}{\sqrt{v}}$$

$$\therefore t \propto \frac{1}{\sqrt{T}}$$

$$\frac{t_1}{t_2} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{2}{t_2} = \sqrt{\frac{273+30}{273+10}}$$

$$\frac{2}{t_2} = \sqrt{\frac{303}{283}} = 1.03$$

$$t_2 = \frac{2}{1.03} = 1.9s$$

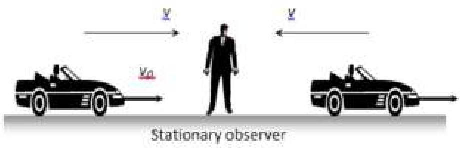
332 **(c)**

Frequency of $p\ th$ harmonic

$$n = \frac{pv}{2l} \Rightarrow p = \frac{2ln}{v} = \frac{2 \times 0.33 \times 1000}{330} = 2$$

333 **(a)**

$n_{Before} = \frac{v}{v-v_c} n$ and $n_{After} = \frac{v}{v+v_c} . n$



$$\frac{n_{Before}}{n_{After}} = \frac{11}{9} = \left(\frac{v+v_c}{v-v_c}\right) \Rightarrow . v_c \Rightarrow \frac{v}{10}$$

334 **(c)**

Since frequency remains unchanged

V=v'

$$\frac{v}{\lambda} = \frac{v'}{\lambda'}$$

$$\frac{v}{\lambda} = \frac{2v}{\lambda'}$$

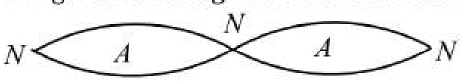
$$\lambda' = \frac{2v}{v}\lambda$$

$$\lambda' = 2\lambda$$

Hence, its wavelength will become twice.

336 **(d)**

The given standing wave is shown in the figure



As length of loop or segment is

$$\frac{\lambda}{2}$$

So length of 2 segments is

$$2\left(\frac{\lambda}{2}\right)$$

$$\therefore 2\frac{\lambda}{2} = 1.21Å$$

$$\Longrightarrow \lambda = 1.21Å$$

337 **(b)**

$$n_1 - n_2 = 6$$

$$\Rightarrow \frac{1}{2l}\sqrt{\frac{T'}{m}} - \frac{1}{2l}\sqrt{\frac{T}{m}} = 6$$

$$\Rightarrow \frac{1}{2l}\sqrt{\frac{T'}{m}} - 600 = 6$$

$\frac{1}{2l}\sqrt{\frac{T'}{m}} = 606 =$ Fundamental frequency ...(i)

Given,

$\frac{1}{2l}\sqrt{\frac{T}{m}} = 600$ ...(ii)

Dividing Equation (i) by Equation (ii), we get

$$\frac{\frac{1}{2l}\sqrt{\frac{T'}{m}}}{\frac{1}{2l}\sqrt{\frac{T}{m}}} = \frac{606}{600}$$

$$\Rightarrow \sqrt{\frac{T'}{T}} = (1.01) \Rightarrow \frac{T'}{T} = (1.02)$$

$$\Rightarrow T' = T(1.02)$$

Increase in tension

$\Delta T' = T \times 1.02 - T = (0.02\text{T})$

Hence, $\frac{\Delta T'}{T} = 0.02$

338 **(a)**

Since sources of frequency x gives 8 beats per second with frequency 250 Hz, it's possible frequencies are 258 or 242. As source of frequency x gives 12 beats per second with a frequency 270 Hz, it's possible frequencies are 282 and 258 Hz. The only possible frequencies of x which gives 8 beats with frequency 250 Hz also 12 beats per second with 270 Hz is 258 Hz

339 **(a)**

Due to rise in temperature, the speed of sound increases. Since $n = \frac{v}{\lambda}$ and λ remains unchanged, hence n increases

340 **(c)**

$$n = \frac{1}{2l}\sqrt{\frac{T}{\pi r^2 \rho}} \propto \sqrt{\frac{T}{r^2\rho}}$$

$$\Rightarrow \frac{n_1}{n_2} = \sqrt{\left(\frac{T_1}{T_2}\right)\left(\frac{r_2}{r_1}\right)^2\left(\frac{\rho_2}{\rho_1}\right)} = \sqrt{\left(\frac{1}{2}\right)\left(\frac{2}{1}\right)^2\left(\frac{1}{2}\right)} = 1$$

$$\therefore n_1 = n_2$$

341 **(d)**

Compare the given equation with

$$y = a\sin(\omega t + kx) \Rightarrow \omega = 2\pi n = 100 \Rightarrow n = \frac{50}{\pi} Hz$$

$k = \frac{2\pi}{\lambda} = 1 \Rightarrow \lambda = 2\pi$and $v = \omega/k = 100\ m/s$

Since $' + '$ is given between t terms and x term, so wave is travelling in negatie x-direction

343 **(d)**

Frequency $f = \frac{1}{2L}\sqrt{\frac{T}{M}} = \frac{1}{2L}\sqrt{\frac{T}{\pi r^2(1)\rho}}$

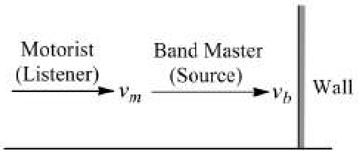
$$= \frac{1}{2rL}\sqrt{\frac{T}{\pi\rho}} \Rightarrow \frac{f_1}{f_2} = \left(\frac{r_2}{r_1}\right)\left(\frac{L_2}{L_1}\right) \Rightarrow \frac{1}{2} = \left(\frac{r_2}{r_1}\right)\left(\frac{4}{1}\right)$$

$$\Rightarrow \frac{r_2}{r_1} = \frac{1}{8} \Rightarrow \frac{r_1}{r_2} = \frac{8}{1}$$

344 **(c)**

The motorist receives two sound waves, direct one from the band and that reflected from the wall, figure. For direct sound waves, apparent frequency

$$f' = \frac{(v + v_m)f}{v + v_b}$$



For reflected sound waves.

Frequency of sound wave reflected from the wall

$$f'' = \frac{v \times f}{v - v_b}$$

Frequency of reflected waves as received by the moving motorist,

$$f' = \frac{(v + v_m)f''}{v} = \frac{(v + v_m)f}{v - v_b}$$

$\therefore$ Beat frequency $= f'' - f'$

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

345 **(c)**

For closed pipe in general $n = \frac{v}{4l}(2N - 1) \Rightarrow n \propto \frac{1}{l}$

i.e. if length of air column decreases frequency increases

346 **(b)**

For infrasonics, frequency $n < 20\ \text{cms}^{-1}$

$$\lambda = \frac{u}{n} > \frac{330}{20} = 15\text{m} = 10^1\text{m}$$

347 **(a)**

Assin$(90 \pm \theta = \cos\theta)$, therefore, phase difference between the two waves is $90°$ *or* $\frac{\pi}{2}$.

348 **(b)**

$$n' = n\left(\frac{v}{v - v_S}\right) = 600\left(\frac{330}{300}\right) = 660\ cps$$

349 **(c)**

Octave stands for an interval 2: 1. Therefore octaves will have a frequency ratio $= 2^3 = 8$.

350 **(c)**

$$\frac{I_{\max}}{I_{\min}} = \left(\frac{\frac{a_1}{a_2} + 1}{\frac{a_1}{a_2} - 1}\right)^2 = \left(\frac{\frac{4}{3} + 1}{\frac{4}{3} - 1}\right)^2 = \frac{49}{1}$$

351 **(b)**

$$n' = n\left(\frac{v - v_O}{v + v_S}\right) = n\left(\frac{340 - 10}{340 + 10}\right) = 1950$$

$$\Rightarrow n = 2068\ Hz$$

352 **(d)**

Comparing the given equation with standard equation

$$y = a\sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right) \Rightarrow T = 0.04sec \Rightarrow v = \frac{1}{T} = 25Hz$$

Also $(A)_{\max} = \omega^2 a = \left(\frac{2\pi}{T}\right)^2 \times a = \left(\frac{2\pi}{0.04}\right) \times 3$
$= 7.4 \times 10^4 cm/sec^2$

353 **(c)**

In our case both source and observer are moving, so perceived frequency

$$v' = \frac{v(c - v_o)}{(c - v_s)}$$

Where v_o is the velocity of observer, v_s is the velocity of source and c is velocity of sound.

Given,

$v_o = -2v, v_s = -v$

$$\therefore v' = \frac{v(c + 2v)}{(c + v)}$$

354 **(d)**

Given,

$$y = 5\sin\left(30\pi t - \frac{\pi}{7}x + 30°\right) \text{... (i)}$$

Now,

$$y = a\sin\left(\frac{2\pi t}{T} - \frac{2\pi x}{\lambda} + \phi\right) \quad \text{... (ii)}$$

On comparing Eqs. (i) and (ii)

$$\frac{2\pi x}{\lambda} = \frac{\pi x}{7}$$

$$\Rightarrow \quad \lambda = 14m$$

We know that relation between phase difference and path difference

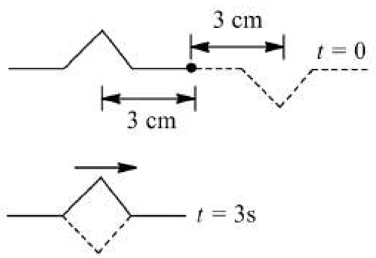
$$\Delta\phi = \frac{2\pi}{\lambda} \times \Delta x = \frac{2\pi}{14} \times 3.5$$

$$\Rightarrow \Delta\phi = \frac{\pi}{2}$$

355 **(a)**

When O is a fixed end, the formation of reflected pulse is equivalent to overlapping of two inverted pulses travelling in opposite direction as shown in figure.

Here at $t = 3$ s, net displacement of all particles of the string will be zero ie the string will be straight as shown in figure.



Choice (a) is correct.

356 **(b)**

If d is the distance between man and reflecting surface of sound then for hearing echo

$$2d = v \times t \Rightarrow d = \frac{330 \times 1.5}{2} = 247.5\ m$$

357 **(a)**

Fundamental frequency of cylindrical open tube

$$\text{n} = \frac{\text{v}}{2\text{L}} = 390\ \text{Hz}$$

When it is immersed in water it become a closed tube of length

$\frac{3^{\text{th}}}{4}$ of the initial length.

Therefore, its fundamental frequency is

$$\text{n}' = \frac{\text{v}}{4\left(\frac{3}{4}\text{L}\right)} = \frac{\text{v}}{3\text{L}} = \frac{2}{3}\left(\frac{\text{v}}{2\text{L}}\right)$$

$$= \frac{2}{3} \times 390\text{Hz} = 260\text{Hz}$$

358 **(a)**

Time required for a point to move from maximum displacement to zero displacement is

$$t = \frac{T}{4} = \frac{1}{4n}$$

$$\Rightarrow n = \frac{1}{4t} = \frac{1}{4 \times 0.170} = 1.47\ Hz$$

359 **(b)**

From Doppler's effect, perceived frequency is

$$v' = v\left(\frac{v - v_o}{v - v_s}\right)$$

$$v_s = 72kmh^{-1} = \frac{72 \times 1000}{60 \times 60} = 20ms^{-1}$$

$$v_o = 0, v = 332\ ms^{-1}, v' = 260\ Hz$$

$$260 = v\left(\frac{332}{332 - 20}\right)$$

$$\Rightarrow v = \frac{260 \times 312}{332} = 244\ Hz$$

360 **(b)**

From the relation, $v_m = \sqrt{\frac{\gamma p}{\rho}}$

Where, p=pressure of the gas

P=density of the gas

Since, density of moist air is less than that of dry air

i.e., $\rho_m < \rho_d$

Therefore, $v_m > v_d$

361 **(a)**

Here, $\frac{ct}{\lambda}$ is dimensionless and unit of ct is same as that of x. Also unit of λ is same as that of A, which is also the unit of x

362 **(a)**

Y=2cos 2π(330 t-x)

$$\omega = 2\pi \times 330$$

$$T = \frac{1}{330}s$$

363 **(c)**

Resonance occurs when amplitude is maximum*ie*, when the denominator of this equation is minimum.

364 **(d)**

Number of waves per minute = 54

∴ Number of waves per second = 54/60

Now $v = n\lambda \Rightarrow n = \frac{54}{60} \times 10 = 9m/s$

365 **(a)**

$$v_{\max} = a\omega = 3 \times 10 = 30$$

366 **(c)**

Resultant amplitude

$$A_R = 2A\cos\left(\frac{\theta}{2}\right) = 2 \times (2a)\cos\left(\frac{\theta}{2}\right) = 4a\cos\left(\frac{\theta}{2}\right)$$

368 **(b)**

Let the base frequency be n for closed pipe then notes are $n, 3n, 5n$ ....

∴ note $3n = 255 \Rightarrow n = 85$, note $5n = 85 \times 5 = 425$ note $7n = 7 \times 85 = 595$

369 **(b)**

$$y_1 = 10^{-6}\sin[100\,t + (x/50) + 0.5]$$

$y_2 = 10^{-6} \sin\left[100t + \left(\frac{x}{50}\right) + \left(\frac{\pi}{2}\right)\right]$

Phase difference ϕ

$= [100t + (x/50) + 1.57] - [100t + (x/50) + 0.5]$

$= 1.07\ radians$

371 **(d)**

In n is frequency of first fork, then frequency of the last (10th fork)$= n + 4(10-1) = 2\,n$

$\therefore n = 36$ and $2\,n = 72$

372 **(a)**

Phase difference is 2π means constrictive interference so resultant amplitude will be maximum

373 **(a)**

At nodes pressure change (strain) is maximum

374 **(d)**

According to Laplace, the speed of sound in gas is given by

$v = \sqrt{\frac{\gamma RT}{M}},$

Where γ is ratio of specific heats, M the molecular weight, R the gas constant and T the temperature,

$\therefore \frac{v_o}{v_H} = \sqrt{\frac{M_H}{M_o}}$

$\therefore \frac{v_O}{v_H} = \sqrt{\frac{1}{16}} = \frac{1}{4}$

$\therefore \quad v_O : v_H = 1:4$

375 **(a)**

Here, $u_s = 50\text{ms}^{-1}, v_L = 0, v = 350\text{ms}^{-1}$

When source is moving towards observer,

$v' = 1000$

$v' = \frac{u \times v}{u - u_s}$

$v = \frac{(u - u_s)v'}{u}$

$= \frac{(350-50)1000}{350} = \frac{6000}{7}\text{Hz}$

When source is moving away from observer,

$v' = \frac{u \times v}{u + v_s}$

$= \frac{350}{(350+50)} \times \frac{6000}{7}$

$= 750$ Hz

376 **(d)**

Frequency is decreasing (becomes half), it means source is going away from the observe. In this case frequency observed by the observer is

$n' = n\left(\frac{v}{v+v_S}\right) \Rightarrow \frac{n}{2} = n\left(\frac{v}{v+v_S}\right) \Rightarrow v_S = v$

377 **(a)**

From $n = \frac{1}{lD}\sqrt{\frac{T}{\pi\rho}}$

When radius of string is doubled, Diameter D becomes twice. As $T\ and\ \rho$ are same, n becomes $1/2$, ie, $n/2$.

378 **(d)**

Here, $A_1 = A, A_2 = A, \phi = 120°$

The amplitude of the resultant wave is

$A_R = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$

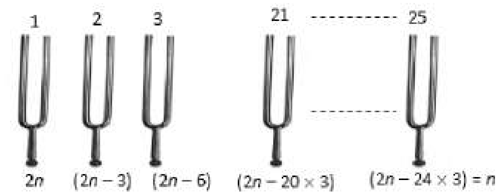
$= \sqrt{A^2 + A^2 + 2AA\cos 120°}$

$= \sqrt{A^2 + A^2 - A^2} \qquad \left[\because \cos 120° = -\frac{1}{2}\right]$

$\therefore A_R = A$

379 **(c)**

According to the question frequencies of first and last tuning forks are $2n$ and n respectively. Hence frequency is given arrangement are as follows



$\Rightarrow 2n - 24 \times 3 = n \Rightarrow n = 72\ Hz$

So, frequency of 21st tuning fork

$n_{21} = (2 \times 72 - 20 \times 3) = 84\ Hz$

380 **(c)**

$\frac{I_1}{I_2} = \frac{4}{1} = \frac{a^2}{b^2} \therefore \frac{a}{b} = \frac{2}{1}$

$\therefore \frac{I_{max}}{I_{min}} = \frac{(a+b)^2}{(a-b)^2} = \frac{(2+1)^2}{(2-1)^2} = 9$

Now, $L_1 - L_2 = 10\log\frac{I_{max}}{I_0} - 10\log\frac{I_{mim}}{I_0}$

$= 10\log\frac{I_{max}}{I_{min}} = 10\log 9$

$L_1 - L_2 = 10\log 3^2 = 20\log 3$

381 **(c)**

For an organ pipe open at one end,

Frequency of 1st overtone $n_1 = \frac{3v}{4l_1}$

For the organ pipe open at both ends,

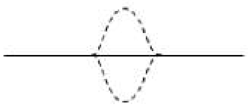
Frequency of 3rd harmonic,$n_2 = \frac{3v}{2l_2}$

As $n_1 = n_2$

$\therefore \frac{3v}{4l_1} = \frac{3v}{2l_2}$ or $\frac{l_1}{l_2} = \frac{2}{4} = \frac{1}{2}$

382 **(c)**

After two seconds each wave travel a distance of $2.5 \times 2 = 5\ cm$ $i.e.$ the two pulses will meet in mutually opposite phase and hence the amplitude of resultant will be zero.



383 **(b)**

$\frac{I_1}{I_2} = \frac{a_1^2}{a_2^2} \Rightarrow \frac{I_1}{I_2} = \frac{25}{100} = \frac{1}{4}$

384 **(a)**

Frequency

$v = \frac{1}{2l}\sqrt{\left(\frac{T}{m}\right)}$

$\therefore v + \frac{3}{2} = \frac{1}{2l}\sqrt{\left(\frac{101\,T}{100\,m}\right)}$

$= 1.005 \times \frac{1}{2l}\sqrt{\left(\frac{T}{m}\right)}$

$\Longrightarrow$ v+1.5=1.005v

$\Longrightarrow$ v=300 Hz

385 **(c)**

Reverberation time, $T = \frac{0.61V}{aS}$

$\Rightarrow \frac{T_1}{T_2} = \left(\frac{V_1}{V_2}\right)\left(\frac{S_2}{S_1}\right) = \left(\frac{V}{8V}\right)\left(\frac{4S}{S}\right) = \frac{1}{2}$

$\Rightarrow T_2 = 2T_1 = 2 \times 1 = 2$ sec. [$\because T_1 = 1$ sec]

386 **(b)**

As $\frac{v}{4l_1} = \frac{3v}{2l_2}$

$\therefore \frac{l_1}{l_2} = \frac{2}{12} = \frac{1}{6}$

387 **(d)**

It is known that Doppler's effect depends on velocity not on distance. When the source is approaching the stationary observer, the apparent frequency heard by the observer is

$n' = \frac{v \times n}{v - v_s} =$ constant

But $n' > n$.

When the source has crossed the observer, apparent frequency heard by the observer is

$n'' = \frac{v \times n}{v + v_s} =$ another constant

But $n'' < n$.option (d) is correct.

388 **(b)**

Sound geard directly

$v_1 = v_o\left(\frac{v}{v - v_s}\right)$

$\therefore 970 = 1000\left(\frac{330}{330 + v_s}\right)$

Or $v_s = 10.2ms^{-1}$

The frequency of reflected sound is given by

$v_2 = v_o\left(\frac{v}{v - v_s}\right) = 1000\left(\frac{330}{330 - 10.2}\right)$

$= \frac{1000 \times 330}{319.8} \approx 1032Hz$

389 **(c)**

A pulse of a wave train when travels along a stretched string and reaches the fixed end of the string, then it will be reflected back to the same medium and the reflected ray suffers a phase change of π with the incident wave but wave velocity after reflection does not change.

390 **(a)**

Given, y(x,t)=0.005 cos (ax-βt)

$$\frac{2\pi}{\lambda} = a \quad and \frac{2\pi}{T} = \beta$$
So,
$$a = \frac{2\pi}{0.08} = 25\pi \quad and\ \beta = \frac{2\pi}{2} = \pi$$
391 **(a)**
Length of air column in resonance is odd integer multiple of
$$\frac{\lambda}{4}$$
And prongs of tuning fork are kept in a vertical plane.
392 **(b)**
As $p\sqrt{T}$ = constant $\therefore \frac{T_2}{T_1} = \frac{p_1^2}{p_2^2} = \frac{4^2}{6^2}$
$$T_2 = \frac{16}{36} T_1 = \frac{16}{36} \times 65 = 29$$
$\therefore$ Weight to be removed $= 65 - 29 = 36$ g
393 **(c)**
The amplitude of a plane progressive wave=a, that of a cylindrical progressive wave is $a/\sqrt{r}$.
394 **(a)**
The average power per unit area that is incident perpendicular to the direction of propagation is called the intensity, i.e.,
$$I = \frac{P}{4\pi r^2}$$
Or
$$I \propto \frac{I}{r^2}$$
Or
$$\frac{I_2}{I_2} = \left(\frac{r_2}{r_1}\right)^2$$
Here, $r_1 = 2m, r_2 = 3m$
$$\therefore \frac{I_1}{I_2} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$$
395 **(a)**
Wavelength of closed organ pipe is
$$\lambda = \frac{4L}{(2n-1)}$$
Putting n=1,2,3,..... we find that
$$\lambda_1 = 4L, \frac{4L}{3}, \frac{4L}{5}, \ldots.$$
So frequency of vibration corresponding to modes n=1,2,3...is
$$v_1 = \frac{v}{\lambda_1} = \frac{v}{4L} = v_1$$
$$v_2 = \frac{v}{\lambda_2} = \frac{v}{4L/3} = \frac{3v}{4L} = 3v_1$$
$$v_2 = \frac{v}{\lambda_3} = \frac{v}{4L/5} = \frac{5v}{4L} = 5v_1$$
$\therefore \; v_1 L v_2 : v_3 \ldots . = 1:3:5: \ldots.$
So, only odd harmonics are present.

396 **(c)**
The standard equation of wave is
Y=a sin (ωt-kx)
Where a is amplitude, ω the angular velocity and x the displacement at instant t.
Given equation is
Y=0.1sin (100πt-kx)
Comparing Eq. (i) with Eq. (ii), we get
$$\therefore \text{Wave number} = \frac{\omega}{v} = \frac{100\pi}{100} = \pi \text{m}^{-1}$$
397 **(a)**
The velocity of wave
$$v = \frac{\omega(\text{Co} - \text{efficient of } t)}{k(\text{Co} - \text{efficient of } x)} = \frac{10}{1} = 10\ m/s$$
398 **(a)**
Speed of wave on a string
$$v = \sqrt{\frac{T}{m}}$$
Or
$$v \propto \sqrt{T}$$
Or
$$\frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}}$$
Or
$$T - \frac{2}{T_1} = \frac{v_2^2}{v_1^2}$$
Or
$$\frac{T_2 - T_1}{T_1} = \frac{v_2^2 - v_1^2}{v_1^2}$$
Initially, $T_1 = 120\ N$,
$$v_1 = 150 ms^{-1}$$
$$v_2 = v_1 + \frac{20}{100} v_1$$
$$= v_1 + \frac{v_1}{5} = \frac{6v_1}{5}$$
$$= \frac{6}{5} \times 150 = 180 ms^{-1}$$
So, from eq. (i), we get
$$\frac{T_2 - T_1}{T_1} = \frac{(180)^2 - (150)^2}{(150)^2}$$
$$= \frac{30 \times 330}{150 \times 150} = 0.44$$
Hence, % increases in tension

$= \left(\frac{T_2 - T_1}{T_1}\right) \times 100 = 0.44 \times 100 = 44\%$

400 **(c)**

$n \propto \sqrt{T} \Rightarrow \frac{\Delta n}{n} = \frac{\Delta T}{2T}$

If tension increases by 2%, then frequency must increases by 1%.

