Exercise - I (Conceptual Questions) Build Up Your Understanding

WAVE AND ITS CHARACTERISTICS

1. Water waves are of the nature :
(1) Transverse
(2) Longitudinal
(3) Sometimes longitudinal and sometimes transverse and longitudinal both
(4) Neither transverse nor longitudinal

PWA001

2. Sound wave are not polarized because :
(1) Their speed is less
(2) A medium is needed for their propagation
(3) These are longitudinal
(4) Their speed depends on temperature

PWA002

3. A thunder tap is heard 5.5 second after the lightening flash. The distance of the flash is (velocity of sound in air is 330 m/sec.): -
(1) 3560 m (2) 300 m
(3) 1780 m (4) 1815 m

PWA003

4. Transverse waves can propagate
(1) only in solids
(2) both in solids and gases
(3) neither in solids nor in gases
(4) only in gases

PWA004

5. Transverse elastic waves can be propagate in
(1) Both solid & gas
(2) In solid but not gas
(3) Neither solid nor gas
(4) None

PWA005

6. A wave of frequency 500 Hz travels between X and Y and travel a distance of 600 m in 2 sec. between X and Y. How many wavelength are there in distance XY :
(1) 1000 (2) 300 (3) 180 (4) 2000

PWA006

7. If at a place the speed of a sound wave of frequency 300 Hz is V, the speed of another wave of frequency 150 Hz at the same place will be:
(1) V (2) V/2 (3) 2V (4) 4V

PWA007

8. The equation of a progressive wave for a wire is: $Y = 4\sin\left[\frac{\pi}{2}\left(8t - \frac{x}{8}\right)\right]$. If x and y are measured in cm then velocity of wave is :
(1) 64 cm/s along – x direction
(2) 32 cm/s along – x direction
(3) 32 cm/s along + x direction
(4) 64 cm/s along + x direction

PWA008

9. The equation of progressive wave is $Y = 4\sin\left\{\pi\left(\frac{t}{5} - \frac{x}{9}\right) + \frac{\pi}{6}\right\}$ where x and y are in cm. Which of the following statement is true?
(1) λ = 18 cm
(2) amplitude = 0.04 cm
(3) velocity v = 50 cm/s
(4) frequency f = 20 Hz

PWA009

10. A plane progressive wave is represented by the equation $y = 0.25 \cos(2\pi t - 2\pi x)$.
The equation of a wave is with double the amplitude and half frequency but travelling in the opposite direction will be.
(1) $y = 0.5 \cos(\pi t - \pi x)$
(2) $y = 0.5 \cos(2\pi t + 2\pi x)$
(3) $y = 0.25 \cos(\pi t + 2\pi x)$
(4) $y = 0.5 \cos(\pi t + \pi x)$

PWA010

11. 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
(1) 30 (2) $\frac{3\pi}{2}$ (3) 3/4 (4) 40

PWA011

12. The equation $y = 4 + 2\sin(6t - 3x)$ represents a wave motion with
(1) amplitude 6 units
(2) amplitude 4 units
(3) wave speed 2 units
(4) wave speed 1/2 units

PWA012

13. Due to propagation of longitudinal wave in a medium, the following quantities also propagate in the same direction :
(1) Energy, Momentum and Mass
(2) Energy
(3) Energy and Mass
(4) Energy and Linear Momentum

PWA013

14. The waves in which the particles of the medium vibrate in a direction perpendicular to the direction of wave motion is known as :
(1) transverse waves
(2) propagated waves
(3) longitudinal waves
(4) stationary waves

PWA014

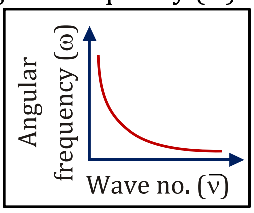
15. Two wave are represented by equation
$y_1 = a \sin \omega t$ $\quad y_2 = a \cos \omega t$
the first wave –
(1) leads the second by π
(2) lags the second by π
(3) leads the second by $\frac{\pi}{2}$
(4) lags the second by $\frac{\pi}{2}$

PWA015

16. The distance between two consecutive crests in a wave train produced in string is 5 m. If two complete waves pass through any point per second, the velocity of wave is
(1) 2.5 m/s (2) 5 m/s
(3) 10 m/s (4) 15 m/s

PWA016

17. The graph between wave number ($\bar{\nu}$) and angular frequency (ω) is :

(1)


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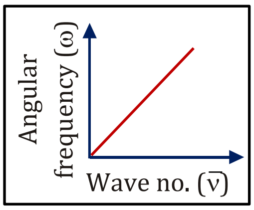

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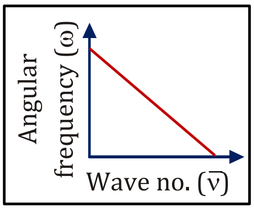
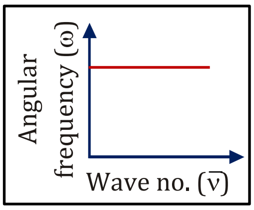


(4)


PWA017

18. The waves produced by a motorboat sailing on water are
(1) Transverse
(2) Longitudinal
(3) Longitudinal and Transverse
(4) Stationary

PWA018

PROGRESSIVE WAVE ON STRING

19. In a string the speed of wave is 10 m/s and its frequency is 100 Hz . The value of the phase difference at a distance 2.5 cm will be :
(1) $\pi/2$ (2) $\pi/8$ (3) $3\pi/2$ (4) 2π

PWA019

20. A uniform rope of mass 0.1 kg and length 2.5 m hangs from ceiling. The speed of transverse wave in the rope at upper end and at a point 0.5 m distance from lower end will be :
(1) 5 m/s, 2.24 m/s (2) 10 m/s, 3.23 m/s
(3) 7.5 m/s, 1.2 m/s (4) 2.25 m/s, 5 m/s

PWA020

21. The equation of a wave on a string of linear density 0.04 kg m^{-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 :
(1) 6.25 N (2) 4.0 N (3) 12.5 N (4) 0.5 N

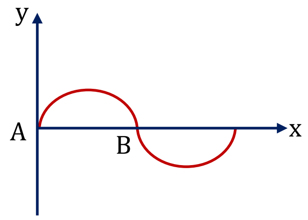
PWA021

22. The mathematical forms for three sinusoidal travelling waves are given by
Wave 1 : y(x,t) = (2cm) sin(3x–6t)
Wave 2 : y(x,t) = (3cm) sin(4x–12t)
Wave 3 : y(x,t) = (4cm) sin(5x–11t)
where x is in meters and t is in seconds. Of these waves :

(1) wave 1 has the greatest wave speed and the greatest maximum transverse string speed.
(2) wave 2 has the greatest wave speed and wave 1 has the greatest maximum transverse string speed.
(3) wave 3 has the greatest wave speed and the greatest maximum transverse string speed.
(4) wave 2 has the greatest wave speed and wave 3 has the greatest maximum transverse string speed.

PWA022

23. The figure shows an instantaneous profile of a rope carrying a progressive wave moving from left to right, then



(a) the phase at A is greater than the phase at B
(b) the phase at B is greater than the phase at A
(c) A is moving upwards
(d) B is moving upwards

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

PWA023

24. Linear density of a string is 1.3×10^{-4} kg/m and wave equation is $y = 0.021\sin(x + 30t)$. Find the tension in the string where x in meter, t in sec.

(1) 1.17×10^{-2} N (2) 1.17×10^{-1} N
(3) 1.17×10^{-3} N (4) None

PWA024

SOUND WAVES AND ITS CHARACTERISTICS

25. The speed of sound in air at constant temperature
(1) is proportional to the atmospheric pressure.
(2) is proportional to the square of atmospheric pressure.
(3) is proportional to the square root of atmospheric pressure
(4) does not depend on atmospheric pressure.

PWA025

26. At the room temperature the velocity of sound in O_2 gas is V. Then in mixture of H_2 and O_2 gas the speed of sound at same temperature:
(1) will be less than V (2) will be more than V
(3) will be equal to V (4) nothing can be said

PWA026

27. The velocity of sound in a gas depends
(1) only on its wave length
(2) on the density and the elasticity of gas
(3) on intensity of the sound
(4) on the amplitude and the frequency.

PWA027

28. If at some point the amplitude of the sound becomes double and the frequency becomes one fourth then at that point the intensity of sound will be :-
(1) Become double (2) Be half
(3) Become one fourth (4) Remain unchanged

PWA028

29. A sound is produced in water and moves towards surface of water and some sound moves in air velocity of sound in water is 1450 m/s and that in air is 330 m/s. When sound moves from water to air then the effect on frequency f and wave length λ will be:
(1) f and λ will remain same
(2) f will remain same but λ will increase
(3) f will remain same but λ will decrease
(4) f will increase and λ will decrease

PWA029

30. When sound wave travels from air to water, which are of the following remain constant :
(1) wavelength (2) velocity
(3) frequency (4) intensity

PWA030

31. Newton's formula for the velocity of sound in gases is :

(1) $v = \sqrt{\frac{2p}{\rho}}$ (2) $v = \sqrt{\frac{p}{\rho}}$

(3) $v = \sqrt{\frac{\rho}{p}}$ (4) $v = \frac{3}{2}\sqrt{\frac{p}{\rho}}$

PWA031

32. Intensity level of a sound of intensity I is 30 dB. The ratio I/I_0 is (I_0 is the threshold of hearing)

(1) 1000 (2) 3000 (3) 300 (4) 30

PWA032

33. If υ_m is the velocity of sound in moist air and υ_d is the velocity of sound in dry air then :

(1) $\upsilon_m < \upsilon_d$ (2) $\upsilon_m > \upsilon_d$
(3) $\upsilon_d >> \upsilon_m$ (4) $\upsilon_m = \upsilon_d$

PWA033

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

(1) V = ν if $A = \frac{\lambda}{2\pi}$

(2) V can not be equal to ν

(3) V = ν if $\lambda = \frac{3A}{2\pi}$

(4) V= ν if A = 2 πλ

PWA034

35. A sings with a frequency (n) and B sings with a frequency 1/8 that of A. If the energy remains the same and the amplitude of A is a, then amplitude of B will be :

(1) 2a (2) 8a (3) 4a (4) a

PWA035

36. The velocities of sound at the same pressure in two monoatomic gases of densities ρ_1 and ρ_2 are v_1 and v_2 respectively. If $\frac{\rho_1}{\rho_2} = 4$, then the value of $\frac{v_1}{v_2}$ is :

(1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) 2 (4) 4

PWA036

37. The time period of SHM of a particle is 12 s. The phase difference between the position at t = 3s and t = 4s will be :

(1) π/4 (2) 3π/5 (3) π/6 (4) π/2

PWA037

38. Velocity of sound in medium is V. If the density of the medium is doubled, what will be the new velocity of sound?

(1) $\sqrt{2}V$ (2) V (3) $V/\sqrt{2}$ (4) 2V

PWA038

REFLECTION OF WAVES AND ECHO

39. A man standing on a cliff claps his hand and hears its echo after one second. If the sound in reflected from another mountain then the distance between the man & reflection points is V_{sound} = 340 m/sec.