If initial frequency $n_1 = n$ then final frequency

$n_2 - n_1 = 5$

$\Rightarrow \frac{101}{100} n - n = 5 \Rightarrow n = 500Hz$

Short trick : If you can remember then apply following formula to solve such type of problems.

Initial frequency of each wire (n)

$= \frac{\text{(Number of beats heard per sec)} \times 200}{\text{(per centage change in tension of the wire)}}$

Here $n = \frac{5 \times 200}{2} = 500Hz$

401 **(c)**

$v = 165$ Hz, and

$$v' = \frac{335 + 5}{335} \times \frac{335}{330} \times 165 = 170\text{Hz}$$

$\therefore$ Number of beats s^{-1}

$= v' - v = 170 - 165 = 5$

402 **(d)**

$2d = v \times t$, where v = velocity of sound = $332\ m/s$

t = Persistence of hearing $= \frac{1}{10}$ sec

$$\Rightarrow d = \frac{v \times t}{2} = \frac{332 \times \frac{1}{10}}{2} = 16.6\ m$$

403 **(c)**

$$\frac{I_1}{I_2} = \frac{a_1^2}{a_2^2} = \left(\frac{0.06}{0.03}\right)^2 = \frac{4}{1}$$

404 **(a)**

$$v_{sound} \propto \frac{1}{\sqrt{\rho}} \Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{4}{1}} = 2 \Rightarrow v_2 = \frac{v_1}{2}$$

$$= \frac{v_s}{2}$$

405 **(a)**

In the same phase $\phi = 0$ so resultant amplitude $= a_1 + a_2 = 2A + A = 3A$

406 **(c)**

$$n' = \frac{vn}{v - v_s}, n'' = \frac{vn}{v + v_s}$$

$$\therefore \frac{n}{n'} = 1 - \frac{v_s}{v}, \frac{n}{n''} = 1 + \frac{v_s}{v}$$

Adding the two, we get

$$\frac{n}{n'} + \frac{n}{n''} = 2 \quad \therefore \quad n = \frac{2n'n''}{n' + n''}$$

407 **(c)**

$$\bar{n} = \frac{1}{\lambda} = \frac{1}{6000 \times 10^{-10}} = 1.66 \times 10^6 m^{-1}$$

408 **(a)**

For a closed pipe, 1st resonance occurs at

$L_1 = \frac{\lambda}{4} = 50\ cm$

2nd resonance occurs at

$L_2 = \frac{3\lambda}{4} = 3\left(\frac{\lambda}{4}\right) = 3 \times 50cm = 150cm$

409 **(a)**

$l_2 = 3l_1 = 3 \times 24.7 = 74.1\ cm$

410 **(b)**

Here , $A_1 = A_2 = A$; $n_1 = \omega_1, n_2 = \omega_2$

$\therefore y_1 = A \sin 2\pi\omega_1 t, y_2 = A \sin 2\pi\omega_2 t$

$y = y_1 + y_2$

$$= 2A \frac{\cos 2\pi(\omega_2 - \omega_1)t}{2} \sin \frac{2\pi(\omega_2 + \omega_1)t}{2}$$

$= A' \sin \pi(\omega_2 - \omega_1)t$

Where $A' = 2A \cos\pi(\omega_2 - \omega_1)t$

Sound heard will be of max- intensity $(> 2A^2)$

When $\cos \pi\,(\omega_2 - \omega_1)t = max = \pm 1$

$\pi(\omega_2 - \omega_1)t = 0, \pi, 2\pi,$

$$t = 0, \frac{1}{\omega_2 - \omega_1}; \frac{2}{\omega_2 - \omega_1}; \ldots\ldots\ldots\ldots\ldots\ldots$$

Time interval between two successive maxima

$$= \frac{1}{\omega_2 - \omega_1} = \frac{2}{10^3} = 10^{-3}\text{s}$$

411 **(a)**

The frequency of reflected sound heard by the girl,

$$n' = n\left[\frac{v - (v_o)}{v - v_s}\right] = n\left[\frac{v + v_o}{v - v_s}\right]$$

$= 480 \left[\frac{340+20}{340-20}\right] = 540\ Hz$

412 **(d)**

Doppler's effect is applicable for both light and sound waves

413 **(b)**

To produce 5 *beats/sec* frequency of one wire should be increased up to 505 *Hz. i.e.* increment of 1% in basic frequency.

$n \propto \sqrt{T}$ or $T \propto n^2 \Rightarrow \frac{\Delta T}{T} = 2\frac{\Delta n}{n}$

$\Rightarrow$ percentage change in Tension $= 2(1\%) = 2\%$

414 **(a)**

$$\frac{n_2}{n_1} = \sqrt{\frac{101}{100}} = \left(1 + \frac{1}{100}\right)^{\frac{1}{2}} = 1 + \frac{1}{200}$$

$$n_2 = n_1 + \frac{n_1}{200}$$

Number of beats $s^{-1} = n_2 - n_1 = \frac{n_1}{200} = \frac{200}{200} = 1$

415 **(b)**

On getting reflected from a rigid boundary the wave suffers

Hence if $y_{incident} = A\sin(\omega t = kx)$

Then $y_{reflected} = (0.8A)\sin[\omega t - k(-x) + \pi]$

$= -0.8A\sin(\omega t + kx)$ an additional phase change of π

416 **(c)**

Maximum number of beats =v+1-(v-1)=2

417 **(c)**

Number of beats per second= $n_1 \sim n_2$

$\omega_1 = 200\pi = 2\pi v_1$

$\Longrightarrow n_1 = 1000$

And $\omega_2 = 2008\pi = 2\pi n_2$

$\Longrightarrow n_2 = 1004$

Number of beats heard per second

=1004-1000=4

418 **(b)**

For observer approaching a stationary source

$n' = \frac{v+v_0}{v}.n$ and given $v_0 = at \Rightarrow n' = \left(\frac{an}{v}\right)t + n$

This is the equation of straight line with positive intercept n and positive slope $\left(\frac{n}{v}\right)$

419 **(a)**

$$\frac{n_1}{n_2} = \frac{l_2}{l_1} = \frac{51}{50}$$

$n_1 - n_2 = 5$. On solving, we get

$n_2 = 250, n_1 = 255$

420 **(b)**

Given equation of stationary wave is

$y = \sin 2\pi x \cos 2\pi t$, comparing it with standard equation

$y = 2A\sin\frac{2\pi x}{\lambda}\cos\frac{2\pi x}{\lambda}$

We have $\frac{2\pi x}{\lambda} = 2\pi x \Rightarrow \lambda = 1m$

Minimum distance of string (first mode) $L_{\min} = \frac{\lambda}{2} = \frac{1}{2}m$

421 **(d)**

Particle velocity $(v_p) = -v \times$ Slope of the graph at that point

At point 1 : Slope of the curve is positive, hence particle velocity is negative or downward (↓)

At point 2 : Slope negative, hence particle velocity is positive or upwards (↑)

At point 3 : Again slope of the curve is positive, hence particle velocity is negative or downward (↓)

422 **(b)**

Equation of wave y=0.2 sin (1.5x+60t)

Comparing with standard equation

y=A sin (kx+ωt)

k=1.5, ω=60

$\therefore$ velocity of wave $v = \frac{\omega}{k} = \frac{60}{1.5} = 40ms^{-1}$

Velocity of wave on a stretched string

$$v = \sqrt{\frac{T}{m}}$$

Where m-linear density

T= tension in the string

So, $T = v^2 m$

$= (40)^2 \times 3 \times 10^{-4} = 0.48$

423 **(c)**

Path difference $\Delta = \frac{\lambda}{2\pi} \times \phi = \frac{\lambda}{2\pi} \times \frac{\pi}{3} = \frac{\lambda}{6}$

424 **(c)**

As the two waves have different amplitude therefore they having different intensity. While quality depends on shape of waveform.

Frequencies will be different because wave have different wavelength in same medium

425 **(a)**

For string fixed at both the ends, resonant frequency are given by

$$\mathrm{v} = \frac{\mathrm{nv}}{2\mathrm{L}}$$

Where symbols have their meaning. It is given that 315 Hz and 420 Hz are two consecutive resonant frequency, let these nth and (n+1)th harmonics.

$315 = \frac{nv}{2L}$ ... (i)

$420 = \frac{(n+1)v}{2L}$ ... (ii)

$\Rightarrow$Eq.(i)$\div$Eq.(ii)

$\Rightarrow \frac{315}{450} = \frac{n}{n+1} \Rightarrow n = 3$

From Eq. (i), lowest resonant frequency

$v_0 = \frac{v}{2L} = \frac{315}{3} = 105 \text{ Hz}$

426 **(c)**

The transverse vibrations of a string are determined by Melde's method.

The frequency of vibration of a string of length l, mass per unit length m and vibration in p loops under tension T is given by

$$n = \frac{p}{2l}\sqrt{\frac{T}{m}}$$

Or

$p\sqrt{T}$ =constant

If n, l and m are constant

Hence,

$T \propto \frac{1}{p^2}$

$\therefore \frac{T_1}{T_2} = \frac{p_2^2}{p_1^2}$

Or

$\frac{(50+15)}{T_2} = \frac{(6)^2}{(4)^2}$

Or

$\frac{65}{T_2} = \frac{36}{16}$

$\therefore T_2 = \frac{65 \times 16}{36} = 26\text{g}$

So, weight removed from the pan

=65-29

=36 g

=0.036 kg-wt

427 **(c)**

When engine approaches towards observer

$n' = n\left(\frac{v}{v - v_S}\right)$

When engine going away from observer

$n" = \left(\frac{v}{v + v_S}\right)n$

$\therefore \frac{n'}{n"} = \frac{v + v_S}{v - v_S} \Rightarrow \frac{5}{3} = \frac{340 + v_S}{340 - v_S} \Rightarrow v_S = 85\ m/s$

428 **(b)**

Let one mole of each gas has same volumes as V. when they are mixed, then density of mixture is

$\rho_{mixture} = \frac{mass\ of\ O_2 + mass\ of\ H_2}{volume\ of\ O_2 + volume\ of\ H_2}$

$= \frac{32+2}{V+V}$

$= \frac{34}{2V} = \frac{17}{V}$

Also, $\rho_{H_2} = \frac{2}{V}$

Now, velocity $v = \left(\frac{\gamma p}{\rho}\right)^{1/2}$

Or

$v \propto \frac{1}{\sqrt{\rho}}$

$\therefore \frac{v_{mixture}}{V_{H_2}} = \sqrt{\left(\frac{\rho_{H_2}}{\rho_{mixture}}\right)}$

$= \sqrt{\left(\frac{2/v}{17/v}\right)} = \sqrt{\left(\frac{2}{17}\right)}$

429 **(d)**

If d is the distance of rock from SONAR then

$2d = vt \Rightarrow d = \frac{v \times t}{2} = \frac{1600 \times 1}{2} = 800m$

430 **(d)**

Frequency of vibration in tight string

$n = \frac{p}{2l}\sqrt{\frac{T}{m}} \Rightarrow n \propto \sqrt{T} \Rightarrow \frac{\Delta n}{n} = \frac{\Delta T}{2T} = \frac{1}{2} \times (4\%)$

$= 2\%$

$\Rightarrow$ Number of beats $= \Delta n = \frac{2}{100} \times n = \frac{2}{100} \times 100 = 2$

431 **(b)**

$n = \frac{p_1}{lD_1}\sqrt{\frac{T}{\pi\rho}} = \frac{p_2}{lD_2}\sqrt{\frac{T}{\pi\rho}}$

$\therefore \frac{p_1}{D_1} = \frac{p_2}{D_2}$

$\frac{p_1}{p_2} = \frac{D_1}{D_2} = \frac{2(r)}{2(2r)} = \frac{1}{2}$

432 **(a)**

Frequency of vibration is given by

$$v = \frac{p}{2l}\sqrt{\frac{T}{m}} \quad \left(where\ v = \sqrt{\frac{T}{m}}\right)$$

$$\therefore v = \frac{p}{2l} v = \frac{5 \times 20}{2 \times 10} = 5Hz$$

433 **(b)**

The progressive wave givesn is

$$y = 0.1 \sin\left(10\pi t - \frac{5}{11}\pi x\right)$$

Comparing it with general equation of progressive wave

Y=a sin (ωt-kx)

We get

$$k = \frac{5\pi}{11}$$

Or

$$\frac{2\pi}{\lambda} = \frac{5\pi}{11}$$

$$\Rightarrow \quad \lambda = \frac{22}{5} = 4.4\ cm$$

Moreover, ωt=10πt

Or 2πvt=10πt

$$\therefore v = \frac{10\pi}{2\pi} = 5Hz$$

$$\therefore velocity\ v = \lambda v = 22\ cm\ s^{-1}$$

434 **(b)**

As the wire is forced to have a frequency= $512 = 2 \times 256 = 2n$,therefore, it must vibrate in two segments.

435 **(a)**

Intensity ∝ $(\text{Amplitude})^2$

436 **(d)**

The doppler's wavelength shift is given by

$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$$

Where, v is velocity and c is speed of light.

Given,

$$\frac{\Delta\lambda}{\lambda} = 0.014\%, \qquad c = 3 \times 10^8 ms^{-1}$$

$$\Rightarrow v = \frac{\Delta\lambda}{\lambda} \times c = \frac{0.014}{100} \times 3 \times 10^8$$

$$= 4.2 \times 10^4 ms^{-1}$$

437 **(d)**

$v = \sqrt{\frac{\gamma P}{\rho}}$; as P also changes, ρ also changes. Hence $\frac{P}{\rho}$ remains constant so speed remains constant

438 **(c)**

Let the distance between the two cliffs be d. since, the man is standing midway between the two cliffs, then the distance of man from either end is d/2

The distance travelled by sound (in producing an echo)

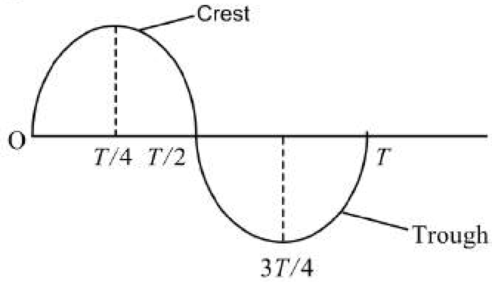
$$2 \times \frac{d}{2} = v \times t$$

$$\Rightarrow \quad d = 340 \times 1 = 340m$$

439 **(b)**

The time taken by the particle to come to mean position from the through=

$$\frac{T}{4}$$



440 **(b)**

For sonometer

$$v \propto \frac{1}{l}$$

$$\therefore \frac{v_1}{v_2} = \frac{l_2}{l_1} \Rightarrow \frac{256}{v_2} = \frac{16}{25}$$

$$v_2 = \frac{256 \times 25}{16} = 400\ Hz$$

441 **(b)**

Frequency

$$\mathrm{n} = \frac{\mathrm{v}}{\lambda} = \frac{\mathrm{v}}{2\iota}$$

$$\therefore \mathrm{v} = \mathrm{n}(2\iota) = 330 \times 2 = 660\ \mathrm{ms}^{-1}$$

443 **(d)**

$$T = \mu v^2 = \mu \frac{\omega^2}{k^2} = 0.04 \frac{\left(\frac{2\pi}{0.004}\right)^2}{\left(\frac{2\pi}{0.50}\right)^2} = 6.25N$$

444 **(b)**

The position f such a wave changes in two dimensional plane with time. Therefore, (b) represents the correct equation.

445 **(c)**

In closed organ pipe. First resonance occurs at $\lambda/4$.

So, in fundamental mode of vibration of organ pipe

$$\frac{\lambda}{4} = (l + 0.3\ d)$$

Where 0.3 d is necessary end correction

Frequency of vibration $n = \frac{v}{\lambda} = \frac{v}{4(l+0.3d)}$

As l is same, wider pipe A will resonate at a lower frequency, $i.e.$, $n_A < n_B$

Note : The value of end correction θ is 0.6 r for closed organ pipe and 1.2 r for an open organ pipe, where r is the radius of the pipe

446 **(c)**

According the concept of sound image

$$n' = \frac{v + v_{\text{person}}}{v - v_{\text{person}}}.272 = \frac{345+5}{345-5} \times 272 = 280\ Hz$$

$\Delta n =$ Number of beats $= 280 - 272 = 8\ Hz$

447 **(d)**

Accordingly

$$v_1 = \frac{v}{2l} \qquad \dots(i)$$

And

$$v_2 = \frac{v}{4l/4} = \frac{v}{l} \qquad \dots(ii)$$

Hence,

$$\frac{v_1}{v_2} = \frac{1}{2}$$

448 **(a)**

Since $\phi = \frac{\pi}{2} \Rightarrow A = \sqrt{a_1^2 + a_2^2} = \sqrt{(4)^2 + (3)^2} = 5$

449 **(d)**

Let intensity of sound be I and I'.

Loudness of sound initially

$$\beta_1 = 10 \log\left(\frac{I}{I_0}\right)$$

Later,

$$\beta_2 = 10 \log\left(\frac{I'}{I_0}\right)$$

Given, $\beta_2 - \beta_1 = 20$

$$\therefore 20 = \log\left(\frac{I'}{I}\right)$$

$I' = 100I$

450 **(a)**

We know that at night amount of carbon dioxide in atmosphere increases which raises the density of atmosphere. Since intensity is directly proportional to density, intensity of sound is more at night

452 **(c)**

Fundamental frequency

$$n = \frac{v}{2l} = \frac{330}{2 \times 0.25} = 660 \text{ Hz}$$

Frequency of overtones are $2n, 3n, 4n, \dots . =$ 1320,1980,2640 Hz.

453 **(c)**

$$I \propto \frac{1}{r^2} \Rightarrow \frac{I_2}{I_1} = \frac{r_1^2}{r_2^2} \Rightarrow \frac{I_2}{1 \times 10^{-2}} = \frac{2^2}{10^2} = \frac{4}{100}$$

$$\Rightarrow I_2 = \frac{4 \times 10^{-2}}{100} = 4 \times 10^{-4}\ \mu\, W/m^2$$

454 **(b)**

At $t = 0$ and $x = \frac{\pi}{2k}$. The displacement

$$y = a_0 \sin\left(\omega x_0 - k \times \frac{\pi}{2x}\right) = -a_0 \sin\frac{\pi}{2} = -a_0$$

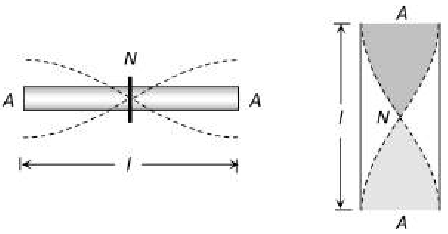
from graph. Point of maximum displacement (a_0) in negative direction is Q

455 **(a)**

$v = n\lambda = 2 \times 5 = 10\ cm/sec$

456 **(a)**

If a rod champed at middle, then it vibrates with similar fashion as open organ pipe vibrates as shown.



Hence, fundamental frequency of vibrating rod is given by

$$n_1 = \frac{v}{2l} \Rightarrow 2.53 = \frac{v}{2 \times 1} \Rightarrow v = 5.06\ km/sec$$

457 **(a)**

The standard equation of wave is given by

Y=a sin (kx-ωt) ....(i)

Where a is amplitude, k the wave constant and ω the angular velocity.

Given wave equation is

$y = 0.07 \sin(12\pi x - 3000\pi t)$......(ii)

Comparing Eqs. (i) with (ii), we get

A=0.07, k=12π

$$\therefore\ \ k = \frac{2\pi}{\lambda} = 12\pi$$

$$\Rightarrow\ \ \lambda = \frac{1}{6} m$$

Also, ω=3000π=2πv

∴ v=1500

Hence, velocity (v)=frequency(v)×wavelength (λ)

$$v = 1500 \times \frac{1}{6} = 250\ ms^{-1}$$

458 **(c)**

$$\lambda = \frac{v}{n} = \frac{340}{200} = 1.7\ m$$

459 **(a)**

Distance between the successive nodes,

$d = \frac{\lambda}{2}$

$= \frac{v}{2f}$

$= \frac{\sqrt{T/\mu}}{2f}$

Substituting the value we get

D=5cm

460 **(b)**

$\frac{n_1}{n_2} = \frac{l_2}{l_1} = \frac{25}{30} = \frac{5}{6}$

$n_2 - n_1 = 4$,On solving, we get $n_2 = 24$ Hz,

$n_1 = 20$ Hz.