(1) 680 m (2) 340 m
(3) 170 m (4) 85 m

PWA039

PRINCIPLE OF SUPERPOSITION OF WAVES : INTERFERENCE, BEATS

40. At a particle two simple harmonic motion are acting along the same direction. These are $y_1 = a_1 \sin \omega t$ and $y_2 = a_2 \sin(\omega t + \phi)$. The resultant motion is also a simple harmonic motion whose amplitude will be:

(1) $a_1^2 + a_2^2 + 2a_1a_2\cos\phi$

(2) $\sqrt{a_1^2 + a_2^2 + 2a_1a_2\cos\phi}$

(3) $\sqrt{a_1^2 + a_2^2 - 2a_1a_2\cos\phi}$

(4) $a_1^2 + a_2^2 - 2a_1a_2\cos\phi$

PWA040

41. The energy in the superposition of waves: -

(1) Is lost
(2) Increase
(3) remain same, only redistribution occurs
(4) None of the above

PWA041

42. Waves from two sources superimpose on each other at a particular point. Amplitude and frequency of both the waves are equal. The ratio of intensities when both waves reach in the same phase and they reach with the phase difference of 90° will be

(1) 1:1 (2) $\sqrt{2}$:1 (3) 2:1 (4) 4:1

PWA042

43. Two waves whose intensity are same (I) move towards a point P in same phase, then the resultant intensity at point P will be:

(1) 4 I (2) 2 I (3) $\sqrt{2}$ I (4) None

PWA043

44. Ratio of amplitudes of two waves is 3:4. The ratio of maximum and minimum intensity obtained from them will be :

(1) 7:1 (2) 49:1 (3) 1:25 (4) 5:1

PWA044

45. Two coherent sources of intensities I_1 and I_2 produce an interference pattern, the maximum intensity in the interference pattern will be –

(1) $I_1 + I_2$ (2) $I_1^2 + I_2^2$

(3) $(I_1+I_2)^2$ (4) $\left(\sqrt{I_1}+\sqrt{I_2}\right)^2$

PWA045

46. Intensities ratio of two waves are 9:1 then the ratio of their maximum and minimum intensities will be:-

(1) 10 : 8 (2) 7 : 2 (3) 4 : 1 (4) 2 : 1

PWA046

47. When two tuning forks are sounded together x beats/sec are heard and frequency of A is n. Now when one prong of B is loaded with a little wax, the number of beats per second decreases. The frequency of fork B is :

(1) n + x (2) n – x

(3) $n - x^2$ (4) n – 2x

PWA047

48. A source x of unknown frequency produces 8 beats with a source of 250 Hz and 12 beats with a source of 270 Hz. The frequency of source x is:

(1) 258 Hz (2) 242 Hz

(3) 262 Hz (4) 282 Hz

PWA048

49. Two waves of wave length 2 m and 2.02 m respectively moving with the same velocity and superimpose to produce 2 beats per sec. The velocity of the waves is:

(1) 400.0 m/s (2) 402 m/s

(3) 404 m/s (4) 406 m/s

PWA049

50. A tuning fork produces 4 beats/sec. with another tuning fork B of frequency 288 Hz. If fork is loaded with little wax no. of beats per sec decreases. The frequency of the fork A, before loading is

(1) 290 Hz (2) 288 Hz

(3) 292 Hz (4) 284 Hz

PWA050

51.

	Column-I		Column-II
A	Longitudinal waves	P	Particles of the medium vibrate perpendicular to the wave propagation.
B	Transverse waves	Q	Two progressive waves of slightly different frequencies superimpose in the same direction
C	Beats	R	Two progressive waves of same frequency superimpose in the opposite directions
D	Stationary waves	S	Particles of the medium vibrate along the wave propagation.

(1) A-Q, B-R, C-Q, D-P (2) A-S, B-P, C-Q, D-R

(3) A-Q, B-S, C-P, D-R (4) A-P, B-Q, C-S, D-R

PWA051

52. What is the path difference for destructive interference?

(1) $n\lambda$ (2) $n(\lambda + 1)$

(3) $\frac{(n+1)\lambda}{2}$ (4) $\frac{(2n+1)\lambda}{2}$

PWA052

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

(1) 3 (2) 1 (3) 4 (4) 2

PWA053

54. What is the beat frequency produced when following two waves are sounded together?

$x_1 = 10 \sin (404\pi t - 5\pi x)$,

$x_2 = 10 \sin (400\pi t - 5\pi x)$.

(1) 4 (2) 1 (3) 3 (4) 2

PWA054

55. Two waves having equation

$x_1 = a \sin(\omega t + \phi_1)$ $x_2 = a \sin(\omega t + \phi_2)$

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

(1) $\frac{\pi}{6}$ (2) $\frac{2\pi}{3}$ (3) $\frac{3\pi}{4}$ (4) $\frac{\pi}{4}$

PWA055

56. Two sources have frequency 256 Hz and 258 Hz, then time difference between two consecutive maxima is –
(1) 1 s (2) 0·5 s (3) 2 ms (4) None
PWA056

57. Two vibrating tuning forks produce progressive waves given by $Y_1 = 4 \sin 500\pi t$ and $Y_2 = 2 \sin 506\pi t$. Number of beats produced per minute is:
(1) 3 (2) 360 (3) 180 (4) 60
PWA057

58. Two plane progressive waves shows destructive interference at point P. Which of the following statement is true at point P :-
(1) Crest of one wave is superimposed on crest of another wave
(2) Trough of one wave is superimposed on crest of another wave
(3) Intensity of resultant wave is equal to the intensity difference of two waves
(4) Resultant amplitude is equal to the amplitude sum of two waves
PWA058

STATIONARY WAVES OR STANDING WAVES IN STRINGS

59. A uniform string of length L and mass M is fixed at both ends under tension T, then it can vibrate with frequency given by the formula.
(1) $f = \frac{1}{2}\sqrt{\frac{T}{ML}}$ (2) $f = \frac{1}{2L}\sqrt{\frac{T}{M}}$
(3) $f = \frac{1}{2}\sqrt{\frac{T}{M}}$ (4) $f = \frac{1}{2}\sqrt{\frac{M}{LT}}$
PWA059

60. The speed of transverse waves in a stretched string is 700 cm/s. If the string is 2 m long, the frequency with which it resonates in fundamental mode is:
(1) (7/2) Hz (2) (7/4) Hz
(3) (14) Hz (4) (2/7) Hz
PWA060

61. A wave represented by the equation $y = a\cos(\omega t - kx)$ is superposed by another wave to form a stationary wave such that the point x = 0 is a node. The equation for other wave is –
(1) $y = a \sin(\omega t + kx)$ (2) $y = -a\cos(\omega t - kx)$
(3) $y = -a\cos(\omega t + kx)$ (4) $y = -a\sin(\omega t - kx)$
PWA061

62. A stretched string is vibrating according to the equation $y = 5\sin\left(\frac{\pi x}{2}\right)\cos 4\pi t$, where y and a are in cm and t is in sec. The distance between two consecutive nodes on the strings is :-
(1) 2 cm (2) 4 cm
(3) 8 cm (4) 16 cm
PWA062

63. A wave of frequency 100 Hz travels along a string towards its fixed end. When this wave travels back, after reflection, a node is formed at a distance of 10 cm from the fixed end. The speed of the wave (incident and reflected) is :
(1) 5 m/s (2) 10 m/s
(3) 20 m/s (4) 40 m/s
PWA063

64. Stationary wave is represented by Y = A sin (100 t) cos (0.01 x) where y and A are in mm, t in sec and x in m. The velocity of the wave:
(1) 1 m/s (2) 10^2 m/s
(3) 10^4 m/s (4) zero
PWA064

65. If the tension in a sonometer wire is increased by a factor of four then fundamental frequency of vibration changes by a factor of :
(1) 4 (2) (1/4)
(3) 2 (4) (1/2)
PWA065

66. A sonometer wire, with a suspended mass of M = 1 kg., is in resonance with a given tuning fork. The apparatus is taken to moon where the acceleration due to gravity is 1/6 that of earth. To obtain resonance on the moon, the value of M should be
(1) 1 kg. (2) $\sqrt{6}$ kg
(3) 6 kg (4) 36 kg
PWA066

67. Stationary waves are produced in 10m long stretched string. If the string vibrates in 5 segments and wave velocity is 20m/sec, then the frequency is-
(1) 10 Hz (2) 5 Hz
(3) 4 Hz (4) 2Hz
PWA067

68. A standing wave having 3 nodes and 2 antinodes is formed between 1.21 Å distance then the wavelength is
(1) 1.21 Å (2) 2.42 Å
(3) 0.605 Å (4) 4.84 Å
PWA068

69. A string under a tension of 129.6 N produces 10 beats/sec when it is vibrated along with a tuning fork. When the tension is the string is increased to 160 N it sounds in unison with same tuning fork. Calculate fundamental freq. of tuning fork.

(1) 100 Hz (2) 50 Hz
(3) 150 Hz (4) 200 Hz

PWA069

70. If vibrations of a string are to be increased to a factor of two, then tension in the string must be made :

(1) half (2) thrice
(3) four times (4) eight times

PWA070

71. Stationary waves are so called because in them –

(1) The particles of the medium are not disturbed at all
(2) The particles of the medium do not execute S.H. M.
(3) There occurs no flow of energy along the wave
(4) The interference effect can't be observed

PWA071

72. In a sonometer wire, the tension is maintained by suspending a mass M from free end of wire. The fundamental frequency of the wire is N Hz. If the suspended mass is completely immerged in water the fundamental frequency will

(1) increases (2) constant
(3) decrease (4) can't say

PWA072

73. A second harmonic has to generated in a string of length ℓ stretched between two rigid supports. The points where the string has to be plucked and touched are –

(1) Pluck at $\frac{\ell}{2}$ touch at $\frac{3\ell}{4}$
(2) Pluck at $\frac{\ell}{2}$ touch at $\frac{\ell}{4}$
(3) Pluck at $\frac{\ell}{4}$ touch at $\frac{3\ell}{4}$
(4) Pluck at $\frac{\ell}{4}$ touch at $\frac{\ell}{2}$

PWA073

74. If the tension and diameter of a sonometer wire of fundamental frequency (n) is doubled and density is halved then its fundamental frequency will become: -

(1) $\frac{n}{4}$ (2) $\sqrt{2}n$ (3) n (4) $\frac{n}{\sqrt{2}}$

PWA074

75. The tension in a piano wire is 10N. What should be the tension in the wire to produce a note of double the frequency?