461 **(a)**

For closed pipe $l_1 = \frac{v}{4n}; l_2 = \frac{3v}{4n} \Rightarrow v = 2n(l_2 - l_1)$

$\Rightarrow n = \frac{v}{2(l_2 - l_1)} = \frac{330}{2 \times (0.49 - 0.16)} = 500\ Hz$

462 **(d)**

The apparent frequency heard by the stationary observer is

$v' = v_0 \left(\frac{v}{v - v_s}\right)$ ...(i)

where,

$v_0 =$ frequency of source

$v =$ velocity of sound

$v_s =$ velocity of source

According to problem

$v' = v_0 + \frac{50}{100} v_0$

$v' = \frac{3}{2} v_0$

Substituting this value of v' in (i), we get

$\frac{3}{2} v_0 = \eta v_0 \left(\frac{v}{v - v_s}\right)$

$3v - 3v_s = 2v \Rightarrow v = 3v_s$

$\Rightarrow v_s = \frac{v}{3} = \frac{330}{3} ms^{-1} = 110 ms^{-1}$

463 **(b)**

Let m=mass per unit length of rope

T=tension in the rope at a distance x from the lower end

$\therefore$ T$=(mg)x =$ weight of x meter of rope

As $v = \sqrt{\frac{T}{m}}$ $\therefore v = \sqrt{\frac{mgx}{m}} = \sqrt{gx}$

$ie\ \ v \propto \sqrt{x}$

464 **(d)**

Using $\lambda = 2(l_2 - l_1) \Rightarrow v = 2n(l_2 - l_1)$

$\Rightarrow 2 \times 512(63.2 - 30.7) = 33280 cm/s$

Actual speed of sound $v_0 = 332 m/s - 33200 cm/s$

Hence error $= 33280 - 33200 = 80\ cm/sec$

465 **(d)**

Compare the given equation with the standard form

$y = r \sin\left[\frac{2\pi t}{T} + \frac{2\pi x}{\lambda}\right]$

$\frac{2\pi}{T} = 10, \frac{2\pi}{\lambda} = 1$

$v = \frac{\lambda}{T} = \frac{10}{1} = 10\ \mathrm{ms^{-1}}$

466 **(d)**

We know $l \propto \sqrt{T}$

$\therefore \frac{l_{air}}{l_{water}} = \sqrt{\frac{T_{air}}{T_{water}}}$

But specific gravity 8=

$\frac{T_{air}}{T_{air} - T_{water}}$

$\Rightarrow T_{water} = \frac{7}{8} T_{air}$

$\therefore \frac{l_{air}}{l_{water}} = \sqrt{\frac{8}{7}}$

But

$l_{air} = \frac{1}{\sqrt{7}} l$ $\qquad (Given)$

$\therefore\ \ l_{water} = \frac{1}{\sqrt{8}} l$

467 **(d)**

The distance between adjacent nodes $x = \frac{\lambda}{2}$

Also $k = \frac{2\pi}{\lambda}$. Hence $x = \frac{\pi}{k}$

468 **(d)**

Indian classical vocalists don't like harmonium because it uses tempered scale

469 **(d)**

Given,

$v_o = \frac{v}{5}$

$\Rightarrow\ \ v_o = \frac{320}{5} = 64 ms^{-1}$

When observers moves towards the stationary source, then

$$n' = \left(\frac{v + v_o}{v}\right) n$$
$$n' = \left(\frac{320 + 64}{320}\right) n$$
$$n' = \left(\frac{384}{320}\right) n$$
$$\frac{n'}{n} = \frac{384}{320}$$
Hence, percentage increases
$$\left(\frac{n' - n}{n}\right) = \left(\frac{384 - 320}{320} \times 100\right)\%$$
$$= \left(\frac{64}{320} \times 100\right)\% = 20\%$$

470 **(b)**

Velocity of source
$v_s = r\omega = 2 \times 15 = 30 ms^{-1}$
The highest frequency heard by the stationary listener
$$v' = v\left(\frac{v}{v - v_s}\right)$$
or
$$v' = 540\left(\frac{330}{330 - 30}\right) = 594\ Hz$$

472 **(a)**

In the fundamental mode.
frequency $\quad n = \frac{v}{\lambda}$
$$n = \frac{v}{4\iota}$$
$$n = \frac{1}{t \times 4\iota} \quad \left(\because v = \frac{1}{t}\right)$$
$$n = \frac{1}{0.01 \times 4}$$
$$n = 25$$

473 **(a)**

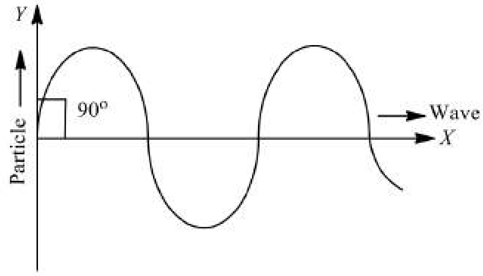
Second overtone of open pipe of length $\boldsymbol{l}$ is
$$v_0 = \frac{v}{2l} \quad \ldots\ldots(i)$$
First overtone of a close pipe is
$$v_c = \frac{v}{4l} = \frac{v}{4 \times 2} \ldots\ldots(ii)$$
Equating Eqs. (i) and (ii), we get
$$\frac{v}{2l} = \frac{v}{8} \Rightarrow l = 4m$$

474 **(a)**

The resultant amplitude is given by
$$A_R = \sqrt{A^2 + A^2 + 2AA\cos\theta} = \sqrt{2A^2(1 + \cos\theta)}$$
$$= 2A\cos\theta/2 \qquad (\because 1 + \cos\theta = 2\cos^2\theta/2)$$

475 **(c)**

In a transverse wave the particle of the medium vibrate about their mean position in a direction of wave propagation.



Here, the particle velocity is given by dy/dt and wave velocity is given by dx/dt.
Hence, the angle between particle velocity in a transverse wave is
$$\frac{\pi}{2}$$

477 **(c)**

In the fundamental mode of vibration
$$\frac{\lambda}{4} = (l + 0.3d)$$
Where 0.3d the necessary end correction.
frequency of vibration,
$$v = \frac{v}{\lambda} = \frac{v}{4(l + 0.3)}$$
As $\boldsymbol{l}$ is same for both pipes, wider pipe (A) will resonate at a lower frequency, i.e., $v_A < v_B$.

478 **(a)**

$$n' = \frac{v}{v - v_s\cos 60°} n$$
Here,
v=340, $v_s = 20$m/s, n=660Hz
$$n' = \frac{340}{340 - 20 \times \frac{1}{2}} \times 660$$
$$= \frac{340}{330} \times 660 = 680\ Hz$$

479 **(a)**

Speed of sound in a stretched string
$$v = \sqrt{\frac{T}{\mu}} \qquad \ldots(i)$$
Where T is the tension and μ is mass per unit length.
According to Hooke's law, $F \propto x$
$$T \propto x \qquad \ldots(ii)$$
From Eqs. (i) and (ii)
$$v \propto \sqrt{x}$$
$$v' = \sqrt{1.5}v = 1.22\ v$$

480 **(d)**

No change in frequency

481 **(c)**

Here $\frac{\lambda}{2} = 5.0\ cm \Rightarrow \lambda = 10\ cm$

Hence $n = \frac{v}{\lambda} = \frac{200}{10} = 20\ Hz$

482 **(c)**

Beat period $T=\frac{1}{n_1 \sim n_2}=\frac{1}{384-380}=\frac{1}{4}$sec. Hence minimum time interval between maxima and minima $t=\frac{T}{2}=\frac{1}{8}$sec

483 **(b)**

$$\frac{I_{\max}}{I_{\min}}=\left(\frac{\sqrt{\frac{I_1}{I_2}}+1}{\frac{\sqrt{I_1}}{\sqrt{I_2}}-1}\right)^2=\left(\frac{\sqrt{\frac{9}{4}}+1}{\sqrt{\frac{9}{4}}-2}\right)^2=\frac{25}{1}$$

484 **(c)**

Fundamental frequency is given by

$$v=\frac{1}{2\ell}\sqrt{\frac{T}{\mu}} \Rightarrow v \propto \frac{1}{\ell}$$

Here $\ell=\ell_1+\ell_2+\ell_3$

So $\frac{1}{v}=\frac{1}{v_1}+\frac{1}{v_2}+\frac{1}{v_3}$

485 **(b)**

Since, an open pipe produces both even and odd harmonics, hence frequency of pipe

$=200 \pm 5$

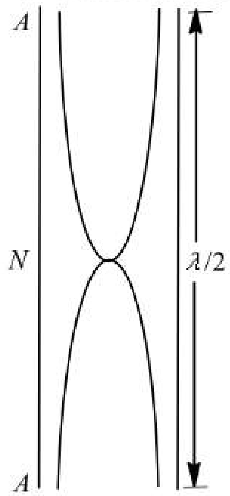
=195 Hz or 205 Hz.

Frequency of second harmonic of pipe =2v.

Now, the number of beats=10

$\therefore$ $2v=420 \pm 10=410$ Hz or 430 Gz

$\therefore$v=205 Hz or 215Hz.



486 **(a)**

When source is approaching the observer, the frequency heard

$$n_a=\left(\frac{v}{v-v_S}\right) \times n=\left(\frac{340}{340-20}\right) \times 1000$$
$$=1063 Hz$$

When source is receding, the frequency heard

$$n_r=\left(\frac{v}{v+v_S}\right) \times n=\frac{340}{340+20} \times 1000=944$$

$\Rightarrow n_a: n_r=9: 8$

Short tricks : $\frac{n_a}{n_r}=\frac{v+v_S}{v-v_S}=\frac{340+20}{340-20}=\frac{9}{8}$

487 **(b)**

Let Δlbe the end correction. Given that, Fundamental tone for a length 0.1m=first overtone for the length 0.35m

$$\therefore \frac{v}{4(0.1+\Delta l)}=\frac{3v}{4(0.35+\Delta l)}$$

Solving this equations we get Δl=0.025m=2.5 cm

488 **(c)**

When the source is moving towards the stationary observer.

Apparent frequency

$$n'=n\left[\frac{v-0}{v-v_s}\right]$$

$$2n=n\left[\frac{340}{340-v_s}\right]$$

$\Longrightarrow$ $v_s=170$m/s

489 **(a)**

Required distance $=\frac{\lambda}{4}=\frac{v/n}{4}=\frac{1200}{4\times 300}=1\ m$

490 **(c)**

Equation of given wave is

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

Let equation of other wave be

y=-a cos (kx+ωt) ....(ii)

And y=a cos (kx+ωt) ....(iii)

If Eq. (i) propagates with Eq. (ii), then from the principle of superposition, we have

Eq.(i)+Eq.(ii)

$\therefore$ y=a cos (kx-ωt)-a cos (kx+ωt)

Y= a [cos (kx-ωt)-a cos (kx+ωt)]

Using

$$\cos A-\cos B=2\sin\frac{A+B}{2}.\sin\frac{B-A}{2},$$

We get

Y=2a sin kx sin ωt ....(iv)

Similarly when Eqs. (i) propagates with Eq. (iii), we get

Y=2a cos kx cos ωt

After putting x=0 ,in Eq.(iv) and (v),weget

Y=o and y=2a cos ωt

Hence Eq. (ii) is an equation of unknown wave.

491 **(a)**

No beat is heard, because frequency received by listener directly from the source and that received on reflection from the wall is same

$$=\frac{256\times 330}{330-5} \text{ Hz}$$

492 **(a)**

Intensity $= \frac{\text{Power}}{\text{Area}} = \frac{4}{4\pi\times(200)^2} = 7.9\times10^{-6} W/m^2$

493 **(d)**

$\lambda = \frac{v}{n} = \frac{352}{384}$; during 1 vibration of fork sound will travel $\frac{352}{384} m$; during 36 vibration of fork sound will

travel $\frac{352}{384}\times 36 = 33\ m$

494 **(c)**

$$\Delta n = \left[\frac{v}{v-u} - \frac{v}{v+u}\right] n = \frac{2uv}{v^2-u^2} n$$

$$= \frac{2\times4\times332}{(332)^2-(4)^2}\times300 = 7$$

495 **(a)**

$y = 10^{-5}\sin\left[100t - \frac{x}{10}\right]$ comparing it with the equation of wave motion $y = r\sin\left[\frac{2\pi}{T}t - \frac{2\pi}{\lambda}x\right]$

$$\frac{2\pi}{T} = 100, T = \frac{2\pi}{100} = \frac{\pi}{50} s$$

$$\frac{2\pi}{\lambda} = \frac{1}{10}, \lambda = 20\pi$$

velocity, $v = \frac{\lambda}{T} = \frac{20\pi}{\pi/50} = 100\ \text{ms}^{-1}$

496 **(a)**

Frequency

$$\nu = \frac{1}{2\iota}\sqrt{\frac{T}{m}}$$

$$\Longrightarrow \quad \nu \propto \frac{\sqrt{T}}{\iota}$$

$$\frac{T_2}{T_1} = \left[\frac{\nu_2}{\nu_1}\right]^2\left[\frac{\iota_2}{\iota_1}\right]^2$$

$$= \left[\frac{300}{200}\right]^2\left[\frac{2\iota}{\iota}\right]^2 = \frac{9}{1}$$

497 **(b)**

Beat frequency, $\nu = \frac{18}{3} = 6Hz$

Let ν_2 be the frequency of other source

$\therefore \nu_2 = \nu_1 \pm \nu = (341\pm6)Hz = 347Hz$ or 335 Hz

498 **(a)**

Equation of wave y=2 sin (kx-2t)

Comparing with standard equation

Y=a sin (kx-ωt)

a=2, ω=2

∴Maximum particle velocity

$v_{\max} = a\omega = 2\times2\times2 = 4$ unit

499 **(a)**

Fundamental frequency of wire

$$f = \frac{1}{2\pi}\sqrt{\frac{T}{m}}$$

Or

$f \propto \sqrt{T}$

Or

$$\frac{f_2}{f_1} = \sqrt{\frac{T_2}{T_1}}$$

Or

$$\frac{900}{450} = \sqrt{\frac{T_2}{9}}$$

Or

$T_2 = 4\times9 = 36\ kg - wt$

500 **(b)**

$v = 330\ m/s; n = 165\ Hz$. Distance between two successive nodes

$$= \frac{\lambda}{2} = \frac{v}{2n} = \frac{330}{2\times165} = 1m$$

501 **(b)**

For observer note of B will not change due to zero relative motion.

Observed frequency of sound produced by A

$$= 660\frac{(330-30)}{330} = 600\ Hz$$

∴ No. of beats = 600 − 596 = 4

502 **(c)**

$$v_1 = \frac{v}{l}$$

(2nd harmonic of open pipe)

Here, n is odd and $v_2 > v_1$

It is possible when n=5

Because with n=5

$$v_2 = \frac{5}{4}\left(\frac{v}{l}\right) > v_1$$

503 **(b)**

$$a_1 = 5, a_2 = 10 \Rightarrow \frac{I_{\max}}{I_{\min}} = \frac{(a_1+a_2)^2}{(a_1-a_2)^2} = \left(\frac{5+10}{5-10}\right)^2 = \frac{9}{1}$$

504 **(a)**

Frequency detected by Indian submarine

$$n' = n\left(\frac{v+v_E}{v-v_I}\right)\left(\frac{v+v_I}{v-v_E}\right) = 1.04\ kHz$$

505 **(c)**

For the given super imposing waves

$a_1 = 3, a_2 = 4$ and phase difference $\phi = \frac{\pi}{2}$

$$\Rightarrow A = \sqrt{a_1^2 + a_2^2 + 2a_1a_2\cos\pi/2} = \sqrt{(3)^2+(4)^4} = 5$$

506 **(b)**

Frequency

$n=\frac{\mathrm{v}}{4\mathrm{l}}$ or $\mathrm{l}=\frac{\mathrm{v}}{4\mathrm{v}}$

$\therefore l_1=\frac{v}{4v_1}=\frac{300}{4\times 500}=0.165\text{m};$

$\mathrm{l}_2=\frac{3\mathrm{v}}{4\mathrm{v}_1}=3\iota_1=0.495\text{ m}$

$\mathrm{l}_3=\frac{5\mathrm{v}}{4\mathrm{v}_1}=5\iota_1=0.825\text{m}$

and $\mathrm{l}_4=\frac{7\mathrm{v}}{4\mathrm{v}_1}=7\mathrm{l}_1=1.155>1m$

Therefore, number of resonance =3

507 **(b)**

The velocity of a transverse wave

$$v=\sqrt{\frac{T}{\rho A}}$$

$$v\propto\frac{1}{\sqrt{A}}$$

Or

$$v\propto\frac{1}{R}$$

Because the velocity of wire depend on the radius. So transverse wave travels faster in thinner wire.

508 **(c)**

Path difference $\Delta=\frac{\lambda}{2\pi}\times\phi\Rightarrow 1=\frac{\lambda}{2\pi}\times\frac{\pi}{2}\Rightarrow\lambda=4m$

Hence $v=n\lambda=120\times 4=480\ m/s$

509 **(d)**

$$n'=n\left(\frac{v}{v-v_S}\right)=1200\left(\frac{400}{400-100}\right)=1600\ Hz$$

510 **(a)**

Fundamental frequency of open pipe

$$n_1=\frac{v}{2l}=\frac{350}{2\times 0.5}=350\ Hz$$

511 **(a)**

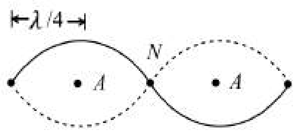
Frequency of reflected sound heard by the driver.

$$n'=n\left[\frac{v-(-v_o)}{v-v_s}\right]=n\left[\frac{v+v_o}{v-v_s}\right]=n\left[\frac{v+v_{car}}{v-v_{car}}\right]$$

$$=600\left[\frac{330+30}{330-30}\right]=720\ Hz$$

512 **(c)**

The distance between the nearest node and antinode in a stationary wave is $\frac{\lambda}{4}$



513 **(d)**

Comparing with standard wave equation

$y=a\sin\frac{2\pi}{\lambda}(vt-x)$, we get, $v=200\ m/s$

514 **(c)**

Number of beats per second,

$$n=\frac{16}{20}=\frac{4}{5}\Rightarrow n=n_1=\frac{v}{4}\left(\frac{1}{l_1}-\frac{1}{l_2}\right)$$

$$\Rightarrow\frac{4}{5}=\frac{v}{4}\left(\frac{1}{1}-\frac{1}{1.01}\right)=\frac{0.01v}{4\times 1.01}$$

$$v=\frac{16\times 101}{5}=323.2\ ms^{-1}$$

515 **(a)**

$$v=\sqrt{\frac{K}{\rho}}\ \therefore K=v^2\rho=2.86\times 10^{10}N/m^3$$

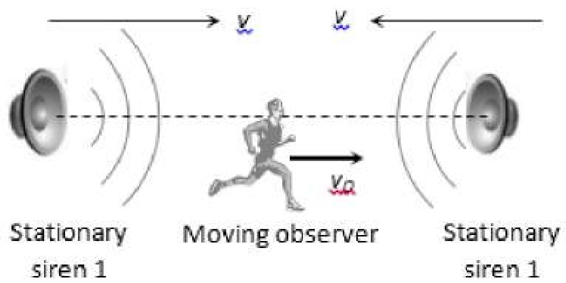
516 **(d)**

Intensity $\propto a^2\omega^2$

Here $\frac{a_A}{a_B}=\frac{2}{1}$ and $\frac{\omega_A}{\omega_B}=\frac{1}{2}\Rightarrow\frac{I_A}{I_B}=\left(\frac{2}{1}\right)^2\times\left(\frac{1}{2}\right)^2=\frac{1}{1}$

517 **(b)**

Observer is moving away from siren 1 and towards the siren 2.



Hearing frequency of sound emitted by siren 1

$$n_1=n\left(\frac{v-v_O}{v}\right)=330\left(\frac{330-2}{330}\right)=328Hz$$

Hearing frequency of sound emitted by siren 2

$$n_2=n\left(\frac{v+v_O}{v}\right)=330\left(\frac{330+2}{330}\right)=332Hz$$

Hence, beat frequency $=n_2-n_1=332-328=4$

518 **(d)**

$\because$ frequency is same in both the medium

$\therefore\lambda\propto$ speed

519 **(d)**

$$v'=\frac{u\times v}{u-u_s}$$

$$=\frac{330\times 500}{330-30}=550\text{ Hz}$$

520 **(d)**

$$n\propto\frac{1}{l}\Rightarrow\frac{n_2}{n_1}=\frac{l_1}{l_2}\Rightarrow n_2=\frac{l_1}{l_2}n_1=\frac{1\times 256}{1/4}$$

$$=1024Hz$$

521 **(a)**

Probable frequencies of tuning fork be $n+4$ or $n-4$

Frequency of sonometer wire $n \propto \frac{1}{l}$

$\therefore \frac{n+4}{n-4} = \frac{100}{95}$ or $95(n+4) = 100(n-4)$

Or $95n + 380 = 100n - 400$ or $5n = 780$ or $n = 156$

522 **(a)**

Z_1 and Z_2, are displacements of two waves of same frequency travelling in opposite direction. They will form a stationary wave.

523 **(b)**

In the transmission of sound through air, there is no actual movement of air from the sound producing body to our ear. The air layers only vibrate back and forth, and transfer the sound energy from one layer to the next layer till it reaches our ear. This back and forth motion causes the compression and rarefaction in a sound wave. This motion is along the direction of propagation of sound and hence, the sound waves are longitudinal. Note that the layers of air consist of molecules of gases. Note that the layers of air consist of molecules of gases. So, when the air layers vibrate back and forth, we actually mean that the molecules in air layers vibrate back and forth by a small distance.

Therefore, it simply means that air does not have modulus of rigidity.

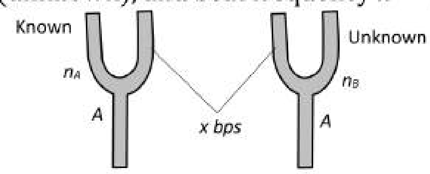
524 **(b)**

$$n \propto \frac{\sqrt{T}}{l} \Rightarrow l \propto \sqrt{T} \qquad [\text{As } n = \text{constant}]$$

$\Rightarrow \frac{l_2}{l_1} = \sqrt{\frac{T_2}{T_1}} = l_1\sqrt{\frac{169}{100}} \Rightarrow l_2 = 1.3 l_1 = l_1 + 30\%$ of l_1

525 **(c)**

Suppose two tuning forks are named A and B with frequencies $n_A = 256\ Hz$ (known), $n_B = ?$ (unknown), and beat frequency $x = 4\ bps$.



Frequency of unknown tuning fork may be $n_B = 256 + 4 = 260\ Hz$ and $n_B = 256 - 4 = 252\ Hz$

It is given that on sounding waxed fork A (fork of frequency 256 Hz) and fork B, number of beats (beat frequency) increases. It means that with decrease in frequency of A, the difference in new frequency of A and the frequency of B has increased. This is possible only when the frequency of A while decreasing is moving away from the frequency of B.

This is possible only if $n_B = 260\ Hz$.

Alternate method : It is given $n_A = 256\ Hz, n_B = ?$ and $x = 4\ bps$

Also after loading A ($i.e. n_A \downarrow$), beat frequency ($i.e. x$) increases ($\uparrow$).

Apply these informations in two possibilities to known the frequency of unknown tuning fork.