(1) 10N (2) 20N (3) 40N (4) 80N

PWA075

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

(1) $n/\sqrt{3}$ (2) n/3
(3) $n\sqrt{3}$ (4) $n/3\sqrt{3}$

PWA076

77. 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, then required length of string is: -

(1) 62.5 cm (2) 50 cm
(3) 40 cm (4) 37.5

PWA077

78. Four wires of identical lengths, diameters and of the same material are stretched on a sonometer wire. The ratio of their tension is 1 : 4 : 9 : 16. The ratio of their fundamental frequencies is

(1) 1 : 2 : 3 : 4 (2) 16 : 9 : 4 : 1
(3) 1 : 4 : 9 : 16 (4) 4 : 3 : 2 : 1

PWA078

79. Given equation is related to

$$y = \cos\left(\frac{2\pi}{\lambda}x\right)\cos(2\pi\nu t)$$

(1) Transverse progressive
(2) Longitudinal progressive
(3) Longitudinal stationary wave
(4) Transverse stationary wave

PWA079

80. A stretched string is 1 m long. Its mass per unit length is 0.5 g/m. It is stretched with a force of 20 N. It plucked at a distance of 25 cm from one end. The frequency of note emitted by it will be:

(1) 400 Hz (2) 300 Hz
(3) 200 Hz (4) 100 Hz

PWA080

STATIONARY WAVE IN ORGAN PIPES

81. With the increase of temperature, the frequency of the organ pipe-
(1) increases (2) decreases
(3) remains unchanged (4) can not say
PWA081

82. An empty vessel is partially filled with water the frequency of vibration of air column in the vessel
(1) decreases
(2) increases
(3) depends on the purity of water
(4) remains the same
PWA082

83. The end correction of resonance tube is 1 cm. If lowest resonant length is 15 cm then next resonant length will be: -
(1) 36 cm (2) 45 cm
(3) 46 cm (4) 47 cm
PWA083

84. If the fundamental frequency for a COP is n, then the next three overtones will have ratio: -
(1) 2 : 3 : 4 (2) 3 : 4 : 5
(3) 3 : 7 : 11 (4) 3 : 5 : 7
PWA084

85. A tube closed at one end and containing air produces, when excited, the fundamental note of frequency 512 Hz. If the tube is open at both ends, the fundamental frequency that can be excited is (in Hz)
(1) 1024 (2) 512 (3) 256 (4) 128
PWA085

86. An air column in pipe, which is closed at one end will be in resonance with a vibrating tuning fork of frequency 264 Hz if the length of the column in cm is : [v = 330 m/s]
(1) 31.25 (2) 62.50 (3) 110 (4) 125
PWA086

87. Velocity of sound in air is 320 m/s. A pipe closed at one end has a length of 1 m neglecting end corrections, the air column in the pipe can resonant for sound of frequency.
(a) 80 Hz (b) 240 Hz
(c) 500 Hz (d) 400 Hz
(1) a (2) a,b (3) a,b,d (4) a,d
PWA087

88. The velocity of sound in air is 330 m/s. The fundamental frequency of an organ pipe open at both ends and of length 0.3 metre will be:
(1) 200 Hz (2) 550 Hz
(3) 300 Hz (4) 275 Hz
PWA088

89. An air column having one end closed contains minimum resonance length 50 cm. If it is vibrated by same tuning fork then its next resonance length will be –
(1) 250 cm (2) 200 cm
(3) 150 cm (4) 100 cm
PWA089

90. If the air column in a pipe which is closed at one end, is in resonance with a vibrating tuning fork of frequency 260 Hz, then the length of the air column is : (v_{sound} = 330 m/s)
(1) 35.7 cm (2) 31.7 cm
(3) 12.5 cm (4) 62.5 cm
PWA090

91. A sound wave of frequency 330Hz is incident normally at reflected wall then minimum distance from wall at which particle vibrate very much: - (V_{sound} = 330 m/s)
(1) 0.25 m (2) 0.125 m
(3) 1 m (4) 0.5 m
PWA091

92. An open organ pipe of length 33 cm, vibrates with frequency 1000 Hz. If velocity of sound is 330 m/s, then its frequency is: -
(1) Fundamental frequency
(2) First overtone of pipe
(3) Second overtone
(4) Fourth overtone
PWA092

93. If V is the speed of sound in air then the shortest length of the closed pipe which resonates to a frequency n :
(1) $\frac{V}{2n}$ (2) $\frac{V}{4n}$
(3) $\frac{4n}{V}$ (4) $\frac{2n}{V}$
PWA093

94. The lengths of two closed organ pipes are 0.750 m and 0.770 m. If they are sounded together, 3 beats per second are produced. The velocity of sound will be :-

(1) 350.5 m/sec (2) 335.5 m/sec
(3) 346.5 m/sec (4) None of these

PWA094

95. 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)

(1) 50 cm (2) 100 cm
(3) 75 cm (4) 25 cm

PWA095

96. An underwater sonar source operating at a frequency of 60 kHz directs its beam towards the surface. If velocity of sound in air is 330 m/s, wavelength and frequency of the waves in air are: -

(1) 5.5 mm, 60 kHz (2) 3.30 m, 60kHz
(3) 5.5 mm, 30 kHz (4) 5.5 mm, 80 kHz

PWA096

97. An organ pipe 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

(1) 14 (2) 13 (3) 6 (4) 9

PWA097

98. Length of the close organ pipe is 1 m. At which frequency resonance will not occur (v = 320 m/sec.)

(1) 80 Hz (2) 240 Hz
(3) 300 Hz (4) 400 Hz

PWA098

99. An open resonating tube has fundamental frequency of n. When half of its length is dipped into water, then its fundamental frequency will be:

(1) n (2) n/2
(3) 2n (4) 3/2 n.

PWA099

100. A pipe is closed from one end and open from another end then which statement is true?

(1) Node is formed slightly above the open end.
(2) Node is formed slightly below the open end.
(3) Antinode is formed slightly above the open end.
(4) Antinode formed slightly below the open end.

PWA100

EXERCISE-I (Conceptual Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	3	3	4	2	2	1	1	4	1	4	1	3	4	1	4
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	3	2	3	1	1	1	4	2	2	4	2	2	3	3	3
Question	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Answer	2	1	2	1	2	2	3	3	3	2	3	3	1	2	4
Question	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Answer	3	1	1	3	3	2	4	3	4	2	2	3	2	1	2
Question	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Answer	3	1	3	4	3	3	2	1	1	3	3	3	4	3	3
Question	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Answer	4	3	1	4	3	1	2	4	4	1	1	3	2	3	2
Question	91	92	93	94	95	96	97	98	99	100					
Answer	1	2	2	3	1	1	3	3	1	3					

Exercise - II (Previous Year Questions) AIPMT/NEET

AIPMT 2014

1. 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 given by :-

(1) $\frac{1}{n}=\frac{1}{n_1}+\frac{1}{n_2}+\frac{1}{n_3}$

(2) $\frac{1}{\sqrt{n}}=\frac{1}{\sqrt{n_1}}+\frac{1}{\sqrt{n_2}}+\frac{1}{\sqrt{n_3}}$

(3) $\sqrt{n}=\sqrt{n_1}+\sqrt{n_2}+\sqrt{n_3}$

(4) $n = n_1 + n_2 + n_3$

PWA137

2. The number of possible natural oscillations of air column in a pipe closed at one end of length 85 cm whose frequencies lie below 1250 Hz are: (velocity of sound = 340 ms^{-1})

(1) 4 (2) 5 (3) 7 (4) 6

PWA138

AIPMT 2015

3. The fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of organ pipe open at both the ends is :-

(1) 100 cm (2) 120 cm
(3) 140 cm (4) 80 cm

PWA139

RE-AIPMT-2015

4. A string is stretched between two fixed points separated by 75.0 cm. It is observed to have resonant frequencies of 420 Hz and 315 Hz. There are no other resonant frequencies between these two. The lowest resonant frequencies for this string is :-

(1) 105 Hz (2) 155 Hz
(3) 205 Hz (4) 10.5 Hz

PWA141

NEET-I 2016

5. A uniform rope of length L and mass m_1 hangs vertically from a rigid support. A block of mass m_2 is attached to the free end of the rope.

A transverse pulse of wavelength λ_1 is produced at the lower end of the rope. The wavelength of the pulse when it reaches the top of the rope is λ_2. The ratio λ_2/λ_1 is :

(1) $\sqrt{\frac{m_1}{m_2}}$ (2) $\sqrt{\frac{m_1+m_2}{m_2}}$

(3) $\sqrt{\frac{m_2}{m_1}}$ (4) $\sqrt{\frac{m_1+m_2}{m_1}}$

PWA143

6. An air column, closed at one end and open at the other, resonates with a tuning fork when the smallest length of the column is 50 cm. The next larger length of the column resonating with the same tuning fork is :

(1) 66.7 cm (2) 100 cm
(3) 150 cm (4) 200 cm

PWA144

NEET-II 2016

7. The second overtone of an open organ pipe has the same frequency as the first overtone of a closed pipe L metre long. The length of the open pipe will be

(1) $\frac{L}{2}$ (2) 4 L (3) L (4) 2 L

PWA145

8. Three sound waves of equal amplitudes have frequencies (n – 1), n, (n + 1). They superimpose to give beats. The number of beats produced per second will be :-

(1) 3 (2) 2 (3) 1 (4) 4

PWA146

NEET(UG) 2017

9. The two nearest harmonics of a tube closed at one end and open at other end are 220 Hz and 260 Hz. What is the fundamental frequency of the system?

(1) 20 Hz (2) 30 Hz
(3) 40 Hz (4) 10 Hz

PWA147

NEET(UG) 2018

10. A tuning fork is used to produce resonance in a glass tube. The length of the air column in this tube can be adjusted by a variable piston. At room temperature of 27°C two successive resonances are produced at 20 cm and 73 cm column length. If the frequency of the tuning fork is 320 Hz, the velocity of sound in air at 27°C is:-

(1) 330 m/s (2) 339 m/s
(3) 350 m/s (4) 300 m/s

PWA149

11. The fundamental frequency in an open organ pipe is equal to the third harmonic of a closed organ pipe. If the length of the closed organ pipe is 20 cm, the length of the open organ pipe is :-

(1) 13.2 cm (2) 8 cm
(3) 12.5 cm (4) 16 cm

PWA150

NEET(UG) 2019 (Odisha)

12. A tuning fork with frequency 800 Hz produces resonance in a resonance column tube with upper end open and lower end closed by water surface. Successive resonance are observed at length 9.75 cm, 31.25 cm and 52.75 cm. The speed of sound in air is :-

(1) 500 m/s (2) 156 m/s
(3) 344 m/s (4) 172 m/s

PWA151

NEET(UG) 2020

13. In a guitar, two strings A and B made of same material are slightly out of tune and produce beats of frequency 6 Hz. When tension in B is slightly decreased, the beat frequency increases to 7 Hz. If the frequency of A is 530 Hz, the original frequency of B will be:

(1) 537 Hz (2) 523 Hz
(3) 524 Hz (4) 536 Hz

PWA152

NEET(UG) 2020 (Covid-19)

14. The length of the string of a musical instrument is 90 cm and has a fundamental frequency of 120 Hz. Where should it be pressed to produce fundamental frequency of 180 Hz?