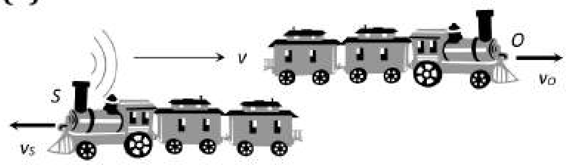
$n_A \downarrow - n_B = x$ ...(i)

$n_B - n_A \downarrow = x \uparrow$ ...(ii)

It is obvious that equation (i) is wrong (ii) is correct so

$n_B = n_A + x = 256 + 4 = 260\ Hz$

526 **(b)**



$$n' = n\left(\frac{v - v_O}{v - v_S}\right) = 750\left(\frac{330 - 180 \times \frac{5}{18}}{330 + 108 \times \frac{5}{18}}\right)$$

$$= 625 Hz$$

527 **(b)**

$$C_{rms=v}\sqrt{\frac{3}{\gamma}} = 330 \times \sqrt{\frac{3}{1.4}} = 471.4\ \text{ms}^{-1}$$

528 **(a)**

$$n_c = \frac{v}{4l}, n_0 = \frac{v}{2l}$$

As $\quad n_0 - n_c = 2$

$$\therefore \frac{v}{2l} - \frac{v}{4l} = 2 \text{ or } \frac{v}{l} = 8$$

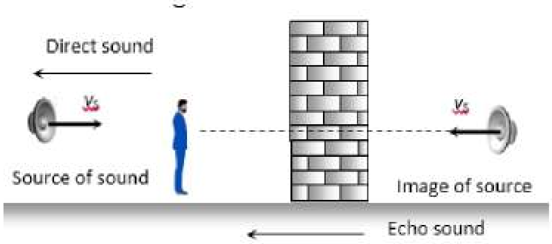
Now $n_0' = \frac{v}{2l/2} = \frac{v}{l}$ and $n_c' = \frac{v}{4(2l)} = \frac{v}{8l}$

Number of beats $\text{s}^{-1} = n_0' - n_c'$

$$= \frac{v}{l} - \frac{v}{8l} = \frac{7v}{8l} = \frac{7}{8} \times 8 = 7$$

529 **(d)**

The observer will hear two sounds, one directly from source and other from reflected image of sound



Hence number of beats heard per second

$$= \left(\frac{v}{v - v_S}\right) n - \left(\frac{v}{v - v_S}\right) n = 0$$

530 **(a)**

From $v = \sqrt{\frac{\gamma RT}{M}}$

$$\frac{\Delta v}{v} = \frac{1}{2}\frac{\Delta T}{T}$$

$$\frac{\Delta v}{v} \times 100 = \frac{1}{2}\left(\frac{\Delta T}{T}\right) \times 100$$

$$= \frac{1}{2} \times \frac{1}{300} \times 100 = 0.167\ \%$$

531 **(b)**

The fundamental frequency

$$v = \frac{1}{2L}\sqrt{\frac{T}{m}}$$

$$\therefore \quad \frac{v'}{v} = \sqrt{\frac{T'}{T}} = \sqrt{\frac{25T}{T}} = 5$$

Or $v' = 5v$

532 **(c)**

Here $A = 0.05m, \frac{5\lambda}{2} = 0.25 \Rightarrow \lambda = 0.1m$

Now standard equation of wave

$$y = A \sin \frac{2\pi}{\lambda}(vt - x)$$

$$\Rightarrow y = 0.05 \sin 2\pi(3300t - 10x)$$

533 **(d)**

Let the equation of two waves are

$y_1 = a\sin(\omega t - kx)$ ... (i)

And $y_2 = a\sin(\omega t - kx + \phi)$ ... (ii)

When they superpose, the resultant wave is

$$y = y_1 + y_2$$

$$= a[\sin(\omega t - kx) + \sin(\omega t - kx + \phi)]$$

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

$$= 2a\sin\left(\omega t - kx + \frac{\phi}{2}\right)\cos\frac{\phi}{2}$$

$$= \left(2a\cos\frac{\phi}{2}\right)\sin\left(\omega t - kx + \frac{\phi}{2}\right) \ ...(iii)$$

Comparing Eq. (iii) with (i) or (ii), we get

$$a = 2a\cos\frac{\phi}{2} \Rightarrow \cos\frac{\phi}{2} = \frac{1}{2}$$

$$\Rightarrow \cos\frac{\phi}{2} = \cos\frac{\pi}{3}$$

$$\therefore \cos\frac{\phi}{2} = \cos\frac{\pi}{3}$$

$$\therefore \frac{\phi}{2} = \frac{\pi}{3}$$

or $\quad \phi = \frac{2\pi}{3}$

534 **(c)**

Fundamental frequency of closed pipe

$$n = \frac{v}{4l} = 220\ Hz \Rightarrow v = 220 \times 4l$$

If $\frac{1}{4}$ of the pipe is filled water then remaining length of air column is $\frac{3l}{4}$

Now fundamental frequency $= \frac{v}{4\left(\frac{3l}{4}\right)} = \frac{v}{3l}$ and

First overtone $= 3 \times$ fundamental frequency

$$= \frac{3v}{3l} = \frac{v}{l} = \frac{220 \times 4l}{l} = 880\ Hz$$

535 **(d)**

Equation of stationary wave is

$$y_1 = a \sin kx \cos \omega t$$

And equation of progressive wave is

$$y_2 = a\sin(\omega t - kx)$$

$$= a(\sin \omega t \cos kx - \cos \omega t \sin kx)$$

At $\quad x_1 = \frac{\pi}{3k}$ *and* $x_2 = \frac{3\pi}{2k}$

$\sin kx_1$ *or* $\sin kx_2$ is zero.

$\therefore$neitherx_1 nor x_2 is node.

$$\Delta x = x_1 - x_2 = \frac{3\pi}{2k} - \frac{\pi}{3k} = \frac{7\pi}{6k}$$

As $\Delta x = \frac{7\pi}{6k}$, therefore, $\frac{2\pi}{k} > \Delta x > \frac{\pi}{k}$

But $\frac{2\pi}{k} = \lambda$, so, $\lambda > \Delta x > \frac{\lambda}{2}$.

In case of a stationary wave, phase difference between any two points is either zero or π.

$$\therefore \quad \phi_1 = \pi \text{ and } \phi_2 = k\Delta x = k\frac{7\pi}{6k} = \frac{7}{6}\pi$$

$$\therefore \quad \frac{\phi_1}{\phi_2} = \frac{\pi}{\frac{7}{6}\pi} = \frac{6}{7}$$

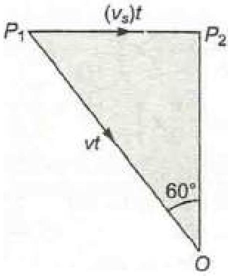
536 **(a)**

Using $n_{\text{Last}} - n_{First} + (N-1)x$

$\Rightarrow 2n = n + (16-1) \times 8 \Rightarrow n = 120\ Hz$

537 **(b)**

When aeroplane is at P_2 vertically above the observer O, sound comes along P_1O at $60°$ with the vertical.



$\therefore P_1O = v \times t, P_1P_2 = v_p t.$

$$\sin 60° = \frac{P_1P_2}{P_1O} = \frac{v_p t}{v \times t} = \frac{v_p}{v}$$

$\therefore v_p = v \sin 60° = v\sqrt{3}/2$

538 **(c)**

Given : $\frac{I_{\max}}{I_{\min}} = 25$

$$\frac{I_{\max}}{I_{\min}} = \frac{(a+b)^2}{(a-b)^2}$$

where a, b are amplitudes of two waves

$$\Rightarrow \frac{a+b}{a-b} = \frac{5}{1} \Rightarrow a + b = 5a - 5b$$

$$\Rightarrow \frac{a}{b} = \frac{3}{2}\ \therefore \frac{I_1}{I_2} = \frac{a^2}{b^2} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$$

539 **(a)**

The quality of sound depends upon the number of harmonics present. Due to different number of harmonics present in two sounds, the shape of the resultant wave is also different

540 **(b)**

Frequency of wave is

$$n = \frac{3600}{2 \times 60} Hz \Rightarrow \lambda = \frac{v}{n} = \frac{760}{30} = 25.3\ m$$

541 **(d)**

$$v_{He} = 460 \times \sqrt{\frac{25}{21} \times 8} = 1420\ m/s$$

542 **(b)**

As the source is moving perpendicular to straight line joining the observer and source, (as if moving along a circle), apparent frequency is not affected $n_1 = 0$.

543 **(c)**

Velocity of sound in air $= 300\ ms^{-1}$

Let v be the maximum value of source velocity for which the person is able to hear the sound, then

$$10000 = f_{app} = \left(\frac{300}{300 - v}\right) \times 9500$$

$\Rightarrow\ v = 15ms^{-1}$

544 **(c)**

$$n \propto \sqrt{T} \Rightarrow \frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}} \Rightarrow \frac{n}{2n} = \sqrt{\frac{10}{T_2}} \Rightarrow T_2 = 40N$$

545 **(a)**

$$\lambda = \frac{v}{n} = \frac{340}{170} = 2m, n' = \frac{340}{340-17} \times 170 \Rightarrow n' = 178.9Hz$$

Now $\lambda' = \frac{v}{n'} = \frac{340}{178.9} = 1.9$

$\Rightarrow \lambda - \lambda' = 2 - 1.9 = 0.1$

546 **(b)**

For closed pipe $n_1 = \frac{v}{4l} \Rightarrow 250 = \frac{v}{4 \times 0.2} \Rightarrow v = 200m/s$

547 **(a)**

$$\Delta n = v\left[\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right] = 396\left[\frac{1}{0.99} - \frac{1}{1}\right] = 3.96 \approx 4$$

548 **(c)**

Let $n-1(= 400), n(= 401)$ and $n+1(= 402)$ be the frequencies of the three waves. If a be the amplitude of each then $y_1 = a \sin 2\pi(n-1)t,\ y_2 = a \sin 2\pi nt$ and $y_3 = a \sin 2\pi(n+1)t$

Resultant displacement due to all three waves is

$y = y_1 + y_2 + y_3$

$= a \sin 2\pi nt + a[\sin 2\pi(n-1)t + \sin 2\pi(n+1)t]$

$= a \sin 2\pi nt + a[2 \sin 2\pi nt \cos 2\pi t]$

$= a[2\cos 2\pi t + 1] \sin 2\pi nt$

$= a' \sin 2\pi nt$ with $a' = a[1 + 2\cos 2\pi t]$

So, $I \propto (a')^2 \propto a^2(1 + 2\cos 2\,\pi t)^2$

For I to be max or min

$$\frac{dI}{dt} = 0 \Rightarrow \frac{d}{dt}(1 + 2\cos 2\,\pi t)^2 = 0$$

$i.e., 2(1 + 2\cos \pi t)(2 \sin 2\,\pi t) \times 2\pi = 0$

$\sin 2\pi t = 0$ or $1 + 2\cos 2\pi t = 0$

So, if $1 + 2\cos 2\pi t = 0 \Rightarrow 2\pi t = 2\pi n \pm \frac{2\pi}{3}$ with $n = 0,1,2 \ldots$

$t = \frac{1}{3}, \frac{2}{3}, \frac{4}{3}, \frac{5}{3} \ldots$ and for these value of t

$\cos 2\pi t = -\left(\frac{1}{2}\right), I = 0, i.e.,\ I$ is min and if

$\sin 2\pi t = 0$

$2\pi t = n\pi, n = 0,1,2, \ldots \Rightarrow t = 0, \frac{1}{2}, 1, \frac{3}{2}, 2 \ldots$

(I) from equation (i)

$9a^2, a^2, 9a^2, a^2$

i.e., Intensity is max. (with two different values)

i.e., number of beats per sec is two

549 **(d)**

By using

$$v' = v\left[\frac{v - v_o}{v - v_s}\right]$$

$$2v = v\left[\frac{v - v}{v - 0}\right]$$

$\Longrightarrow v_o = -v$

Negative sign indicates that observer is moving opposite to the direction of velocity of sound.

550 **(c)**

Critical hearing frequency for a person is $20{,}000 Hz$.

If a closed pipe vibration in N^{th} mode then frequency of vibration

$$n = \frac{(2N - 1)v}{4l} = (2N - 1)n_1$$

(where n_1 = fundamental frequency of vibration)

Hence $20{,}000 = (2N - 1) \times 1500$

$\Rightarrow N = 7.1 = 7$

Also, in closed pipe

Number of over tones = (No. of mode of vibration) -1

$= 7 - 1 = 6$

551 **(c)**

When listener is moving towards the source then apparent frequency

$$v' = \frac{v + v_o}{v} \times v$$

$$\Longrightarrow 200 = \frac{v + 40}{v} \times v \quad \ldots (i)$$

Where, v=velocity of sound in air

V=actual frequency of sound source

Similarly, when listener is moving away,

Then

$$1160 = \frac{v - 40}{v} \times v \quad \ldots (ii)$$

From Eqs. (i)and (ii), we have

$$\frac{200}{160} = \frac{v + 40}{v - 40}$$

$5v - 200 = 4v + 160$

$\therefore v = 360 ms^{-1}$

552 **(d)**

Frequency of unknown fork $= 256 \pm 4 = 260$ *or* 252.

As frequency decreases on loading, therefore, original frequency of unknown fork = 260 Hz.

553 **(c)**

Suppose n_A = known frequency = $100\ Hz, n_B = ?$

$x = 5\ bps$, which remains unchanged after loading

Unknown tuning fork is loaded so $n_B \downarrow$

Hence $n_A - n_B \downarrow = x \quad$ ...(i)

$n_B \downarrow - n_A = x \quad$ ...(ii)

From equation (i), it is clear that as n_B decreases, beat frequency. $(i.e.\, n_A - (n_B)_{\text{new}})$ can never be x again.

From equation (ii), as $n_B \downarrow$, beat frequency $[i.e.\,(n_B)_{new} - n_A]$ decreases as long as $(n_B)_{new}$ remains greater than n_A. If $(n_B)_{new}$ becomes lesser than n_A the beat frequency will increase again and will be x. Hence this is correct.

So, $n_B = n_A + x = 100 + 5 = 105 Hz$

554 **(a)**

Particle velocity $v_p = -v(slope\ of\ y - x\ graph)$

Here, v=+ve, as the wave is travelling in positive x-direction.

Slope at P is negative.

$\therefore$ Velocity of particle is in positive y $(+\hat{j})$ direction.

555 **(d)**

$$\frac{I_{\max}}{I_{\min}} = \left(\frac{a_1 + a_2}{a_1 - a_2}\right)^2 = \frac{(5 + 3)^2}{(5 - 3)^2} = \frac{16}{1}$$

556 **(a)**

$$\text{Beat frequency} = \frac{\text{Number of beats}}{\text{Time}} = \frac{2}{0.04}$$

$$= 50\ Hz$$

557 **(a)**

$\lambda = \frac{v}{n}; n \approx 50{,}000\ Hz, v = 330 m/sec \Rightarrow \lambda$

$$= \frac{330}{50000} m$$

$= 6.6 \times 10^{-1} cm \approx 5 \times 10^{-1} cm$

558 **(d)**

$$n \propto \frac{1}{l}\sqrt{T} \Rightarrow \frac{n'}{n} = \sqrt{\frac{T'}{T}} \times \frac{l}{l'} = \sqrt{4} \times \frac{1}{2} = 1 \Rightarrow n' = n$$

559 **(b)**

Motor cycle, u=0, $a = 2ms^{-2}$

Observe is in motion and source is at rest

$$\Rightarrow \quad n' = n\frac{v - v_2}{v + v_s}$$

$$\Rightarrow \frac{94}{100} n = n\frac{330 - v_o}{330}$$

$$\Rightarrow 330 - v_o = \frac{330 \times 94}{100}$$

$$\Rightarrow v_o = 330 - \frac{94 \times 33}{10} = \frac{33 \times 6}{10} ms^{-1}$$

$$s = \frac{v^2 - u^2}{2a} = \frac{9 \times 33 \times 33}{100}$$

$$= \frac{9 \times 1089}{100} = 98m.$$

560 **(b)**

When one end is closed, $n_1 = \frac{100}{2} = 50$ Hz

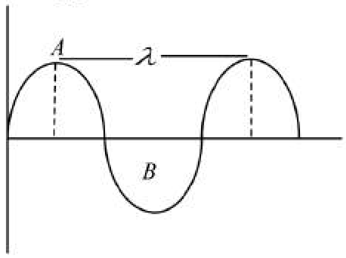
$n_2 = 3n_1 = 150\text{Hz}, n_3 = 5n_1 = 250$ Hz and so on.

563 **(a)**

Since wave

Particle velocity

$$v_p = \frac{dy}{dt} = \text{slope of wave}$$



At that point. As slope at A and B is zero. Hence, the velocity at A and B will be same. Distance between A and B is

$$\frac{\lambda}{2}$$

564 **(c)**

Taken time by the wave to travel a distance equal to one wavelength =0.14×4=0.565

Frequency

$$f_c = \frac{I}{t} = \frac{1}{0.56}$$

$$f = \frac{100}{56}$$

or

$$f = 1.79\ Hz$$

565 **(b)**

Molecular weight of mixture

$$M_{mix} = \frac{n_1 M_1 + n_2 M_2}{n_1 + n_2} = \frac{1 \times 4 + 2 \times 32}{1 + 2} = \frac{68}{3}$$

$$= \frac{68}{3} \times 10^3 \text{kg mol}^{-1}$$

For helium $C_{v_1} = \frac{3}{2}R$

For oxygen $C_{v_2} = \frac{5}{2}R$

$$(C_v)_{mix} = \frac{n_1 C_{v_1} + n_2 C_{v_2}}{n_1 + n_2}$$

$$= \frac{1 \times \frac{3R}{2} + 2 \times \frac{5R}{2}}{1 + 2} = \frac{13R}{6}$$

$$(C_p)_{\text{mix}} = (C_v)_{\text{mix}} + R$$

$$= \frac{13R}{6} + R = \frac{19R}{6}$$

$$y_{mix} = \sqrt{\frac{(C_p)_{mix}}{(C_v)_{mix}}} = \frac{19}{13}$$

$$v = \sqrt{\frac{\gamma_{mix} RT}{M_{mix}}}$$

$$= \sqrt{\frac{19}{13} \times \frac{8.31 \times 300}{\frac{68}{3} \times 10^{-3}}} = 400.9 \text{ ms}^{-1}$$

566 **(a)**

Resultant displacement along X - axis is $x = y_1 - y_3 = 8 - 2 = 6$

Resultant displacement along Y - axis is $y = y_2 - y_4 = 4 - 1 = 3$

Net displacement,

$$r = \sqrt{x^2 + y^2} = \sqrt{6^2 + 3^2} = \sqrt{45}$$

Also, $\tan\theta = \frac{y}{x} = \frac{3}{6} = \frac{1}{2}$

$$\theta = \tan^{-1}(1/2)$$

567 **(b)**

Distance between the consecutive node $= \frac{\lambda}{2}$,

but $\lambda = \frac{v}{n} = \frac{20}{n}$ so $\frac{\lambda}{2} = \frac{10}{n}$

568 **(c)**

Comparing the given equation with standard equation

$k = \frac{2\pi}{\lambda} = \pi \times 10^{-2} \Rightarrow \lambda = 200\ m$

And $\omega = 2\pi v = 2\pi \times 10^6 \Rightarrow v = 10^6 Hz$

569 **(a)**

Change in amplitude does not produce change in frequency,

$\left(n = \frac{1}{2l}\sqrt{\frac{T}{\pi r^2 \rho}}\right)$

570 **(c)**

Doppler's effect, $n' = \frac{V}{V - V_S} . n$

$$2n = \frac{V}{V - V_S} n$$

$$\Rightarrow 2V - 2V_S = V \Rightarrow V_S = \frac{V}{2}$$

$$\therefore V_S = \frac{340}{2} = 170\ m/s$$

571 **(a)**

$$\Delta n = n_1 - n_2 \Rightarrow 10 = \frac{v}{2l_1} - \frac{v}{2l_2} = \frac{v}{2}\left[\frac{1}{l_1} - \frac{1}{l_2}\right]$$

$$\Rightarrow 10 = \frac{v}{2}\left[\frac{1}{0.25} - \frac{1}{0.255}\right] \Rightarrow v = 255 m/s$$

572 **(d)**

Frequency of 1st overtone of A

$$n_1 = \frac{2}{2l_1}\sqrt{\frac{T}{m}} = \frac{2}{l_1 D_1}\sqrt{\frac{T}{\pi\rho}}$$

Frequency of 2nd overtone of B

$$n_2 = \frac{3}{2l_2}\sqrt{\frac{T}{m}} = \frac{2}{l_2 D_2}\sqrt{\frac{T}{\pi\rho}}$$

As $n_1 = n_2$

$$\therefore \frac{2}{l_1 D_1} = \sqrt{\frac{T}{\pi\rho}} = \frac{3}{l_2 D_2}\sqrt{\frac{T}{\pi\rho}}$$

$$\frac{l_1 D_1}{l_2 D_2} = \frac{2}{3}$$

$$\frac{l_1}{l_2} = \frac{2D_2}{D_2} = \frac{2}{3}; \frac{l_1}{l_2} = 1:3$$

573 **(b)**

$$\frac{n_2}{n_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{81}{100}} = \frac{9}{10}$$

$$\therefore \left(\frac{n_1 - n_2}{n_1}\right) \times 100 = 10\%$$

574 **(b)**

Here, v=500 Hz,$v_o - o$

$v_s = 30 ms^{-1}, v = 330 ms^{-1}$

From ,

$$v' = v\left(\frac{v - v_o}{v - v_s}\right) = 500\left(\frac{300}{330 - 30}\right) = 550 Hz$$

575 **(a)**

In a wave equation, x and t must be related in the form $(x - vt)$. Therefore, we rewrite the given equation as

$$y = \frac{1}{1 + (x - vt)^2}$$

For $t = 0$, it becomes $y = \frac{1}{1+x^2}$

And for $t = 2$, it becomes

$$y = \frac{1}{[1 + (x - 2v)^2]} = \frac{1}{1 + (x - 1)^2}$$

$\therefore 2v = 1$ or $v = 0.5\ \text{ms}^{-1}$

576 **(a)**

Here, $E = 6 V/m, c = 3 \times 10^8 ms^{-1}$

$$B = \frac{E}{C} = \frac{6 V/m}{3 \times 10^8 ms^{-1}} = 2 \times 10^{-8} T$$

E is along the y-direction and the plane $e.m.$ wave propagate along x-direction. Therefore, B should be in a direction perpendicular to both x and y-axis. Using vector algebra $\bar{E} \times \bar{B}$ should be along x-direction. Since $(+\hat{j}) \times (+\hat{k}) = \hat{i}, B$ is along the z-direction.

Thus, magnetic field component B would be 2×10^{-8}T along z-direction

577 **(c)**

Suppose I_i *and* I_r are intensities of incident and reflected waves.

Reflection coefficient $= \frac{I_r}{I_i} = \left(\frac{\mu - 1}{\mu + 1}\right)^2$

Where $\mu = \frac{v_1}{v_2} = \frac{\sqrt{T/m_1}}{\sqrt{T/m_2}} = \sqrt{\frac{m_2}{m_1}} = \sqrt{\frac{25}{9}} = \frac{5}{3}$

$\therefore$ Reflection coefficient $= \left(\frac{5/3 - 1}{5/3 + 1}\right)^2 = \frac{1}{16}$

578 **(d)**

When source approaches the observer, the apparent frequency heard by observer is

$v' = v\left(\frac{v}{v - v_s}\right)$ ... (i)

v_s =speed of source of sound

During its recession, apparent frequency

$v'' = v\left(\frac{v}{v + v_s}\right)$ ... (ii)

Accordingly

$v' = v'' = \frac{2}{100}v$ (given)

$\therefore v\left(\frac{v}{v - v_s}\right) - v\left(\frac{v}{v + v_s}\right) = \frac{2}{100}v$

Or

$v\left[\frac{v + v_s - v + v_s}{(v - v_s)v + v_s}\right] = \frac{2}{100}$

Or

$\frac{2vv_s}{(v - v_s)(v + v_s)} = \frac{2}{100}$

Or

$100vv_s = v^2 - v_s^2$

But speed of sound in air v=300 ms^{-1}

$\therefore 3000v_s = (300)^2 - v_s^2$

$\Longrightarrow v_s^2 + 30000v_s - 90000$

$v = \frac{-30000 \pm \sqrt{(30000)^2 + 4 \times 90000}}{2}$

$= -\frac{30000 \pm 30006}{2} = \frac{6}{2} = 3ms^{-1}$

(Taking +ve sign only)

579 **(c)**

$v \propto \sqrt{T} \Rightarrow \sqrt{\frac{T_2}{T_1}} = \frac{v_2}{v_1} \Rightarrow T_2 = T_1\left(\frac{v_2}{v_1}\right)^2$

$\Rightarrow T_2 = 273 \times 4 = 1092K$

580 **(c)**

Beat frequency =number of beats/s.