(1) 75 cm (2) 60 cm
(3) 45 cm (4) 80 cm

PWA153

NEET(UG) 2022

15. If the initial tension on a stretched string is doubled, then the ratio of the initial and final speeds of a transverse wave along the string is:

(1) $\sqrt{2}:1$ (2) $1:\sqrt{2}$
(3) 1 : 2 (4) 1 : 1

PWA172

RE-NEET(UG) 2022

16. An organ pipe filled with a gas at 27°C resonates at 400 Hz in its fundamental mode. If it is filled with the same gas at 90°C, the resonance frequency at the same mode will be :-

(1) 420 Hz (2) 440 Hz
(3) 484 Hz (4) 512 Hz

PWA173

NEET(UG) 2023

17. The ratio of frequencies of fundamental harmonic produced by an open pipe to that of closed pipe having the same length is :

(1) 2 : 1 (2) 1 : 3
(3) 3 : 1 (4) 1 : 2

PWA174

RE-NEET(UG) 2024

18. Interference pattern can be observed due to superposition of the following waves :

A. $y = a \sin \omega t$ B. $y = a \sin 2\omega t$
C. $y = a \sin (\omega t - \phi)$ D. $y = a \sin 3\omega t$

Choose the **correct** answer from the options given below :

(1) B and C (2) B and D
(3) A and C (4) A and B

PWA175

19. The displacement of a travelling wave is $y = C \sin \frac{2\pi}{\lambda}(at - x)$ where t is time, x is distance and λ is the wavelength, all in S.I. units. Then the frequency of the wave is :

(1) $\frac{2\pi\lambda}{a}$ (2) $\frac{2\pi a}{\lambda}$

(3) $\frac{\lambda}{a}$ (4) $\frac{a}{\lambda}$

PWA176

EXERCISE-II (Previous Year Questions) **ANSWER KEY**

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	1	4	2	1	2	3	4	2	1	2	1	3	3	2	2
Question	16	17	18	19											
Answer	2	1	3	4											

Exercise - III (Analytical Questions) Master Your Understanding

1. Given below are two statements:

Statement I : For same length but different gas COP fundamental frequency are different.

Statement II : For same length but different gas COP fundamental wavelength remains same.

In light of above statement choose the most **appropriate** answer from the options given below:

(1) Both statement I and statement II are correct.

(2) Statement I is correct and statement II is incorrect.

(3) Statement I is incorrect and statement II is correct.

(4) Both statements I and statements II are incorrect.

PWA154

2. Given below are two statements:

Statement I : Mechanical transverse waves cannot be generated in gaseous medium.

Statement II : Mechanical transverse waves can be produced only in such medium which have shearing property.

In light of above statement choose the most **appropriate** answer from the options given below:

(1) Both statement I and statement II are correct.

(2) Statement I is correct and statement II is incorrect.

(3) Statement I is incorrect and statement II is correct.

(4) Both statements I and statements II are incorrect.

PWA155

3. Consider the following statements :

Statement I : The velocity of sound in the air increases due to presence of moisture in it.

Statement II : The presence of moisture in air lowers the density of air.

In light of above statement choose the most **appropriate** answer from the options given below:

(1) Both statement I and statement II are correct.

(2) Statement I is correct and statement II is incorrect.

(3) Statement I is incorrect and statement II is correct.

(4) Both statements I and statements II are incorrect.

PWA156

4. The equation of travelling wave is given by (all quantities are in SI units)

$y = 0.02 \sin 2\pi (10t - 5x)$

	Column-I		Column-II
i	Speed of wave	a	$20\ \pi$
ii	Angular frequency of wave	b	$0.4\ \pi$
iii	Wavelength of wave	c	2
iv	Maximum particle speed	d	0.2

(1) $i \to c, ii \to a, iii \to d, iv \to c$

(2) $i \to a, ii \to b, iii \to c, iv \to d$

(3) $i \to c, ii \to b, iii \to a, iv \to d$

(4) $i \to c, ii \to a, iii \to d, iv \to b$

PWA157

5. In a resonance tube experiment, a close organ pipe of length 120 cm resonate when tuned with a tuning fork of frequency 340 Hz. If water is poured in the pipe then (given $v_{air} = 340 m/sec.$):

(a) Minimum length of water column to have the resonance is 45 cm.

(b) The distance between two successive nodes is 50 cm.