$n = n_2 \pm n_1$

$\therefore n_1 = n_2 \pm n$

581 **(b)**

$v = \frac{\omega}{k} = \frac{600}{2} = 300\text{ms}^{-2}$

582 **(c)**

Open pipe resonance frequency $f_1 = \frac{2v}{2L}$

Closed pipe resonance frequency $f_2 = \frac{nv}{4L}$

$f_2 = \frac{n}{4}f_1$ (where n is odd add $f_2 > f_1$) $\therefore n = 5$

583 **(c)**

For an open pipe of length *l*, the frequency v is given by

$v = v'.\frac{v}{2l}$

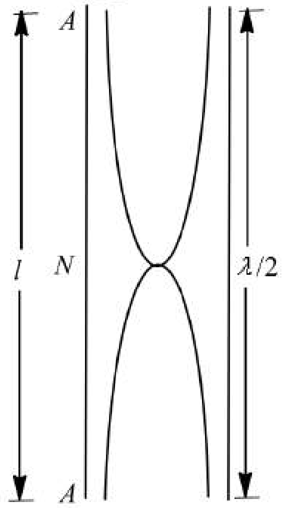
Where v is velocity of sound, v' the overtone.

Given, v=450 Hz, $\boldsymbol{l}$=1m,

$v = 330\ ms^{-1}$

$v' = \frac{v(2l)}{v}$

$= \frac{480 \times 2 \times 1}{330} = 2.3 \approx 3$



Hence, this is the second overtone or third harmonic.

584 **(a)**

Comparing given equation with standard equation

$y = 2a\sin\frac{2\pi x}{\lambda}\cos\frac{2\pi vt}{\lambda}$ gives us $\frac{2\pi}{\lambda} = \frac{\pi}{15} \Rightarrow \lambda = 30$

Distance between nearest node and antinodes

$= \frac{\lambda}{4} = \frac{30}{4} = 7.5$

586 **(b)**

Superposition of waves does not alter the frequency of resultant wave and resultant amplitude

$\Rightarrow a^2 = a^2 + a^2 + 2a^2\cos\phi = 2a^2(1 + \cos\phi)$

$\Rightarrow \cos\phi = -1/2 = \cos 2\pi/3\ \therefore \phi = 2\pi/3$

587 **(c)**

The blast is blown at an interval of $1s$, so frequency = $1Hz$

Frequency heard by the observer

$n' = \frac{v}{v - v_s}.n = \frac{v}{v - \frac{v}{20}} \times 1 = \frac{v}{\frac{19v}{20}} = \frac{20}{19}Hz$

Therefore, observed time interval between two successive blasts = $\frac{1}{20/19} = \frac{19}{20}s$

588 **(c)**

$I = 2\pi^2a^2n^2v\rho \Rightarrow I \propto a^2n^2$

$\Rightarrow \frac{I_1}{I_2} = \left(\frac{a_1}{a_2}\right)^2 \times \left(\frac{n_1}{n_2}\right)^2 = \left(\frac{1}{2}\right)^2 \times \left(\frac{1}{1/4}\right)^2$

$\Rightarrow I_2 = \frac{I_1}{4}$

589 **(c)**

After filling frequency increases, so n_A increases ($\uparrow$). Also it is given that beat frequency increases ($i.e., x \uparrow$)

Hence $n_A \uparrow - n_B = x \uparrow \quad \rightarrow$ Correct ...(i)

$n_B - n_A \uparrow = x \uparrow \quad \rightarrow$ Wrong ...(ii)

$\Rightarrow n_A = n_B + x = 512 + 5 = 517\ Hz$

590 **(b)**

$y = 4\cos^2(t/2)\sin(1000t)$

$= 2[2\cos^2(t/2)\sin(1000t)]$

$= 2[(1\cos t)\sin(1000t)]$

$= 2\sin 1000t + 2\sin 1000t\cos t$

$y = 2\sin 1000t + \sin(1001t) + \sin(999t)$

$\therefore$ The given wave represents the super position of three waves.

591 **(d)**

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}} \Rightarrow n \propto \frac{\sqrt{T}}{l} \Rightarrow \frac{T_2}{T_1} = \left(\frac{n_2}{n_1}\right)^2\left(\frac{l_2}{l_1}\right)^2$$

$$= (2)^2\left(\frac{3}{4}\right)^2 = \frac{9}{4}$$

592 **(a)**

$n_1 = \frac{v}{\lambda_1} = \frac{v}{0.50}$ and $n_2 = \frac{v}{\lambda_2} = \frac{v}{0.51}$

$$\Delta n = n_1 - n_2 = v\left[\frac{1}{0.50} - \frac{1}{0.51}\right] = 12$$

$$\Rightarrow v = \frac{12 \times 0.51 \times 0.50}{0.01} = 306\ m/s$$

593 **(b)**

Compare the given equation with the standard form of stationary wave equation

$y = 2r\sin\frac{2\pi x}{\lambda}\cos\frac{2\pi vt}{\lambda}$,

We get $\frac{2\pi x}{\lambda} = \frac{2\pi vt}{3} \quad \therefore \lambda = 3\text{cm}$

Separation between two adjacent nodes $= \frac{\lambda}{2} =$ 1.5cm

594 **(b)**

As $n_1 : n_2 : n_3 = 1:2:3$

$$\therefore \quad l_1 : l_2 : l_3 = \frac{1}{1} : \frac{1}{2} : \frac{1}{3} = 6:3:2$$

Sum of the ratio $= 6 + 3 + 2 = 11$

$$\therefore l_1 = \frac{110}{11} \times 6 = 60\text{cm}, l_2 = \frac{110}{11} \times 3 = 30\text{cm}$$

$\therefore$ wedges should be placed from A at 60cm and 90cm.

595 **(a)**

$n_x = 300Hz, n_y = ?$

$x =$ beat frequency $= 4\ Hz$, which is decreasing ($4 \rightarrow 2$) after increasing the tension of the string y.

Also tension of wire y increasing so $n_y \uparrow$ ($\because n \propto \sqrt{T}$)

Hence $n_x - n_y \uparrow = x \downarrow \rightarrow$ Correct

$n_y \uparrow - n_x = x \downarrow \rightarrow$ Wrong

$\Rightarrow n_y = n_x - x = 300 - 4 = 296Hz$

596 **(b)**

Wave number is the reciprocal of wavelength and is written as $\bar{n} = \frac{1}{\lambda}$

597 **(d)**

If front of locomotive, $\lambda' = \frac{\lambda(v - v_s)}{v} = \frac{v - v_s}{n}$

$$\therefore \lambda' = \frac{345 - 30}{500} = \frac{315}{500} = 0.63m$$

Behind locomotive, $\lambda'' = \frac{\lambda}{v}(v + v_s) = \frac{v + v_s}{n}$

$$\therefore \lambda'' = \frac{345 + 30}{500} = \frac{375}{500} = 0.75m$$

599 **(c)**

When source is moving towards observer.

$$n' = \frac{vn}{v + v_s}$$

When source is moving away from observer

$$n'' = \frac{vn}{v - v_s}$$

Now, $n' - n'' = vn\left[\frac{v + v_s - v + v_s}{v^2 - v_s^2}\right] = \frac{(2v_s)vn}{v^2 - v_s^2}$

When $\quad v \gg v_s, n' - n'' = \frac{2v_s n}{v}$

Now $\quad \frac{n' - n''}{n} = \frac{2}{100} = \frac{2v_s}{v} = \frac{2v_s}{300}$

$\therefore v_s = 3\text{ms}^{-1}$

600 **(c)**

From Doppler's effect, the perceived frequency (v') is given by

$$v' = \left(\frac{v - v_o}{v - v_s}\right)v$$

Where v_o is velocity of observer, v_s of source, v of sound and v the original frequency.

Given, $v_o = 0$(stationary), $v = 300\ ms^{-1}$

$v_s = 200\ ms^{-1}$, $v = 400$ Hz

$\therefore v' = \frac{300 \times 400}{300 - 200}$

$= \frac{300 \times 400}{100}$

$\Rightarrow v' = 1200\ Hz$

601 **(c)**

Let v be the actual frequency of sound of horn.

If v_s be the velocity of car, then frequency of sound striking the cliff

$$v' = \frac{v \times v}{v - v_s} \qquad ...(i)$$

The frequency of sound heard on reflection

$$v'' = \frac{(v + v)v'}{v} = \frac{(v + v_s)}{v} \times \frac{v \times n}{(v - v_s)}$$

Or

$$\frac{v''}{v} = \frac{v + v_s}{v - v_s} = 2$$

$v + v_s = 2v - 2v_s$

$\therefore 3v_s = v$

or

$v_s = \frac{v}{3}$

603 **(a)**

Let the frequency of standard fork $= x$

$$\therefore n_A = \frac{102}{100}x, \qquad n_B = \frac{97}{100}x$$

Number of beats $s^{-1} = n_A - n_B = 6$

$$\frac{102}{100}x - \frac{97}{100}x = 6$$

$$x = \frac{6 \times 100}{5} = 120 \text{ Hz}$$

604 **(d)**

We knows

$$c = \sqrt{\frac{\gamma p}{\rho}}$$

$$c = \left(\frac{p}{\rho}\right)^{1/2}$$

605 **(b)**

SONAR emits ultrasonic waves

606 **(b)**

If the frequency of fork v, then speed of sound is given by

$v = 2v(l_2 - l_1)$

Where l_1 and l_2 are length of air columns.

Given, v=500 cycles/s,

$l_2 = 52cm = 52 \times 10^{-2}m$

$l_1 = 17cm = 17 \times 10^{-2}m$

$\therefore v = 2 \times 500(52 - 17) \times 10^{-2}$

$\Rightarrow v = 350ms^{-1}$

607 **(c)**

If the speed of engine is v, the distance traveled by engine in 5 sec will be $5v$, and hence the distance traveled by sound in reaching the hill and coming back to the moving driver $= 900 + (900 - 5v) = 1800 - 5v$

So the time interval between original sound and it's echo

$$t = \frac{(1800 - 5v)}{330} = 5 \Rightarrow v = 30\ m/s$$

608 **(d)**

If the length of the wire between the two bridges is ***l***, then the frequency of vibration is

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}} = \frac{1}{2l}\sqrt{\frac{T}{\pi r^2 d}}$$

If the length and diameter

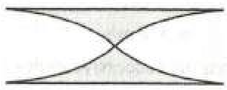
$\left(= \frac{radius}{2}\right)$

Of the wire are doubled keeping the tension same, the new fundamental frequency will be

$\frac{n}{4}$

609 **(a)**

(i) Here, $\frac{\lambda}{2} = l \Rightarrow \lambda = 2l$



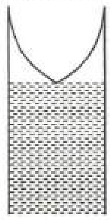
$So, v_1 = \frac{v}{2l}$

(ii)and $\frac{\lambda}{4} = \frac{l}{2}$

$\lambda = \frac{4\lambda}{2} = 2l$

$\therefore v_2 = \frac{v}{2l}$, the same

$\therefore$ (original)is the frequency,



610 **(d)**

$y_1 = a\sin(\omega t - kx)$

and $y_2 = a\cos(\omega t - kx) = a\sin\left(\omega t - kx + \frac{\pi}{2}\right)$

Hence phase difference between these two is $\frac{\pi}{2}$

611 **(c)**

The frequency of sonometer wire is

$$v = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

Taking logarithm and differentiating, we get

$$\frac{\Delta v}{v} = \frac{\Delta l}{l} + \frac{1}{2}\frac{\Delta T}{T} + \frac{1}{2}\frac{\Delta m}{m}$$

$$\therefore \frac{\Delta v}{v} = \frac{\Delta l}{l} + 1 + 1 = 1\%$$

Hence, frequency will increase by 1%

612 **(d)**

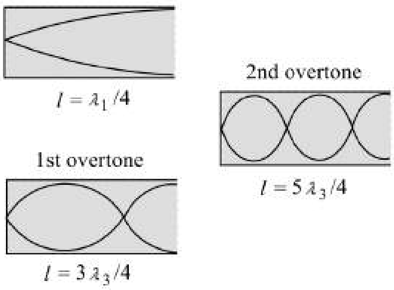
Interference, diffraction and reflection occurs in both transverse and longitudinal waves. Polarisation occurs only in transverse waves

613 **(d)**

When pulse is reflected from a rigid support, the pulse is inverted both lengthwise and sidewise

614 **(d)**

As is clear from figure



$$l = \frac{\lambda_1}{4}, \lambda_2 = 4l$$

$$l = \frac{3\lambda_2}{4}, \lambda_2 = \frac{4l}{3}$$

$$l = \frac{5\lambda_3}{4}, \lambda_3 = \frac{4l}{5}$$

$$\therefore \quad \lambda_1 : \lambda_2 : \lambda_3 = 1 : \frac{1}{3} : \frac{1}{5}$$

615 **(b)**

The motorcyclist observes no beats. So the apparent frequency observed by him from the two sources must be equal.

$$\therefore 176\left(\frac{330 - v}{330 - 22}\right) = 165\left(\frac{330 + v}{330}\right)$$

Solving this equation we get,

$v = 22ms^{-1}$

616 **(a)**

Compare the given equation with $y = a\sin(\omega t + kx)$

We get $\omega = 2\pi n = 100 \Rightarrow n = \frac{50}{\pi} Hz$

617 **(b)**

$$\because y = a\cos\left(\frac{2\pi}{\lambda}vt + \frac{2\pi x}{\lambda}\right) = 0.5\cos(4\pi t + 2\pi x)$$

618 **(c)**

If two of nearly equal frequency superpose, they give beats if they both travel in straight line and $I_{\min} = 0$ if they have equal amplitudes

619 **(c)**

Velocity of longitudinal waves,

$$v_1 = \sqrt{\frac{Y}{\rho}}$$

Velocity of transverse waves

$$v_2 = \sqrt{\frac{T}{m}}$$

Ifa is area of cross-section of string, then

$$\text{m} = \frac{\text{mass}}{\text{length}} = \frac{\text{mass}}{\text{volume}} \times \text{area} = \rho a$$

$$v_2 = \sqrt{\frac{T}{\rho a}}$$

$$\frac{v_1}{v_2} = \sqrt{\frac{Y}{\rho}.\frac{\rho a}{T}} = \sqrt{\frac{Ya}{T}}$$

As $\quad Y = \frac{F}{\frac{a\Delta l}{l}} = \frac{T}{a(\Delta l/l)}$

$$\therefore \frac{v_1}{v_2} = \sqrt{\frac{T}{a\left(\frac{\Delta l}{l}\right)}\frac{a}{T}} = \left(\frac{\Delta l}{l}\right)^{-1/2}$$

We are given, $\frac{\Delta l}{l} = \frac{1}{n}$

$$\therefore \frac{v_1}{v_2} = \left(\frac{1}{n}\right)^{-1/2} = \sqrt{n}$$

If f_1, f_2 are the corresponding fundamental frequencies of longitudinal and transverse vibration, then

$v_1 = f_1\lambda \; and \; v_2 = f_2\lambda$

$\therefore \frac{v_1}{v_2} = \frac{f_1}{f_2} = \sqrt{n}$

620 **(b)**

On comparing the given equation with standard equation

$y = 2a \sin\frac{2\pi x}{\lambda}\cos\frac{2\pi v t}{\lambda} \Rightarrow \frac{2\pi x}{\lambda} = \frac{\pi x}{3} \Rightarrow \lambda = 6$

Separation between two adjacent nodes $= \frac{\lambda}{2} =$ $3\ cm$

621 **(b)**

Reduction in intensity after passing through first slab is 90/100

Of I=0.9I

After second slab, intensity

=90% of (0.9I)

=81% of I

=0.81I

After third slab, intensity =90% of (0.81I)

=72.9% of I

$\therefore$ reduction in intensity =27.1%

622 **(c)**

At given temperature and pressure

$v \propto \frac{1}{\sqrt{\rho}} \Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{4}{1}} = 2:1$

623 **(d)**

As source and observer both are moving in the same direction with the same velocity, their relative velocity is zero. Therefore,$n' = n =$ 200 Hz

624 **(c)**

The relation between velocity, frequency and wavelength is

$v = n\lambda \quad \text{or} \quad \lambda = \frac{v}{n}$

Given, v = 360ms^{-1}, n = 500 Hz

$\therefore \quad \lambda = \frac{360}{500} = 0.72\text{m}$

Path difference $= \frac{\lambda}{2\pi} \times$ phase defference

I, e., $\Delta x = \frac{\lambda}{2\pi} \times \phi$

or $\Delta x = \frac{0.72}{2\pi} \times \frac{\pi}{3} \quad \left(\therefore \Delta\phi = 60° = \frac{\pi}{3}\right)$

=0.12m=12 cm

625 **(a)**

$n' = n\left(\frac{v}{v - v_S}\right) \Rightarrow \frac{n'}{n} = \frac{v}{v - v_S} \Rightarrow \frac{v}{v - v_S} = 3 \Rightarrow v_s = \frac{2v}{3}$

626 **(c)**

Suppose d = distance of epicenter of Earth quake from point of observation

v_S = Speed of S-wave and v_P = Speed of P-wave then

$d = v_P t_P = v_S t_S$ or $8t_P = 4.5\ t_S$

$\Rightarrow t_P = \frac{4.5}{8} t_S$, given that $t_S - t_P = 240$

$\Rightarrow t_S - \frac{4.5}{8} t_S = 240 \Rightarrow t_S = \frac{240 \times 8}{3.5} = 548.5\ s$

$\therefore d = v_S t_S = 4.5 \times 548.5 = 2468.6 \approx 2500 km$

627 **(b)**

$\Delta n = n_1 - n_2 \Rightarrow 4 = \frac{v}{2l_1} - \frac{v}{2l_2} = \frac{v}{2}\left[\frac{1}{1.00} - \frac{1}{1.025}\right]$

$\Rightarrow 8 = v[1 - 0.975] \Rightarrow v = \frac{8}{0.025} \approx 328\ m/s$

628 **(b)**

$L = 10 \log_{10}\left(\frac{I}{I_0}\right) = 30 \Rightarrow \frac{I}{I_0} = 10^3$

629 **(d)**

Since maximum audible frequency is 20,000 Hz,

Hence $\lambda_{\min} = \frac{v}{n_{\max}} = \frac{340}{20{,}000} \approx 20\ mm$

631 **(d)**

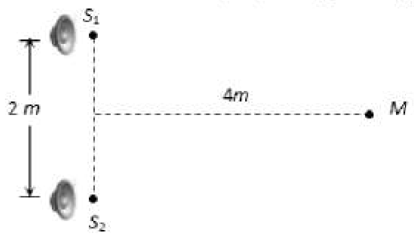
$v = \sqrt{\frac{\gamma RT}{M}} \Rightarrow \frac{T_N}{T_0} = \frac{M_N}{M_0} \Rightarrow \frac{T_N}{273 + 55} = \frac{14}{16} = \frac{7}{8}$

$\Rightarrow T_N = 287K = 14°\text{C}$

633 **(b)**

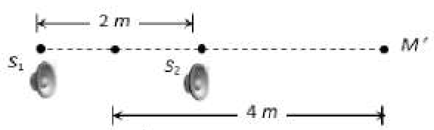
Initially $S_1M = S_2M$

$\Rightarrow$ Path Difference $(\Delta x) = S_1M - S_2M = 0$



Finally when the box is rotated

Path Difference $= S_1M'''''''' - S_2M'''''''' \Rightarrow \Delta x =$ $5 - 3 = 2m$



For maxima

Path Difference = (Even multiple) $\frac{\lambda}{2} \Rightarrow \Delta x = (2n)\frac{\lambda}{2}$

For 5 maximum responses

$$\Rightarrow 2 = 2(5)\frac{\lambda}{2}\left\{\because \Delta x = (2n)\frac{\lambda}{2}\right\} \Rightarrow \lambda = \frac{2}{5} = 0.4m$$

634 **(d)**

From $v = u + at$

$v_s = 0 + g \times 2 = 2g$

As source is moving towards the observer.

$$\therefore\ f = \frac{v}{v - v_s}f_0 = \frac{vf_0}{v - 2g}$$

635 **(c)**

Frequency is given by

$$v = \frac{1}{l}\sqrt{\frac{T}{\mu}}$$

∴first frequency

$$v_1 = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$$

And second frequency

$$v_2 = \frac{1}{4l}\sqrt{\frac{4T}{\mu}}$$

∴hence, the ratio of frequencies

$$\frac{v_1}{v_2} = 1:1$$

636 **(b)**

Given, $y = y_0 \sin 2\pi\left(ft - \frac{x}{\lambda}\right)$

For particle velocity,

$$\left(\frac{dy}{dt}\right)_{\max} = 2\pi f y_o$$

Wave velocity $= f\lambda$

Accordingly,

$2\pi f y_o = 4(f\lambda)$

Or

$$\lambda = \frac{\pi y_0}{2}$$

638 **(d)**

$B_y = 2 \times 10^{-7} \sin(0.5 \times 10^3 z + 1.5 \times 10^{11} t)T$

The electric vector is perpendicular to B as well as direction of propagation of electromagnetic wave. Therefore E_x has to be taken.

Further, $E_0 = B_0 \times c \Rightarrow 2 \times 10^{-7} \times 3 \times 10^8 V/m = 60V/m$

∴ The corresponding value of the electric field is

$E_x = 60 \sin(0.5 \times 10^3 z + 1.5 \times 10^{11} t)V/m$

639 **(b)**

Fundamental frequency of open pipe

First harmonic $= n_1 = \frac{v}{2l} = \frac{330}{2\times 0.3} = 550\ Hz$

Second harmonic $= 2 \times n_1 = 1100\ Hz. = 1.1\ kHz$

640 **(a)**

Here,$n = 500\ Hz, T = \frac{1}{n} = \frac{1}{500} = 2 \times 10^{-3}\ s$

Phase difference corres to $2 \times 10^{-3}\ s = 2\pi$ rad

Phase difference corres to

$1 = 10^{-3} = \frac{2\pi \times 1 \times 10^{-3}}{2 \times 10^{-3}} = \pi$ rad

641 **(c)**

The wave 1 and 3 reach out of phase. Hence resultant phase difference between them is π.

∴ Resultant amplitude of 1 and 3 $= 10 - 7 = 3\ \mu m$

This wave has phase difference of $\frac{\pi}{2}$ with $4\ \mu m$

∴ Resultant amplitude $= \sqrt{3^2 + 4^2} = 5\ \mu m$

642 **(d)**

$$v \propto \lambda \Rightarrow \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2} = \frac{2/3}{3/10} = \frac{20}{9}$$

643 **(d)**

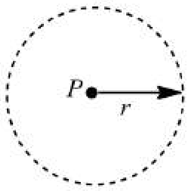
For an isotropic point source of power P, intensity I at a distance r from it is

$$I = \frac{P}{4\pi r^2}$$

$$\therefore \frac{I_1}{I_2} = \left(\frac{r_2}{r_1}\right)^2 = \left(\frac{9}{4}\right)^2$$

Where A is the amplitude of a wave

$$\therefore \frac{A_1}{A_2} = \sqrt{\frac{I_1}{I_2}} = \frac{9}{4}$$



644 **(a)**

$$n' = n\left(\frac{v}{v + v_S}\right) = 800\left(\frac{330}{330 + 30}\right) = 733.33\ Hz$$

645 **(c)**

In open organ pipe 3rd overtone corresponds to 4th harmonic mode.

Also in open pipe, Number of nodes = Order of mode of vibration and number of antinodes = (Number of nodes + 1). Here number of nodes = 4, Number of antinodes = 4 + 1 = 5

646 **(a)**

Given, $x_1 = 3 \sin \omega t$

$and \quad x_2 = 4\sin(\omega t - 90°)$
The phase difference between the two waves is 90°.
So, resultant amplitude
$a = \sqrt{(3)^2 + (4)^2}$
$= \sqrt{9+16} = \sqrt{25}$
$= 5$ unit

647 **(d)**
Given, the speed of sound $v = 330\ ms^{-1}$
Velocity of both trains $=30\ ms^{-1}$
$(\because v_o = v_s = 20ms^{-1})$
And frequency =600 Hz
When both trains are moving towards each other then, apparent frequency
$n' = n\left[\frac{v+v_o}{v-v_s}\right]$
$= 600\left[\frac{330+30}{330-30}\right]$
$= 600\left[\frac{360}{300}\right]$
n'=720 Hz

648 **(c)**
The boat bounces up, ie, it travels from crest to the consecutive crest along wave motion.
Wavelength=distance between two consecutive crest ie,
$\lambda = 100$ m
Velocity of wave=25ms^{-1}
Hence, time in one bounce of boat
$t = \frac{\lambda}{v} = \frac{100}{25} = 4s$

649 **(a)**
String will vibrate in 7 loops so it will have 8 nodes 7 antinodes.
Number of harmonics = Number of loops = Number of antinodes ⇒ Number of antinodes = 7
Hence number of nodes = Number of antinodes + 1
$= 7 + 1 = 8$

650 **(a)**
As $n \propto \frac{1}{l}$ $and\ l = l_1 + l_2 + l_3$
$\therefore \quad \frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$

651 **(a)**
Fundamental frequency of open pipe is double that of the closed pipe

652 **(a)**
Given that, the displacement of a particle is
Y=a sin (ωt-kx) ...(i)
The particle velocity
$v_p = \frac{dy}{dt}$ ... (ii)
Now, on differentiating Eq. (i) w.r.t.t,
$\frac{dy}{dt} = a\cos(\omega t - kx).\omega$
$\Rightarrow \quad \frac{dy}{dt} = a\omega\cos(\omega t - kx)$
From eq. (ii)
$\Rightarrow \quad v_p = a\omega\cos(\omega t - kx)$
For maximum particle velocity,
cos (ωt-kx)=1
so, $v_p = a\omega \times 1 \Rightarrow v_p = a\omega$

653 **(c)**
Since $v = \sqrt{\frac{\gamma RT}{M}}$ $i.e., v \propto \sqrt{T}$

654 **(b)**
Here, $\iota_1 = 18\ cm$
$f = \frac{v_1}{4\iota_1}$
$f = \frac{3v_2}{4\iota_2}$,
where ι_2 = x According to given situation and also $v_1 < v_2$as during summer temperature would be higher.
$\frac{3v_2}{4\iota_2} = \frac{v_\iota}{4\iota_1}$
$\Rightarrow$ x = 54 × (A quantity greater than I)
So, x>54

655 **(b)**
Here, $n = 200 \pm 5\ and\ 2\ n = 420 \pm 10$. This is possible only when $n = 200 + 5 = 205$

656 **(d)**
Speed of sound in gases is $v = \sqrt{\frac{\gamma RT}{M}} \Rightarrow T \propto M$
(Because v, γ-constant). Hence $\frac{T_{H_2}}{T_{O_2}} = \frac{M_{H_2}}{M_{O_2}}$
$\Rightarrow \frac{T_{H_2}}{(273+100)} = \frac{2}{32} \Rightarrow T_{H_2} = 23.2K = -249.7°C$

657 **(b)**
Comparing the given equation with $y = a\cos(\omega t - kx)$
We get $k = \frac{2\pi}{\lambda} = \pi \Rightarrow \lambda = 2cm$

658 **(c)**
For a vibrating string
$n_1 l_1 = n_2 l_2 = n_3 l_3 \dots = \text{constant} = k(\text{say}) = nl$
Also $l_1 + l_2 + l_3 + l_4 + \dots = 1$

$$\frac{k}{n_1}+\frac{k}{n_2}+\frac{k}{n_3}+\frac{k}{n_4}+\ \dots=\frac{k}{n}\Rightarrow\frac{1}{n}$$
$$=\frac{1}{n_1}+\frac{1}{n_2}+\frac{1}{n_3}+\ \dots$$

660 **(d)**

The frequency is a characteristic of source. It is independent of the medium.

Hence the correct option is (d).

661 **(d)**

Frequency of sonometer wire is given by

$$v=\frac{1}{2l}\sqrt{\frac{T}{m}}$$

Where m is mass of string per unit length, and T is tension in the string.

Also, $m=\pi r^2 d$

R being radius of string per unit length, and T is tension in the string.

So,

$$v=\frac{1}{2l}\sqrt{\frac{T}{\pi r^2 d}}$$

Or

$$v\propto\frac{\sqrt{T}}{r}$$

Or

$$\frac{v_1}{v_2}=\sqrt{\frac{T_1}{T_2}}\times\left(\frac{r_2}{r_1}\right)$$

Given, $r_2=2r_1,\quad T_2=\frac{T_1}{2},\quad v_1=v$

Hence,

$$\frac{v}{v_2}=\sqrt{2}\times 2$$

Or

$$v_2=\frac{v}{2\sqrt{2}}$$

662 **(a)**

It is known that when loudness decreases by$10dB$, intensity of sound decreases by a factor 10.therefore, when loudness decreases by$20\ dB$, ie,$2\times 10\ dB$, the intensity of sound would decreases by a factor of 10^2,ie 100.

663 **(a)**

$$v=\frac{\omega}{k}=\frac{2\pi}{2\pi}=1\ m/s$$

664 **(c)**

The wall acts like a rigid boundary and reflects this wave and sends it back towards the open end. At the open an antinode is formed and a node is formed at the wall. The distance between antinode and node is

$$\frac{\lambda}{4}$$

Therefore, if v be the frequency of note emitted then

$$\lambda=\frac{\mathrm{v}}{\mathrm{v}}$$

$$\Rightarrow\ \lambda=\frac{300}{600}=\frac{1}{2}\mathrm{m}$$

Maximum amplitude is obtained at distance

$$=\frac{\lambda}{4}=\frac{1}{2}\times\frac{1}{4}=\frac{1}{8}\mathrm{m}$$

665 **(d)**

The perceived frequency (f') is related to the actual frequency (f_o) and the relative speeds of the source (v_s) and observer (v_o) of waves in the medium is given by

$$f'=f_o\left(\frac{v+v_o}{v-v_s}\right)$$

Given,

v=340m/s $v_o=15\mathrm{m/s}$, $v_s=20\mathrm{m/s}$

$$\therefore f'=600\times\left(\frac{340+15}{340-20}\right)$$

$$=\frac{355}{320}\times 600=666Hz$$

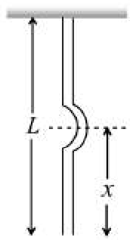
666 **(d)**

As moon has no atmosphere, therefore sound of explosion cannot travel to earth.

667 **(d)**

Let mass and length of the string are M and L

Pulse at distance x from free end



Mass per unit length $=M/L$

$\therefore$ Mass of length x i.e.

Tension $T=\left(\frac{M}{L}\right)xg$

$\therefore$ Velocity $=\sqrt{T/m}$

$$\Rightarrow v=\sqrt{\frac{Mgx/L}{M/L}}=\sqrt{gx}$$

$$\Rightarrow v\propto\sqrt{x}$$

668 **(a)**

In closed pipe only odd harmonics are present

669 **(a)**

In open organ pipe both even and odd harmonics are produced

670 **(c)**

When source and observer both are moving in the same direction and observer is ahead of source, then apparent frequency

$$v' = \frac{v - v_o}{v - v_s} v = \frac{v - \frac{v}{6}}{v - \frac{v}{4}} = \frac{\frac{5v}{6}}{\frac{3v}{4}} v = \frac{10}{9} v$$

671 **(b)**

Distance between six successive node

$$= \frac{5\lambda}{2} = 85cm \Rightarrow \lambda = \frac{2 \times 85}{5} = 34\ cm = 0.34\ m$$

Therefore speed of sound in gas

$$= n\lambda = 1000 \times 0.34 = 340\ m/s$$

672 **(b)**

As $\frac{l_2}{2l} = \frac{l_2'}{l_1'}$

$\therefore \frac{60}{40} = \frac{l_2'}{50'}$,

$$l_2' = \frac{50 \times 60}{40} = 75 \text{ cm}$$

673 **(b)**

The frequency of note 'Sa' is 256 Hz while that of note 'Re' and 'Ga' respectively are 288 Hz and 320 Hz

674 **(a)**

Time taken by stone to reach the level of water t_1 is obtained from $s = ut + \frac{1}{2}at^2$

$h = 0 + \frac{1}{2}gt_1^2, t_1\sqrt{\frac{2h}{g}}a.$

Time taken by sound to reach the top of well$t_2 = \frac{h}{v}$.

Total time $t = t_1 + t_2 = \sqrt{\frac{2h}{g}} + \frac{h}{v}$

675 **(b)**

$$\frac{I_{\max}}{I_{\min}} = \frac{\left(\frac{\sqrt{I_1}}{\sqrt{I_2}} + 1\right)^2}{\left(\frac{\sqrt{I_1}}{\sqrt{I_2}} - 1\right)^2} = \frac{\left(\sqrt{\frac{9}{1}} + 1\right)^2}{\left(\sqrt{\frac{9}{1}} - 1\right)^2} = \frac{4}{1}$$

676 **(d)**

Mass per unit length $m = \frac{2 \times 10^{-4}}{0.5} kg/m = 4 \times 10^{-4} kg/m$

Frequency of 2^{nd} harmonic $n_2 = 2n_1$

$$= 2 \times \frac{1}{2l}\sqrt{\frac{T}{m}} = \frac{1}{0.5}\sqrt{\frac{20}{4 \times 10^{-4}}} = 447.2Hz$$

677 **(b)**

$$v \propto \frac{1}{\sqrt{M}} \Rightarrow \frac{v_{H_2}}{v_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{H_2}}} = \sqrt{\frac{32}{2}} \Rightarrow \frac{v_{H_2}}{v_{O_2}} = \frac{4}{1}$$

678 **(d)**

Given, $f_0 - f_c = 2$ ... (i)

Frequency of fundamental mode for a closed organ pipe,

$f_c = \frac{v}{4L_c}$

Similarly frequency of fundamental mode an open orgen pipe,

$f_0 = \frac{v}{2L_0}$

Given $L_c = L_0$

$\Rightarrow f_0 = 2f_c$ ... (ii)

From Eqs. (i) and (ii), we get

$f_0 = 4Hz$

And $f_c = 2Hz$

When the length of the open pipe is halved, its frequency of fundamental mode is

$f_0' = \frac{v}{2\left[\frac{L_0}{2}\right]}$

$= 2f_0 = 2 \times 4Hz = 8Hz$

When the length of the closed pipe is doubled, its frequency of fundamental mode is

$f_0' = \frac{v}{4(2L_c)}$

$= \frac{1}{2}f_c = \frac{1}{2} \times 2 = 1Hz$

Hence, number of beats produced per second is

$f_0' = f' = 8 - 1 = 7$

679 **(c)**

Given, $y_1 = A\sin(kx - \omega t)$

$y_2 = A\cos(kx - \omega t) or\ y_2 = a\sin\left(kx - \omega t + \frac{\pi}{2}\right)$

Phase difference of two waves=π/2

∴resultant amplitude

$R = \sqrt{A^2 + A^2 + 2AAcos\ \Phi}$

$= \sqrt{A^2 + A^2 + 2A^2\cos\frac{\pi}{2}}$

$= \sqrt{A^2} \quad \left(\because \cos\frac{\pi}{2} = 0\right)$

$R = \sqrt{2}A$

680 **(a)**

Sound waves are longitudinal waves. They produce alternately the states of compression and rarefaction at a point in the medium.

681 **(a)**

Waves A and B satisfy the conditions required for a standing wave

682 **(c)**

Proceeding as in above question,

$$\tan\theta = \tan 60° = \frac{v_p}{v}$$

$$\therefore v_p = v \times \tan 60° = v\sqrt{3}$$

683 **(b)**

$$y_2 = a_2 \cos\left(\omega t - \frac{2\pi x}{\lambda} + \phi\right)$$

$$= a_2 \sin\left[\frac{\pi}{2} + \left(\omega t - \frac{2\pi x}{\lambda} + \phi\right)\right]$$

Compare it with $y_1 = a_1 \sin\left(\omega t - \frac{2\pi x}{\lambda}\right)$

Phase difference= $\left(\frac{\pi}{2} + \phi\right)$

$\therefore$ Path difference $= \frac{\lambda}{2\pi}\left(\frac{\pi}{2} + \phi\right)$

684 **(d)**

$$y = 5\left(\sin 4\pi t + \sqrt{3}\cos 4\pi t\right)$$

$$y = 5\left(\sin 4\pi t + 5\sqrt{3}\cos 4\pi t\right)$$

$$A = \sqrt{A_1^2 + A_2^2}$$

$$A = \sqrt{(5)^2 + \left(5\sqrt{3}\right)^2}$$

$$= \sqrt{25 + 75} = \sqrt{100}$$

$$A = 10$$

685 **(d)**

$$\mu = \frac{\sin \mathrm{i}}{\sin \mathrm{r}} = \frac{\mathrm{v}_1}{\mathrm{v}_2}$$

$$\Rightarrow \sin \mathrm{r} = \sin 30° \times \frac{2\mathrm{v}}{\mathrm{v}} \Rightarrow \sin \mathrm{r} = \frac{1}{2} \times 2 \times 1$$

$$\Rightarrow \mathrm{r} = 90°$$

686 **(d)**

$$2\pi f_1 = 600\pi$$

$$f_1 = 300 \quad \text{...(i)}$$

$$2\pi f_2 = 608\pi$$

$$f_2 = 304 \quad \text{...(ii)}$$

$$|f_1 - f_2| = 4 \text{ beats}$$

$$\frac{I_{\max}}{I_{\min}} = \frac{(A_1 + A_2)^2}{(A_1 - A_2)^2} = \frac{(5+4)^2}{(5-4)^2} = \frac{81}{1}$$

688 **(d)**

Particles have kinetic energy maximum at mean position.

689 **(a)**

Number of beats $\mathrm{s}^{-1} = n_1 - n_2$

$\therefore$ Time interval between two successive beats/successive maxima $= \frac{1}{n_1 - n_2}$

690 **(b)**

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}} \Rightarrow n_1 l_1 = n_2 l_2 = n_3 l_3 = k$$

$$l_1 + l_2 + l_3 = l \Rightarrow \frac{k}{n_1} + \frac{k}{n_2} + \frac{k}{n_3} = \frac{k}{n}$$

$$\Rightarrow \frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$$

691 **(c)**

In general, pth mode of a string fixed at ends has frequency

$v = \frac{4v}{2l}$ p=1,2,3....

Where v is velocity of wave and $\boldsymbol{l}$ is length of string. In fourth normal mode, p=4

$$\therefore \quad v = \frac{4v}{2l}$$

Given, v=500 Hz, $\boldsymbol{l}$=2m

Hence,

$$500 = \frac{4v}{2 \times 2}$$

Or

$$v = \frac{500 \times 4}{4} = 500ms^{-1}$$

692 **(a)**

Frequency of third harmonic of closed pipe

$$n_1 = \frac{3v}{4l}$$

Fundamental frequency of open pipe

$$n_2 = \frac{2}{2l}$$

As $n_1 - n_2 = 100$

$$\frac{v}{4l} = 100$$

$$\therefore \frac{v}{2l} = 200 \text{ Hz}$$

693 **(d)**

If a amplitude of sound from A and B each, then $I_A = I_B k a^2$,where k is constant.

Loudness due to $C(ie\ A+B)$

$I_C = k(2a^2)4I_A$

$\therefore n = 10\log_{10}\left(\frac{I_C}{I_A}\right) = 10\log_{10}4$

$= 10 \times 0.6 = 6$

694 **(d)**
For producing beats, their must be small difference in frequency

695 **(d)**
Frequency of change of resultant amplitude=number of beatss^{-1} $= 260 - 256 =$ 4 Hz.

696 **(d)**
In this problem acceleration is variable
$f = \frac{dv}{dt} = f_0\left(1 - \frac{t}{T}\right)$ ...(i)
At $t = 0, f = f_0$ at $t = T, f = 0$ i.e.,
We have to calculate the velocity of the particle in the time from
$t = 0$ to $t = T$ sec
From (i) equation, $\frac{dv}{dt} = f_0\left(1 - \frac{t}{T}\right)$;
Integrating both sides, $\int dv = \int_0^T f_0\left(1 - \frac{t}{T}\right) dt$;
$v = f_0\left[t - \frac{t^2}{2T}\right]_0^T \ v = f_0\left[T - \frac{T^2}{2T}\right]$;
$v = f_0\left[T - \frac{T}{2}\right]; v = f_0\frac{T}{2}$

697 **(c)**
As fixed end is a node, therefore, distance between two consecutive nodes $= \frac{\lambda}{2} = 10$ cm

$\lambda = 20\ cm = 0.2\ m$

As $v = \nu\lambda$

$\therefore \quad v = 100 \times 0.2 = 20\ \text{ms}^{-1}$

698 **(a)**
As$x \propto F$, therefore, when x becomes 1.5 times, F becomes 1.5 times.

As $v = \sqrt{\frac{T}{m}} = \sqrt{\frac{F}{m}}$,therefore.

$v' \propto \sqrt{1.5}v = 1.22v$

699 **(b)**
Minimum audible frequency $= 20\ Hz$

$\Rightarrow \frac{v}{4l} = 20 \Rightarrow l = \frac{336}{4 \times 20} = 4.2\ m$

700 **(a)**
As $n \propto \sqrt{T}$

$\therefore$ To produce octave of the note (of double the frequency), T has to be made 4 times, *ie,* weight required $= 4 \times 4$kg $= 16$kg

702 **(d)**
Velocity $v_s = r\omega = r.2\pi\nu$
$= 1.2 \times 2 \times 3.14 \times \left(\frac{400}{60}\right) = 50ms^{-1}$
$\nu_{\min} = \frac{v}{v + v_s}\nu$
$= \frac{340}{340 + 50} \times 500 = 436\ Hz$
$\nu_{\max} = \frac{v}{v - v_s}\nu$
$= \frac{340}{340-50} \times 500$
=586 Hz

703 **(b)**
For closed pipe second note $= \frac{3v}{4l} = \frac{3\times330}{4\times1.5} =$ 165 Hz

704 **(b)**
Phase difference between two successive crest is 2π.
Also, phase difference $(\Delta\phi) = \frac{2\pi}{T}$ time interval (Δt)
$\Rightarrow 2\pi = \frac{2\pi}{T} \times 0.2 \Rightarrow \frac{1}{T} = 5\sec^{-1} \Rightarrow n = 5\ Hz$

705 **(d)**
Let v be the speed of sound in air, v_L velocity of observer at time t. As the observer approaches the source, therefore, apparent frequency

$$f = \frac{(v + v_L)}{v} f_0 = \left[\frac{v + (0 + at)}{v}\right] f_0 = f_0 + \left(\frac{f_0 at}{v}\right)$$

This is the equation of a straight line with a positive intercept $(f_0)$and positive slope $\left(\frac{f_0 a}{v}\right)$.
Therefore, option (d) is correct.

706 **(a)**
The wire will vibrate with the same frequency as that of source. This can be considered as an example of forced vibration.
T=10×9.2N=98N
$m = 9.8 \times 10^{-3}kgm^{-1}$
Frequency of wire

$$n = \frac{1}{2L}\sqrt{\left(\frac{T}{m}\right)}$$

$$= \frac{1}{2 \times 1}\sqrt{\left(\frac{98}{9.8 \times 10^{-3}}\right)} = 50Hz$$

707 **(c)**

The given equation representing a wave travelling along $-y$ direction (because $'+'$ sign is given between t term and x term).

On comparing it with $x = A\sin(\omega t + ky)$

We get $k = \frac{2\pi}{\lambda} = 12.56 \Rightarrow \lambda = \frac{2\times 3.14}{12.56} = 0.5\ m$

708 **(a)**

$$\lambda = \frac{v}{n} = \frac{1.7 \times 1000}{4.2 \times 10^6} = 4 \times 10^{-4} m$$

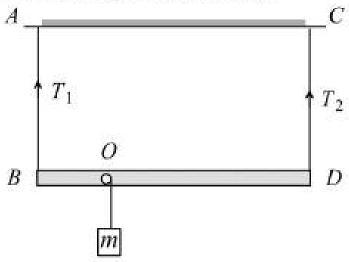
709 **(a)**

By comparing given equation with $y = a\sin(\omega t)\cos kx$

$$\Rightarrow v = \frac{\omega}{k} = \frac{100}{0.01} = 10^4\ m/s$$

710 **(a)**

According to question,



$$\frac{1}{2l}\sqrt{\frac{T_1}{\mu}} = \frac{1}{l}\sqrt{\frac{T_2}{\mu}}$$

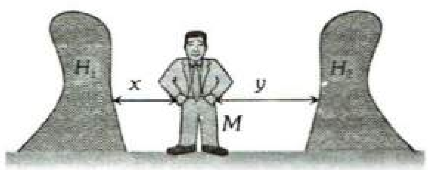
$T_2 = T_1/4$

For rotational equilibrium,

$T_1 x = T_2(L - x) \Rightarrow x - L/5$

711 **(c)**

Let the man M be at a distance x from hill H_1 and y from hill H_2 as shown in figure. Let $y > x$.



The time interval between the original sound and echoes from H_1 and H_2 will be respectively

$t_1 = \frac{2x}{v}$ and $t_2 = \frac{2y}{v}$

where v is the velocity of sound

The distance between the hills is

$$x + y = \frac{v}{2}(t_1 + t_2) = \frac{340}{2}[1 + 2] = 510\ m$$

712 **(d)**

Fundamental frequency of close pipe,

$$v_1 = \frac{v}{4l_1}$$

Fundamental frequency of open pipe,

$$v_2 = \frac{v}{2l_2}$$

But $v_1 = v_2$

$$\therefore \frac{l_1}{l_2} = \frac{1}{2}$$

713 **(a)**

The speed of transverse wave

$$v = \sqrt{\frac{T}{m}}$$

Given, T=20N,

$$\frac{M}{\iota} = \frac{d \times A\iota}{\iota} = d \times A$$

$$\therefore = \sqrt{\frac{20 \times 10^{-3}}{7.5 \times 0.2 \times (10^{-3})^2}}$$

$v \approx 116 ms^{-1}$

714 **(a)**

Sonometer is used to produce resonance of sound source with stretched vibrating string

716 **(a)**

$$n = \frac{\rho}{2l}\sqrt{\frac{T}{m}} \propto \sqrt{T} \Rightarrow \frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}}$$

$$\Rightarrow \frac{260}{n_2} = \sqrt{\frac{50.7g}{(50.7 - 0.0075 \times 10^3)g}} \Rightarrow n_2 = 240$$

717 **(d)**

This is a case of destructive interference

718 **(d)**

The sounds of different source are said to differ in quality. The number of overtones and their relative intensities determines the quality of any musical sound

719 **(c)**

Frequency is that characteristic of sound waves which does not change while passing through boundary separating two media.