(c) The maximum length of water column to create the resonance is 95 cm

(d) None of these

Choose the correct statements :

(1) a, b, c (2) b, c (3) a, c (4) None

PWA158

6. Regarding speed of sound in gas match the following -

	Column-I		Column-II
i	Temperature of gas is made 4 times and pressure 2 times	a	Speed becomes $2\sqrt{2}$ times
ii	Only pressure is made 4 times without change in temperature	b	Speed becomes two times
iii	Only temperature changed to 4 times	c	Speed remain unchanged
iv	Molecular mass of the gas is made 4 times	d	Speed become half

(1) i $\rightarrow$ a, ii $\rightarrow$ c, iii $\rightarrow$ d, iv $\rightarrow$ b
(2) i $\rightarrow$ b, ii $\rightarrow$ c, iii $\rightarrow$ d, iv $\rightarrow$ a
(3) i $\rightarrow$ b, ii $\rightarrow$ c, iii $\rightarrow$ b, iv $\rightarrow$ d
(4) i $\rightarrow$ c, ii $\rightarrow$ b, iii $\rightarrow$ a, iv $\rightarrow$ c

PWA159

7. For a closed organ pipe match the following :

	Column-I		Column-II
i	Third overtone frequency is x times the fundamental frequency. Here, x is equal to	a	3
ii	No. of nodes in second overtone	b	4
iii	No. of antinode in third overtone	c	5
		d	None

(1) i $\rightarrow$ a, ii $\rightarrow$ d, iii $\rightarrow$ b
(2) i $\rightarrow$ d, ii $\rightarrow$ a, iii $\rightarrow$ b
(3) i $\rightarrow$ b, ii $\rightarrow$ a, iii $\rightarrow$ d
(4) i $\rightarrow$ c, ii $\rightarrow$ d, iii $\rightarrow$ b

PWA160

8. In a stationary wave pattern, all the particles -
(a) of the medium vibrate in the same phase
(b) in the region between two antinodes vibrate in the same phase
(c) in the region between two successive nodes vibrate in the same phase
(d) on either side of a node vibrate in opposite phase

Choose the correct statement :
(1) a, c, d (2) a, b, c, d
(3) c, d (4) a, b, c

PWA161

9. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : Sound travels faster on a rainy day than on a dry day.

Reason (R) : Moisture increases the pressure.

In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.
(3) **(A)** is true but **(R)** is false.
(4) **(A)** is false but **(R)** is true.

PWA162

10. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : For a closed pipe, the first resonance length is 60 cm. The second resonance position will be obtained at 120 cm.

Reason (R) : In a closed pipe $\ell_2 = 3\ell_1$.

In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.
(3) **(A)** is true but **(R)** is false.
(4) **(A)** is false but **(R)** is true.

PWA163

11. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : In stationary waves, energy is confined within the wave region.

Reason (R) : Every particle is stationary in a stationary wave.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.
(3) **(A)** is true but **(R)** is false.
(4) **(A)** is false but **(R)** is true.

PWA164

12. Given below are two statements: One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : When two vibrating tuning forks having frequencies 256 and 512 are held near each other, beats cannot be heard.

Reason (R) : The principle of superposition is valid only if frequencies of oscillators are nearly equal.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.
(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.
(3) **(A)** is true but **(R)** is false.
(4) **(A)** is false but **(R)** is true.

PWA165

13. The tension in a stretched string fixed at both ends in changed by 2%, the fundamental frequency is found to get changed by 15 Hz.

(a) Wavelength of the string of fundamental frequency does not change
(b) Velocity of propagation of wave changes by 2%
(c) Velocity of propagation of wave changes by 1%
(d) Original frequency is 1500 Hz

Choose the correct statement(s) -

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

PWA166

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

(a) 80 Hz (b) 240 Hz
(c) 320 Hz (d) 400 Hz

Choose the correct statements:

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

PWA167

15. The equation for the displacement of a stretched string is given by $y = 8 \sin^2\pi \left[\frac{t}{0.02} - \frac{x}{100}\right]$ where y and x are in cm and t in second

Column I		Column II	
(A)	Amplitude of wave in cm	(P)	50
(B)	Frequency of wave in Hz	(Q)	4
(C)	Velocity of wave in ms^{-1}	(R)	4π
(D)	Maximum particle velocity in cm/s	(S)	5000
		(T)	400π

Options :-

(1) (A) → (Q); (B) → (P); (C) → (P); (D) → (T)
(2) (A) → (R); (B) → (S); (C) → (P); (D) → (T)
(3) (A) → (Q); (B) → (P); (C) → (S); (D) → (T)
(4) (A) → (R); (B) → (S); (C) → (S); (D) → (T)

PWA168

16. Which of the following actions would make a pulse travel faster along a stretched string?

(A) Move your hand up and down more quickly as you generate the pulse
(B) Use a heavier string of the same length, under the same tension
(C) Use a lighter string of the same length, under the same tension
(D) Stretch the string tighter to increase the tension.

(1) A,B,D (2) B,D (3) C,D (4) A,C

PWA169

17. Sinusoidal waves travel on five identical strings. Use the mathematical forms of the waves given below. In the expressions given below x is in m and y is in millimeters and t is in seconds.

(a) $y = (2mm)\sin(2x - 4t)$
(b) $y = (3mm)\sin(4x - 10t)$
(c) $y = (2.5mm)\sin(6x - 12t)$
(d) $y = (1mm)\sin(8x - 16t)$
(e) $y = (4mm)\sin(10x - 20t)$

Four of the strings have the same tension, but any one has a different tension. Identify it.

(1) a (2) b (3) d (4) e

PWA170

18. A wave disturbance in a medium is described by $y(x, t) = 0.02\cos(50\pi t + \pi/2)\cos(10\pi x)$, where x and y are in metres and t in seconds.

(A) A node occurs at x = 0.15 m
(B) An antinode occurs at x = 0.3 m
(C) The speed of the wave is 5.0 m/s
(D) The wavelength is 0.2 m

(1) A,C,D
(2) B,C,D
(3) A,B,C,D
(4) C,D

PWA171

EXERCISE-III (Analytical Questions) **ANSWER KEY**

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	1	1	1	4	1	3	2	3	3	4	3	3	3	2	1
Question	16	17	18												
Answer	3	2	3												