720 **(b)**

$$I \propto \frac{1}{r^2} \Rightarrow \frac{I_2}{I_1} = \frac{r_1^2}{r_2^2} = \frac{2^2}{(40)^2} = \frac{1}{400} \Rightarrow I_1 = 400 I_2$$

Intensity level at point 1, $L_1 = 10\log_{10}\left(\frac{I_1}{I_0}\right)$

and intensity at point 2, $L_2 = 10\log_{10}\left(\frac{I_2}{I_0}\right)$

$$\therefore L_1 - L_2 = 10\log\frac{I_1}{I_2} = 10\log_{10}(400)$$

$\Rightarrow L_1 - L_2 = 10 \times 2.602 = 26$
$L_2 = L_1 - 26 = 80 - 26 = 54\ dB$

721 **(a)**
The standard equation is
$y = a\sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda} + \phi\right) \quad ..(i)$
Dividing multiplying the given equation by 2, we get
$y = a\sin 2\pi\left(\frac{10}{2}x + \frac{11}{2}t + \frac{1}{6}\right) \quad ...(ii)$
On comparing Egs. (i) and (ii), we get
Λ=0.2 units

722 **(a)**
$v = \frac{c}{\lambda} = \frac{3 \times 10^8}{1500} = 2 \times 10^5$ Hz

723 **(d)**
Apparent frequency heard by the observer
$v' = \left(\frac{v + v}{v - v_s}\right) \times v$
$= \left(\frac{330 + 10}{330 - 10}\right) \times 256 = \frac{340}{320} \times 256 = 272\ Hz$
∴No of beats heard by the observer =272-256=16

724 **(b)**
Given that, velocity of the car
$= \frac{36000\text{m}}{3600\text{s}} = 10\text{ms}^{-1}$
$\text{v}_{\text{emitted}} = 500$ Hz
$\text{v}_{\text{sound}} = 330\ \text{ms}^{-1}$
We know that
$= \text{v}_{\text{emitted}} \times \frac{(\text{v}_{\text{sound}} - \text{v}_{\text{obs}})}{\text{c}_{\text{sound}}}$
Hence, observed frequency $v_{obs} = 500 \times \frac{330-10}{330}$
$v_{obs} = 485Hz$

725 **(c)**
$v = \sqrt{\frac{T}{m}} \Rightarrow v = \sqrt{\frac{60.5}{(0.035/7)}} = 110\ m/s$

726 **(b)**
$t = \sqrt{\frac{2h}{g}} + \frac{h}{v} = \sqrt{\frac{2 \times 19.6}{9.8}} + \frac{19.6}{v} = 2.06$
$\Rightarrow v = 326.7\ m/s$

727 **(b)**
First tone of open pipe = first overtone of closed pipe
$\Rightarrow \frac{v}{2l_0} = \frac{3v}{4l_c} \Rightarrow l_c = \frac{3 \times 2 \times 0.5}{4} = 0.75m$

728 **(b)**
$n_{\text{Closed}} = \frac{1}{2}(n_{\text{Open}}) = \frac{1}{2} \times 320 = 160\ Hz$

729 **(b)**
Given equation y=3cos π(50t-x)
Comparing with y=a cos (ωt-kx)
$K = \pi \Longrightarrow \frac{2\pi}{\lambda} = \pi$
λ=2 units.

730 **(c)**
Speed $= n\lambda = n(4ab) = 4n \times ab \quad \left[\text{As } ab = \frac{\lambda}{4}\right]$
Path difference between b and e is $\frac{3\lambda}{4}$
So the phase difference $= \frac{2\pi}{\lambda}$. Path difference
$= \frac{2\pi}{\lambda} . \frac{3\lambda}{4} = \frac{3\pi}{2}$

731 **(b)**
Given,
$y_1 = 4\sin 500\pi t \ .....(i)$
$y_2 = 2\sin 506\ \pi t \ .....(ii)$
Comparing Eqs. (i) and (ii)
Y=a sin ωt..............(iii)
We have,
$\omega_1 = 500\pi$
$\Longrightarrow \text{f}_1\ \frac{500\pi}{2\pi} = 250\text{beats/s}$
And
$\omega_2 = 506\pi$
$\Longrightarrow \quad \text{f}_{22} = \frac{506\pi}{2\pi} = 253$ beats/s
Thus, number of beats produced
$= \text{f}_2 - \text{f}_1 = 253 - 250$
=3 beats/s
=3×60 beats/min
=180 beats/min

732 **(c)**
According to question,
1st harmonic of closed organ pipe
= 3rd harmonic of open organ pipe
$\Rightarrow \frac{V}{4L_c} = \frac{3V}{2L_o} \Rightarrow \frac{L_c}{L_o} = \frac{1}{6}$

733 **(a)**
The given equation can be written as
$y = 4\ sin\left[\pi\left(\frac{t}{5} - \frac{x}{9} - \frac{1}{6}\right)\right] ....(i)$
The standard equation can be written as
Y=a sin (ωt-kx+ϕ)
$y = a\sin\left(\frac{2\pi}{T}t - \frac{2\pi}{\lambda}.x + \phi\right) ....(ii)$
Equation Eqs. (i) and (ii), we get
Amplitude a=4cm
Frequency $f = \frac{1}{T} = 1/10$ Hz=0.1 Hz
Wavelength $\lambda = 2 \times 9$=18 cm

Velocity $v = f\lambda = 0.1 \times 18 = 1.8 cms^{-1}$

734 **(c)**

Frequency of reflected sound heard by the bat

$$v' = v\left[\frac{v-(v_o)}{v-v_s}\right]$$

$$= v\left[\frac{v+v_o}{v-v_s}\right] = v\left[\frac{v+v_b}{v-v_b}\right]$$

$$= v\left[\frac{330+4}{330-4}\right] 90 \times 10^3$$

$$= 92.1 \times 10^3 Hz$$

735 **(c)**

A wave travelling in positive x-direction may be represented as $y = A\sin\frac{2\pi}{\lambda}(vt - x)$. On putting values $y = 0.2\sin\frac{2\pi}{60}(360t - x) \Rightarrow y = 0.2\sin 2\pi\left(6t - \frac{x}{60}\right)$

736 **(a)**

Wave number $= \frac{1}{\lambda}$ but $\frac{1}{\lambda'} = \frac{1}{\lambda}\left(\frac{v}{v-v_s}\right)$ and $v_s = \frac{v}{3}$

$$\therefore (\text{W.N.})' = (\text{W.N.})\left(\frac{v}{v - v/3}\right) = 256 \times \frac{v}{2v/3}$$

$$= \frac{3}{2} \times 256 = 384$$

737 **(d)**

Energy $\propto a^2n^2 \Rightarrow \frac{a_B}{a_A} = \frac{n_A}{n_B}$ [$\because$ energy is same]

$$\Rightarrow \frac{a_B}{a_A} = \frac{8}{1}$$

738 **(b)**

Path difference $(\pi r - 2r) = \frac{\lambda}{2} = \frac{32}{2} = 16$

$$r = \frac{16}{\pi - 2} = 14cm$$

739 **(a)**

The average power per unit area that is incident perpendicular to the direction of propagation is called the intensity

Intensity of sound

$$I = \frac{P}{4\pi r^2}$$

Or

$$I \propto \frac{1}{r^2}$$

Or

$$\frac{I_1}{I_2} = \left(\frac{r_2}{r_1}\right)^2$$

Here, $r_1 = 2m, r_2 = 3m$

Substituting the values, we have

$$\frac{I_1}{I_2} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$$

740 **(a)**

Comparing the given equation with standard equation

We get $\omega = 2\pi n = 200\pi \Rightarrow n = 100\ Hz$ and $k = \frac{20\pi}{17}$

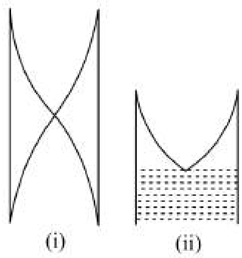
$$\because \lambda = \frac{2\pi}{k} = \frac{2\pi}{20\pi/17} = 1.7\ m$$

And $v = \frac{\omega}{k} = \frac{200\pi}{20\pi/17} = 170\ m/s$

741 **(a)**

Walls of auditorium should be good absorbers to provide optimum value of reverberation time $T = \frac{0.16V}{\sum as}$ where V is volume of hall and $\sum$ as is total absorption of the hall.

742 **(a)**



(i) $\frac{\lambda}{2} = l \Rightarrow \lambda = 2l$

$$v = \frac{v}{2l}$$

(ii) $\frac{\lambda}{4} = \frac{l}{2}$

$$\lambda = \frac{4l}{2} = 2l$$

$\therefore v = \frac{v}{2l}$, the same frequency

743 **(d)**

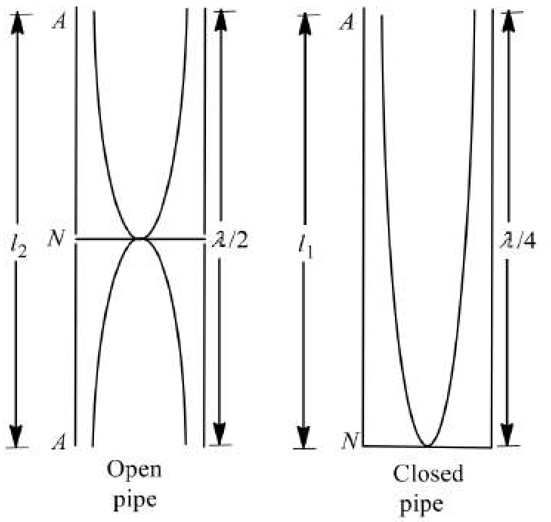
$\frac{\lambda}{4} = 20 \Rightarrow \lambda = 80cm$, also $\Delta\phi = \frac{2\pi}{\lambda}.\Delta x$

$$\Rightarrow \Delta\phi = \frac{60}{80} \times 2\pi = \frac{3\pi}{2}$$

744 **(a)**

If $\boldsymbol{l}$ be length of pipe and v the velocity then, the frequency of first overtone of close pipe is

$$v_1 = \frac{3v}{4l_1}$$



Frequency of third harmonic of organ pipe (open at both ends)

$$v_2 = \frac{3v}{2l_2}$$

the pipes are in resonance, hence

$$v_1 = v_2$$

$$\therefore \frac{3v}{4l_1} = \frac{3v}{2l_2}$$

$$\Rightarrow \frac{l_1}{l_2} = \frac{2}{4} = \frac{1}{2}$$

745 **(b)**

When an observer is moving towards the source apparent frequency

$$n' = n \times \left(\frac{v + v_o}{v}\right)$$

Or

$$n' = n \times \frac{4}{4}$$

Or

$$\frac{n'}{n} = \frac{5}{4}$$

746 **(c)**

Given,

$$\frac{T_A}{T_B} = 1, \frac{L_A}{L_B} = \frac{80}{x}$$

$$\frac{D_A}{D_B} = \frac{2}{1}, \frac{d_A}{d_B} = \frac{0.81}{1}$$

Let μ_1 and μ_2 be the linear densities.

$$\therefore \frac{\mu_A}{\mu_B} = \left(\frac{D_A}{D_B}\right)^2 \times \frac{d_A}{d_B}$$

$$= \left(\frac{2}{1}\right)^2 \times 0.81$$

$$=4 \times 0.81 = 3.24$$

$$\therefore \frac{v_1}{v_2} = \frac{L_B}{L_A} \times \sqrt{\frac{T_A}{T_B} \times \frac{\mu_B}{\mu_A}}$$

$$1 = \frac{x}{80} \times \sqrt{1 \times \frac{1}{3.21}}$$

or $x=144$

747 **(c)**

Given, $\quad v_{\max} = v$

$$\Rightarrow \quad a\omega = v$$

$$\Rightarrow a \times 2\pi v = v\lambda \text{ or } a = \frac{\lambda}{2\pi}$$

748 **(b)**

Positive sign in the argument of sin indicating that wave is travelling in negative x-direction

750 **(b)**

On comparing the given equation with standard equation

$$\frac{2\pi}{\lambda} = 5 \Rightarrow \lambda = \frac{6.28}{5} = 1.256m$$

751 **(b)**

From relation

$$\Delta\phi = \frac{2\pi}{\lambda} \times \Delta x$$

$$\Rightarrow \Delta x = \frac{\lambda}{2\pi} \times \Delta\phi \quad \text{... (i)}$$

also, $\quad \lambda = \frac{v}{n} \qquad \text{... }(ii)$

now, from Eqs.(i)and (ii), we get

$$\Delta x = \frac{v}{2\pi n} \times \Delta\phi$$

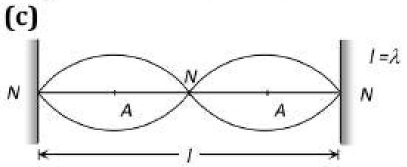
$$\Rightarrow \quad \Delta x = \frac{330}{2\pi \times 50} \times \frac{\pi}{3}$$

Or $\Delta x = 1.1$m

752 **(a)**

In an open organ pipe, both ends of the pipe are open. There are pressure nodes (or displacement antinodes) at both ends. Oscillation from a harmonic series that includes all integral multiples of the fundamental frequency, i.e., all even and odd harmonics is present. Therefore, if fundamental frequency is n, then other frequencies are v, 2v, 3v, 4v.....

753 **(c)**



754 **(c)**

$$n \propto \sqrt{T}$$

755 **(d)**

For spherical wave intensity $(I) \propto \frac{1}{(\text{Distance } r)^2}$

also $I \propto a^2 \Rightarrow a \propto \frac{a}{r}$. Hence equation of a spherical wave is $y = \frac{a}{r}\sin(\omega t - kx)$

756 **(b)**

At the middle of pipe, node is formed

757 **(b)**

$$n' = n\left(\frac{v + v_O}{v - v_S}\right) = 240\left(\frac{340 + 20}{340 - 20}\right) = 270\ Hz$$

758 **(d)**

Higher pitch means higher frequency

Frequency of a stringed system is given by

$$n = \frac{p}{2l}\sqrt{\frac{T}{m}} \Rightarrow n \propto \frac{\sqrt{T}}{l}$$

Hence, to get higher frequency (higher pitch) tension should be increase and length should be shorten

759 **(c)**

Number of beats $s^{-1} = n_1 - n_2 = \frac{v}{3l} - \frac{v}{4(l+\Delta l)}$

$$= \frac{v}{l}\left[\frac{l + \Delta l - l}{l(l + \Delta l)}\right] = \frac{v\Delta l}{4l^2}$$

760 **(a)**

For shortest length of pipe mode of vibration must be fundamental

$$i.e., n = \frac{v}{4l} \Rightarrow l = \frac{v}{4n}$$

761 **(d)**

$$y = 0.021\sin(x + 30t) \Rightarrow v = \frac{\omega}{k} = \frac{30}{1} = 30\ m/s$$

Using, $v = \sqrt{\frac{T}{m}} \Rightarrow 30 = \sqrt{\frac{T}{1.3\times10^{-4}}} \Rightarrow T = 0.117\ N$

762 **(d)**

Fundamental frequency,

$$\mathrm{v} = \frac{1}{2\mathrm{l}}\sqrt{\frac{\mathrm{T}}{\mathrm{m}}} = \frac{1}{2\mathrm{l}}\sqrt{\frac{\mathrm{T}}{\pi \mathrm{r}^2\rho}}$$

or $\quad \mathrm{v} \propto \frac{1}{\mathrm{lr}}$

$$\therefore\ \frac{\mathrm{v}_1}{\mathrm{v}_2} = \frac{\mathrm{l}_2\mathrm{r}_2}{\mathrm{l}_1\mathrm{r}_1} = \frac{2\mathrm{L}\times\mathrm{r}}{\mathrm{L}\times 2\mathrm{r}} = 1$$

763 **(d)**

$A_{\max} = \sqrt{A^2 + A^2} = A\sqrt{2}$, frequency will remain same $i.e. \omega$

764 **(c)**

$$\text{Intensity} = \frac{\text{power}}{\text{area}} = \frac{400\pi}{4\pi\times10^2} = 1\ Watt/m^2$$

$$\text{Now } L = 10\log_{10}\frac{I}{I_0} = 10\log_{10}\left(\frac{1}{10^{-12}}\right)$$

$$= 10\log_{10}10^{12} = 120\ dB$$

765 **(b)**

Suppose N resonance occurred before tube coming out

Hence by using $l = \frac{(2N-1)v}{4n}$

$$\Rightarrow 1.5 = \frac{(2N-1)\times 330}{4\times 660} \Rightarrow N \approx 6$$

766 **(a)**

$y = y_1 + y_2 = a\sin(\omega t - kx) = a\sin(\omega t - kx)$

$y = 2a\sin\omega t\cos kx$

Clearly it is equation of standing wave for position of nodes y=0.

$$i.e., x = (2n+1)\frac{\lambda}{4}$$

$$\Longrightarrow \left(n + \frac{1}{2}\right)\lambda = 0,1,2,3$$

767 **(d)**

According to given information $5\lambda = 4 \Rightarrow \lambda = 0.8m$

So, frequency $v = \frac{v}{\lambda} = \frac{128}{0.8} = 160Hz$

and Angular frequency

$\omega = 2\pi v = 2\times 3.14\times 160 = 1005\ rad/s$

Also propagation constant $k = \frac{2\pi}{\lambda} = \frac{2\pi}{0.8} = 7.85\ m^{-1}$

On Putting these values in standard equation option (d) is correct

768 **(b)**

Only odd harmonics are present

769 **(a)**

Wave on a plucked string is stationary wave. Light waves are EM waves. Water waves are transverse as well as longitudinal

770 **(d)**

The amplitude of a plane progressive wave=a, that of a spherical progressive wave is a/r .

771 **(d)**

$$v = n\lambda \Rightarrow \lambda = \frac{v}{n} = \frac{330}{256} = 1.29m$$

772 **(d)**

Time of fall $= \sqrt{\frac{2h}{g}} = \sqrt{\frac{2\times10}{1000}} = \frac{1}{\sqrt{50}}$

In this time number of oscillations are eight.

So time for 1 oscillation $= \frac{1}{8\sqrt{50}}$

Frequency $= 8\sqrt{50}\ Hz = 56\ Hz$

773 **(a)**

Comparing with $y = (x,t) = a\sin(\omega t - kx)$

$$k = \frac{2\pi}{\lambda} = 0.01\pi \Rightarrow \lambda = 200\ m$$

774 **(c)**

As the string is vibrating in three segments, therefore,

$$l=\frac{3\lambda}{2} \text{ or } \lambda=\frac{2l}{3}=\frac{2(0.6)}{3}=0.4\text{m}$$

As $v=\sqrt{\frac{T}{m}}$ $\therefore v=\sqrt{\frac{80}{0.2}}=20\text{ms}^{-1}$

$$n=\frac{v}{\lambda}=\frac{20}{0.4}=50\text{Hz}$$

Amplitude of particle velocity

$$=\left(\frac{dy}{dt}\right)_{\max}=(a_{\max})\omega=a_{\max}(2\pi n)$$

$$(0.5\times10^{-2})\times 2\pi\times 50=1.57\text{ms}^{-1}$$

775 **(b)**
In stationary wave all the particles in one particular segment (*i.e.*, between two nodes) vibrates in the same phase

776 **(c)**
Distance between modes
$\frac{\lambda}{2}=5$ cm
$\therefore \lambda=10$ cm$=0.1$n
$\therefore$ Frequency $\text{v}=\frac{\text{v}}{\lambda}=\frac{2}{0.1}=20\text{Hz}$

777 **(d)**
In a resonance tube, water works as a reflector and the resonance frequency is independent of the substance (liquid) which is filled in the tube.

778 **(a)**
$n\propto\sqrt{T}$

779 **(a)**
$$y=0.02\sin\left[2\pi\left(\frac{t}{0.04}-\frac{x}{0.50}\right)\right]$$
$$v=\sqrt{\frac{T}{m}}=\frac{\omega}{k}\Rightarrow\sqrt{\frac{T}{0.04}}=\frac{\frac{1}{0.04}}{\frac{1}{0.50}}$$
$$T=\left(\frac{0.50}{0.04}\right)^2\times0.04=(12.5)^2\times0.04$$
$$=6.25\text{ Newton}$$

780 **(c)**
Frequencies of tuning forks is given by
$n_{\text{last}}=n_{\text{first}}+(N-1)x$
$2n=n+(50-1)\times4\Rightarrow n=196Hz$

781 **(a)**
Persistence of hearing is $\frac{1}{10}s$

782 **(a)**
There are four beats between P and Q, therefore the possible frequencies of P or 254 (that is $250\pm$ 4)Hz. When the prong of P is field, its frequency become greater than the original frequency.
If we assume that the original frequency of P is 254, then on filing its frequency will be greater than 254. The beats between P and Q will be more than 4. But it is given that the beats are reduced to 2, therefore, 254 is not possible. Therefore, the required frequency must be 246 Hz.

784 **(b)**
From the given equation $\omega_1=2\pi n_1=646\pi\Rightarrow$ $n_1=323$
And $\omega_2=2\pi n_2=652\pi\Rightarrow n_2=326$
Hence, beat frequency $=326-323=3$

785 **(b)**
The equation of wave travelling along y-axis is
$x=A\sin(ky-\omega t)$

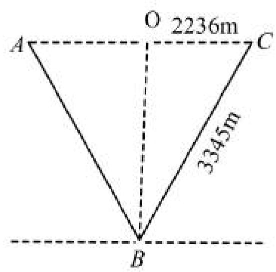
786 **(c)**
By using
$$n'=\left(\frac{v}{v-v_S}\right)\Rightarrow 2n=n\left(\frac{v}{v-v_S}\right)\Rightarrow v_S=\frac{v}{2}$$

787 **(a)**
$$v=\sqrt{\frac{T}{m}}=\sqrt{\frac{500}{0.2}}=50\text{ms}^{-1}$$

788 **(d)**
Energy density of wave is given by
$u=2\pi^2n^2\rho a^2$
Or $u\propto a^2$ (as n and ρ are consants)
$$\therefore\frac{u_1}{u_2}=\frac{a_1^2}{a_2^2}=\frac{5^2}{2^2}$$
So, $u_1:u_2=25:4$

790 **(c)**
All particles between one pair of consecutive nodal points are in phase which is opposite to that of the particles between the preceding of succeeding pair. Thus all alternate antinodes vibrate in phase

791 **(d)**
From the figure sound travel ABC



Given, time for the echo=$10\sqrt{5}s$
Velocity of the plane=$200ms^{-1}$
Hence,
$OC = 200 \times 5\sqrt{5} = 2236\ m$
BC =velocity of sound $\times 5\sqrt{5}$
$\Rightarrow BC = 300 \times 5\sqrt{5} = 3354\ m$
$\therefore OB = \sqrt{BC^2 - OC^2}$
OB=2500m
The plane is 2500 m above the ground.

792 **(b)**
Intensity of waves $I = \frac{1}{2}\ p\omega^2 A^2 v$
Here p=density of medium
A=amplitude
ω=angular frequency and
v=velocity of wave
Intensity depends upon amplitude, frequency and waves velocity of the wave.
also, $I_1 = I_2$

793 **(d)**
Velocity of sound in steel is maximum out of the given materials water and air. In vacuum sound cannot travel, it's speed is zero

794 **(d)**
Observer receives sound waves (music) which are longitudinal progressive waves

795 **(a)**
Since,
$\frac{720}{1200} = \frac{6}{10} = \frac{3}{5}, i.e., 3:5$
Odd harmonics are produced only if the pipe is closed at one end.

796 **(d)**
Points B and F are in same phase as they are λ distance apart

797 **(d)**
$$n = \frac{1}{2l}\sqrt{\frac{T}{m}} \Rightarrow \frac{n_1}{n_2} = \frac{l_2}{l_1}\sqrt{\frac{T_1}{T_2}} = \frac{1}{4}\sqrt{\frac{1}{4}} = \frac{1}{8}$$
$\Rightarrow n_2 = 8n_1 = 8 \times 200 = 1600Hz$

798 **(a)**
The fundamental frequency is
$$f = \frac{1}{2L} = \sqrt{\frac{T}{\mu}}$$
$$f = \frac{1}{2L} = \sqrt{\frac{T}{\rho\pi\frac{d^2}{4}}} = \frac{1}{LD}\sqrt{\frac{T}{\pi\rho}}$$
$$\therefore f \propto \frac{1}{LD}$$

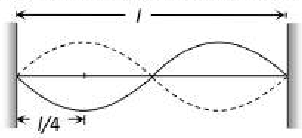
799 **(c)**
$n_{\text{closed}} = \frac{v}{4l}, n_{\text{open}} = \frac{v}{2l} \Rightarrow n_{\text{open}} = 2n_{\text{closed}} = 2f$

800 **(a)**
The time interval between successive maximum intensities will be
$\frac{1}{n_1 \sim n_2} = \frac{1}{454 - 450} = \frac{1}{4}\text{sec}$

801 **(d)**
Sound waves are longitudinal in nature so they can not be polarised

802 **(a)**
Ultrasonic waves are produced by piezoelectric effect.

804 **(a)**
Second harmonic means 2 loops in a total length



Hence plucking distance from one end
$= \frac{l}{2p} = \frac{l}{2 \times 2} = \frac{l}{4}$

805 **(a)**
We Doppler phenomena is related with frequency. So option (a) is correct.

806 **(b)**
n_A = Known frequency = $288\ cps, n_B = ?$
$x = 4\ bps$, which is decreasing (from 4 to 2) after loading $i.e.\ x \downarrow$
Unknown fork is loaded so $n_B \downarrow$
Hence $n_A - n_B \downarrow = x \downarrow\ \rightarrow$ Wrong
$n_B \downarrow - n_A \downarrow = x \downarrow \rightarrow$ Correct
$\Rightarrow n_B = n_A + x = 288 + 4 = 292\ Hz$

807 **(a)**
$$n \propto \frac{1}{l} \Rightarrow \frac{l_2}{l_1} = \frac{n_1}{n_2} \Rightarrow l_2 = l_1\left(\frac{n_1}{n_2}\right) = 50 \times \frac{270}{1000}$$
$$= 13.5cm$$

808 **(b)**
The given equations of waves be written as
$y_1 = 0.25\sin(310t)$ ... (i)
And $y_2 = 0.25\sin(316t)$ ... (ii)
Comparing Eqs. (i) and (ii) with the standard wave equation, written as
$y = a\sin(\omega t)$ ... (iii)
We have, $\omega_1 = 310$
$\Rightarrow v_1 = \frac{310}{2\pi}$ unit
And $\omega_2 = 316$
$\Rightarrow v_2 = \frac{316}{2\pi}$ unit

Hence, beat frequency$=v_2 - v_1$

$= \frac{316}{2\pi} - \frac{310}{2\pi} = 3\pi$ unit

809 **(a)**

When a listener moves towards a stationary source apparent frequency

$n' = \left(\frac{v+v_O}{v}\right) n = 200$ ...(i)

When listener moves away from the same source

$n'' = \frac{(v-v_O)}{v} n = 160$ ...(ii)

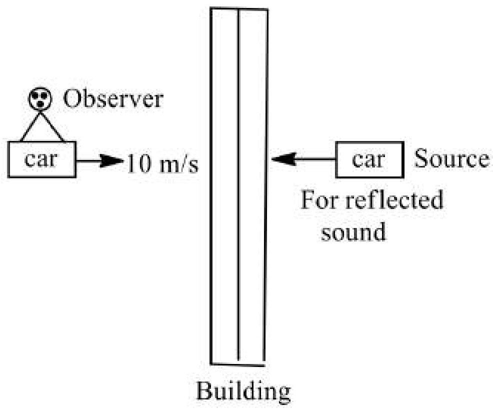
From (i) and (ii)

$\frac{v+v_O}{v-v_O} = \frac{200}{160} \Rightarrow \frac{v+v_O}{v-v_O} = \frac{5}{4} \Rightarrow v = 360 m/sec$

810 **(a)**

36 km/h$= 36 \times \frac{5}{18}$

$=10$m/s



Apart frequency of sound heard by car driver (observer)

$f' = f\left(\frac{v+v_o}{v-v_s}\right)$

$= 8\left(\frac{320+10}{320-10}\right)$

$f' = 8.5\ kHz$

WAVES

Assertion - Reasoning Type

This section contain(s) 0 questions numbered 1 to 0. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1

b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1

c) Statement 1 is True, Statement 2 is False

d) Statement 1 is False, Statement 2 is True

1

Statement 1: A tuning fork is in resonance with a closed pipe. But the same tuning fork cannot be in resonance with an open pipe of the same length.

Statement 2: The same tuning fork will not be in resonance with open pipe of same length due to end correction of pipe.

2

Statement 1: Sound waves cannot propagate through vacuum but light waves can

Statement 2: Sound waves cannot be polarised but light waves can be polarised

3

Statement 1: The change in air pressure effect the speed of sound

Statement 2: The speed of sound in a gas is proportional to square root of pressure

4

Statement 1: It is not possible to have interference between the waves produced by two violins

Statement 2: For interference of two waves the phase difference between the waves must remain constant

5

Statement 1: In a stationary wave, there is not transfer of energy.

Statement 2: There is no outward motion of the disturbance from one particle to adjoining particle in a stationary wave.

6

Statement 1: In the case of a stationary wave, a person hear a loud sound at the nodes as compared to the antinodes

Statement 2: In a stationary wave all the particles of the medium vibrate in phase

7

Statement 1: When two waves each of amplitude a produce a resultant wave of amplitude$a$, the phase difference between them must be 120^0.

Statement 2: If follows from R= $\sqrt{a^2 + b^2 + 2ab\cos\phi}$.

8

Statement 1: A wave of frequency 500 Hz is propagating with a velocity of350ms^{-1}. Ditance between two particles with 60^0 phase difference is 12 cm.

Statement 2: $x = \frac{\lambda}{2\pi}\phi$.

9

Statement 1: Transverse waves travel through air in an organ pipe

Statement 2: Air possesses only volume elasticity

10

Statement 1: The reverberation time dependent on the shape of enclosure, position of source and observer

Statement 2: The unit of absorption coefficient in mks system is metric sabine

11

Statement 1: The basic of Laplace correction was that, exchange of heat between the region of compression and rarefaction in air is not possible

Statement 2: Air is a bad conductor of heat and velocity of sound in air is large

12

Statement 1: On a rainy day sound travels slower than on a dry day

Statement 2: When moisture is present in air the density of air increases

13

Statement 1: Under given conditions of pressure and temperature, sound travels faster in a monoatomic gas than in the diatomic gas.

Statement 2: Opposition to travel is more in diatomic gas than in monoatomic gas.

14

Statement 1: Sound produced by an open organ pipe is richer than the sound produced by a closed organ pipe

Statement 2: Outside air can enter the pipe from both ends, in case of open organ pipe

15

Statement 1: Transverse waves are not Produced in liquids and gases.

Statement 2: Light waves are transverse waves.

16

Statement 1: Where two vibrating tuning forks having frequencies 256 Hz and 512 hz are held near each other, beats cannot be heard

Statement 2: The principle of superposition is valid only if the frequencies of the oscillators are nearly equal

17

Statement 1: A tuning fork is made of an alloy of steel, nickel and chromium

Statement 2: The alloy of steel, nickel and chromium is called elinvar

18

Statement 1: A tuning fork produces 4 beats s^{-1} with 49 cm lengths of a stretched sonometer wire. The frequency of fork is 396 Hz.

Statement 2: $n = 4\,(49 + 50) = 396$ Hz.

19

Statement 1: Solids can support both longitudinal and transverse waves, but only longitudinal waves can propagate in gases.

Statement 2: Solids possess two types of elasticity.

20

Statement 1: Quality of sound depends on number and frequency of overtones produced by the instrument.

Statement 2: Pitch of sound depends on frequency of the source.

21

Statement 1: The change in air pressure effects the speed of sound

Statement 2: The speed of sound in gases is proportional to the square of pressure

22

Statement 1: The flash of lightening is seen before the sound of thunder is heard

Statement 2: Speed of sound is greater than speed of light

23

Statement 1: Like sound, light can not propagate in vacuum

Statement 2: Sound is a square wave. It propagates in a medium by a virtue of damping oscillation

24

Statement 1: After Laplace correction for Newton's formula for finding the speed of sound in gases, we find

Statement 2: Laplace replace p by yp in the relation v=$\frac{\sqrt{p}}{p}$

25

Statement 1: If speed of sound in a gas is$336.6 ms^{-1}$, number of beat s^{-1} by 2 waves of length 1m and 1.01m is 3.

Statement 2: Using the relation $v = n\lambda$

26

Statement 1: Two persons on the surface of moon cannot talk to each other

Statement 2: There is no atmosphere on moon

27

Statement 1: Displacements produced by two waves at a point are$y_1 = a\sin\omega t$, $y_2 = a sin\left(\omega t + \frac{\pi}{2}\right)$. The resultant amplitude is$a\sqrt{2}$.

Statement 2: $R = \sqrt{a^2 + b^2 + 2ab\cos\pi/2}$

28

Statement 1: The sound of train coming from some distance can be easily detected by placing our ears near the rails.

Statement 2: Sound travels faster in air than solids.

29

Statement 1: Particle velocity and wave velocity both are independent of time

Statement 2: For the propagation of wave motion, the medium must have the properties of elasticity and inertia

30

Statement 1: Violet shift indicates that a star is approaching the earth.

Statement 2: Violet shift indicates decrease in apparent wavelength of light.

31

Statement 1: When a beetle moves along the sand with in a few tens of centimeters of a sand scorpion the scorpion immediately turn towards the beetle and dashes to it

Statement 2: When a beetle disturbs the sand, it sends pulses along the sands surface one set of pulses is longitudinal while other set is transverse

32

Statement 1: Speed of wave $= \frac{\text{Wave length}}{\text{Time period}}$

Statement 2: Wavelength is the distance between two nearest particles in phase

33

Statement 1: The equation of a stationary wave is $y = 20 sin\frac{\pi x}{4}\cos\omega t$.the distance between two consecutive antinodes will be 4m.

Statement 2: The data is insufficient

WAVES

: ANSWER KEY :

1)	c	2)	b	3)	d	4)	a	21)	d	22)	c	23)	d	24)	a
5)	b	6)	c	7)	a	8)	a	25)	a	26)	a	27)	a	28)	c
9)	d	10)	d	11)	a	12)	d	29)	d	30)	b	31)	a	32)	b
13)	c	14)	b	15)	b	16)	c	33)	c						
17)	b	18)	a	19)	b	20)	b								

WAVES

: HINTS AND SOLUTIONS :

1 **(c)**
If a closed pipe of length L is in resonance with a tuning fork of frequency v, then

$$v = \frac{v}{4L}$$

An open pipe of some length l produces vibrations of

Frequency $\frac{v}{2L}$. Obviously, it cannot be in reasonance

With the be given tuning fork of frequency $v\left(=\frac{v}{4l}\right)$.

2 **(b)**
Sound waves cannot propagate through vacuum because sound waves are mechanical waves. Light waves can propagate through vacuum because light waves are electromagnetic waves. Since sound waves are longitudinal waves, the particles moves in the direction of propagation, therefore these waves cannot be polarised

3 **(d)**
Speed of sound is independent of pressure because $v = \sqrt{\frac{\gamma P}{\rho}}$. At constant temperature, if P changes then ρ also changes in such a way that the ratio $\frac{P}{\rho}$ remains constant hence there is no effect of the pressure change on the speed of sound

4 **(a)**
Since the initial phase difference between the two waves coming from different violins changes, therefore, the waves produced by two different violins does not interfere because two waves interfere only when the phase difference between them remain constant throughout

5 **(b)**
In stationery wave, total energy associated with it is twice the energy of each of incidence and reflected wave.

Large amount of energy are stored equally in standing waves and become trapped with the waves. Hence, there is no transmission of energy through the waves.

6 **(c)**
The person will hear the loud sound at nodes than at antinodes. We know that at anti-nodes the displacement is maximum and pressure change is minimum while at nodes the displacement is zero and pressure change is maximum. The sound is heard due to vibration of pressure.

Also in stationary waves particles in two different segment vibrates in opposite phase

7 **(a)**
When $b = a$, then from

$$R = \sqrt{a^2 + b^2 + 2ab\cos\phi}$$

$$a^2 = a^2 + a^2 + 2a\,a\,\cos\phi = 2a^2(1+\cos\phi)$$

$$1 + \cos\phi = \frac{1}{2}$$

$$\cos\phi = \frac{1}{2} - 1 = \frac{1}{2}, \phi = 120°$$

The assertion and reason, both are true and reason is correct explanation of the assertion.

8 **(a)**

$$\lambda = \frac{v}{n} = \frac{350}{500} = 0.7 \text{ m}$$

$$\phi = 60° = 60 \times \frac{\pi}{180} = \frac{\pi}{3} \text{ rad}$$

As $x = \frac{\lambda}{2\pi}\phi$

$$\therefore x = \frac{0.7}{2\pi} \times \left[\frac{60\pi}{180}\right] = 0.12\text{m} = 12\text{cm}$$

9 **(d)**
Since transverse wave can propagate through medium which posses elasticity of shape. Air posses only volume elasticity therefore transverse wave cannot propagate through air

11 **(a)**
According to Laplace, the changes in pressure and volume of a gas, when sound waves propagated through it, are not isothermal, but adiabatic. A gas is a bad conductor of heat. It does not allow the free exchange of heat between compressed layer, rarefied layer and surrounding

12 **(d)**
When moisture is present in air, the density of air decreases. It is because the density of water vapours is less than that of dry air. The velocity of sound is inversely proportional to the square root of density, hence sound travel faster in moist air than in the dry air. Therefore, on a rainy day sound travels faster than on a dry day

13 **(c)**
The correct formula for velocity of sound in a gas is $v = \sqrt{\frac{\gamma p}{\rho}}$

For monoatomic gas, $\gamma = 1.67$;

For diatomic gas$\gamma = 1.40$.

$\therefore$ v is larger in case of monoatomic gas compared to its value in diatomic gas.

14 **(b)**
Sound produced by an open organ pipe is richer because it contains all harmonics and frequency of fundamental note in an open organ pipe is twice the fundamental frequency in a closed organ pipe of same length.

Reason is also correct, but it is not explaining the assertion

15 **(b)**
Transverse waves travel in the form of crest and troughs involving change in shape of the medium. As liquids and gases do not posses the rigidity therefore transverse waves cannot be produced in liquid and gases. Also light wave is one example of transverse wave.

16 **(c)**
The principle of superposition does not state that the frequencies of the oscillation should be nearly equal. For beats to be heard the condition is that difference in frequencies of the two oscillations should not be more than 10 times per seconds for a normal human ear to recognise it. Hence we cannot hear beats in the case of two tuning forks vibrating at frequencies 256 Hz and 512 Hz respectively

17 **(b)**
A tuning fork is made of a material for which elasticity does not change. Since the alloy of nickel, steel and chromium (elinvar) has constant elasticity, therefore it is used for the preparation of tuning fork

18 **(a)**
Let v be the frequency of fork.

$n_1 - n = 4$

And $n - n_2 = 4$ ....(i)

$\therefore n_1 - n_2 = 8$ ...(ii)

Also, $\frac{n_1}{n_2} = \frac{l_2}{l_1} = \frac{50}{49}$

$$\therefore n_1 = \frac{50}{49}n_2$$

From (ii), $\frac{50}{49}n_2 - n_2 = 8, \frac{1}{49}n_2 = 8$

$n_2 = 49 \times 8 = 392.$

From (i), $n = 4 + n_2 = 4 + 392 = 396$ Hz

Choice (a) is correct.

20 **(b)**
The Assertion is true, and the Reason is also true. But the Reason given is no explanation for the Assertion.

21 **(d)**
The speed of sound in gaseous medium is given by

$v=\sqrt{\frac{\gamma p}{\rho}}$ ...(i)

At constant temperature

pV = constant ...(ii)

If V is the volume of one mole of a gas, then density of gas

$\rho=\frac{M}{V}$ or $V=\frac{M}{\rho}$

Where M is the molecular weight of the gas.

$\therefore$ Eq. (ii) becomes

$\frac{pM}{\rho}$ = constant

or $\frac{p}{\rho}$ = constant as M is a constant

Therefore, from Eq. (i), we have

v = constant $\times\sqrt{\gamma}$

Thus, change in air pressure does not effect the speed of sound.

Reason is clear from Eq. (i)

22 **(c)**
Speed of light is greater than that of sound, hence flash of lightening is seen before the sound of thunder

24 **(a)**
According to Newton, speed of sound in gases,

$V=\sqrt{\frac{K_{iso}}{p}}=\sqrt{\frac{p}{p}}$

Laplace pointed out that since the changes taking place in the gases due to the propagation of sound cannot be isothermal but are adiabatic in nature, he corrected the Newton's formula accordingly ie,

$V=\sqrt{\frac{K_{adia}}{p}}=\sqrt{\frac{\gamma p}{p}}$

25 **(a)**
Number of beats $s^{-1}m=n_1-n_2$

$=\frac{v}{\lambda_1}-\frac{v}{\lambda_2}=v\left[\frac{1}{\lambda_1}-\frac{1}{\lambda_2}\right]$

$=336.6\left[\frac{1}{1}-\frac{1}{1.01}\right]=3$

26 **(a)**
Sound waves require material medium to travel. As there is no atmosphere (vacuum) on the surface of moon, therefore of sound waves cannot reach from one person to another

27 **(a)**
Equations show that the phase difference between two waves $\phi=\pi/2$

$\therefore$ From $R=\sqrt{a^2+b^2+2ab\ \cos\pi/2}$

$=\sqrt{a^2+a^2+2a^2\cos 90°}$

$=\sqrt{2a^2}=a\sqrt{2}$

Both the assertion and reason are true and reason is correct explanation of the assertion.

28 **(c)**
It is clear fact that sounds has greater speed in solid then in air. Hence, when ear is placed on the rails the sound of train coming from some distance is heard Hence, Assertion is true and Reason is false.

29 **(d)**
The velocity of every oscillating particle of the medium is different positions in one oscillation but the velocity of wave motion is always constant $i.e$, particle velocity vary with respect to time, while the wave velocity is independent of time.

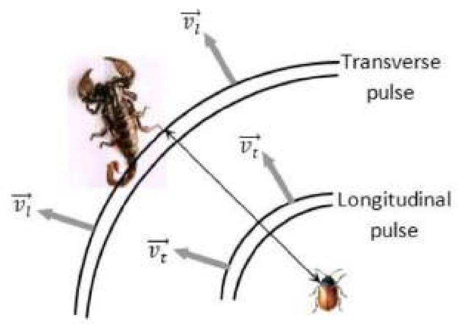
Also for wave propagation medium must have the properties of elasticity and inertia

30 **(b)**
As $\lambda_v<\lambda_r$

$\therefore$ Violet shift means apparent wavelength of light form a star decreases. Obviously, apparent frequency increases. This would happen when the star is approaching the earth. Thus the Reason, though correct, is not a correct explanation of Assertion

31 **(a)**

A beetle motion sends fast longitudinal pulses and slower transverse waves along the sends surface. The send scorpion first intercept the longitudinal pulses and learns the direction of the beetle; it is in the direction of which ever leg is disturbed earliest by the pulses. The scorpion then senses the time interval (Δt) between that first interception and the interception of slower transverse waves and uses it to determine the distance of the beetle. The distance is given by $\Delta t = \frac{d}{v_t} - \frac{d}{v_l}$



32 **(b)**

$$\text{Velocity of wave} = \frac{\text{Distance travelled by wave } (\lambda)}{\text{Time period } (T)}$$

Wavelength is also defined as the distance between two nearest points in phase

33 **(c)**

The equation of stationary waves is

$$y = 20 \sin \frac{\pi x}{4} \cos \omega t$$

Compare with $y = 2a \sin Kx \cos \omega t$

$$K = \frac{\pi}{4}\ As\ \lambda = \frac{2\pi}{K}$$

$$\therefore \lambda = \frac{2\pi}{\pi/4} = 8\text{m}$$

Distance between two consecutive antinodes

$$= \frac{\lambda}{2} = \frac{8}{2} = 4\text{m}$$

Assertion is true. The data is sufficient.

Reason is false.

WAVES

Matrix-Match Type

This section contain(s) 0 question(s). Each question contains Statements given in 2 columns which have to be matched. Statements (A, B, C, D) in **columns I** have to be matched with Statements (p, q, r, s) in **columns II.**

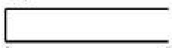
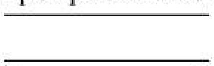
1. Each of the properties of sound in list I primarily depends on one of the quantities in List II. Select the correct answer (matching List I with List II) as per code given below the lists.

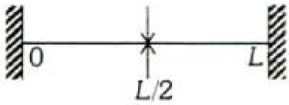
Column-I	Column- II
(A) Loudness	(1) Waveform
(B) Pitch	(2) Frequency
(C) Quality	(3) Intensity

CODES :

	A	**B**	**C**	**D**
a)	1	2	3	
b)	3	2	1	
c)	2	3	1	
d)	2	1	3	

2. Column I shows four systems, each of the same length L, for producing standing waves. The lowest possible natural frequency of a system is called its fundamental frequency, whose wavelength is denoted as λ_f. Match each system with statements given in Column II describing the nature and wavelength of the standing waves

Column-I	Column- II
(A) Pipe closed at one end  0 L	(p) Longitudinal waves A
(B) Pipe open at both ends  0 L	(q) Transverse waves
(C) Stretched wire clamped at both ends 	(r) $\lambda_f = L$
(D) Stretched wire clamped at both ends and at mid-point	(s) $\lambda_f = 2L$



(t) $\lambda_f = 4L$

CODES :

	A	**B**	**C**	**D**
a)	P,t	p,s	q,s	q,r
b)	p,s	p,t	q,r	q,s
c)	q,s	p,s	p,t	q,r
d)	q,r	q,s	p,s	p,t

WAVES

: ANSWER KEY :

1)	b	2)	a

WAVES

: HINTS AND SOLUTIONS :

1 **(b)**

The loudness that we sense is related to the intensity of the sound though it is not directly proportional.

A sound of high pitch is said to be shrill and its frequency is high. A sound of low pitch is said to be grave and its frequency is low.

The quality of sound is given by waveform.

2 **(a)**

(A) $\frac{\lambda}{4} = L, \lambda = 4L,$

Sound waves are longitudinal waves

(B) $\frac{\lambda}{2} = L, \lambda = 2L$

Sound waves are longitudinal waves

(C) $\frac{\lambda}{2} = L, \lambda = 2L$

String waves are transverse waves

(D) $\lambda = L$

String waves are transverse waves