EXERCISE-I

Basics of Mechanical Waves

1. When sound waves travel from air to water, which of the following remains constant

(A) Velocity (B) Frequency
(C) Wavelength (D) All the above

2. A stone is dropped in a well which is 19.6*m* 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*

3. At what temperature velocity of sound is double than that of at 0°*C*

(A) 819 *K* (B) 819°*C*
(C) 600°*C* (D) 600 *K*

4. Velocity of sound is maximum in

(A) Air (B) Water
(C) Vacuum (D) Steel

5. If velocity of sound in a gas is 360 *m/s* and the distance between a compression and the nearest rarefaction is 1*m*, then the frequency of sound is

(A) 90 *Hz* (B) 180 *Hz*
(C) 360 *Hz* (D) 720 *Hz*

6. If the density of oxygen is 16 times that of hydrogen, what will be the ratio of their corresponding velocities of sound waves

(A) 1 : 4 (B) 4 : 1
(C) 16 : 1 (D) 1 : 16

7. 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*

8. 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

9. 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

10. Which of the following is different from others

(A) Velocity (B) Wavelength
(C) Frequency (D) Amplitude

11. 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) 180s^{-1}
(C) 120 sec^{-1} (D) 360 sec^{-1}

12. 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) $\frac{3}{2}v_s^2$

13. It takes 2.0 seconds for a sound wave to travel between two fixed points when the day temperature is $10^o C$. If the temperature rise to $30^o C$ the sound wave travels between the same fixed parts in

(A) 1.9 *sec* (B) 2.0 *sec*
(C) 2.1 *sec* (D) 2.2 *sec*

14. 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) $v_m = v_d$ (D) $v_m v_d = 1$

15. 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) 340 *m* (B) 1620 *m*

(C) 680 *m* (D) 1700 *m*

16. A source of sound of frequency 600 *Hz* is placed inside water. The speed of sound in water is 1500 *m/s* and in air is 300 *m/s*. The frequency of sound recorded by an observer who is standing in air is

(A) 200 *Hz* (B) 3000 *Hz*

(C) 120 *Hz* (D) 600 *Hz*

17. 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

18. 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*

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

(A) 2λ (B) $\lambda/2$

(C) $\lambda/6$ (D) $\lambda/3$

20. It is possible to distinguish between the transverse and longitudinal waves by studying the property of

(A) Interference (B) Diffraction

(C) Reflection (D) Polarisation

Progressive Waves

21. 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

22. 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) $100\,\text{Hz},\ 4.7\times10^{3}\ \text{cm/s}^2$

(B) $50\,\text{Hz},\ 7.5\times10^{3}\ \text{cm/s}^2$

(C) $25\,\text{Hz},\ 4.7\times10^{4}\ \text{cm/s}^2$

(D) $25\,\text{Hz},\ 7.4\times10^{4}\ \text{cm/s}^2$

23. 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) $v = 5\,\text{m/sec}$ (B) $\lambda = 18\,\text{m}$

(C) $a = 0.04\,\text{m}$ (D) $n = 50\,\text{Hz}$

24. 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

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

(A) 1000 π *Hz* (B) 2000 *Hz*

(C) 20 *Hz* (D) $\frac{1000}{\pi}$ Hz

26. Which of the following equations represents a wave

(A) $Y = A(\omega t - kx)$

(B) $Y = A\sin\omega t$

(C) $Y = A\cos kx$

(D) $Y = A\sin(at - bx + c)$

27. The equation of a transverse wave is given by

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

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

(A) 1 (B) 2

(C) 25 (D) 100

28. The equation of a plane progressive wave 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*

29. The equation of a 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

30. In the given progressive wave equation, what is the maximum velocity of particle $Y = 0.5\sin(10\pi t - 5x)$ *cm*

(A) 5 *cm/s* (B) 5π *cm/s*

(C) 10 *cm/*s (D) 10.5 *cm/s*

31. 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 meterand *t* is time in second. This represented a wave

(A) Of frequency $\frac{100}{\pi}$ *Hz*

(B) Of wavelength one metre

(C) Travelling with a velocity of $\frac{50}{\pi} ms^{-1}$ in the positive *X*-direction

(D) Travelling with a velocity of 100 ms^{-1} in the negative *X*-direction

32. A transverse wave is given by $y = A\sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right)$. The maximum particle velocity is equal to 4 times the wave velocity when

(A) $\lambda = 2\pi A$ (B) $\lambda = \frac{1}{2}\pi A$

(C) $\lambda = \pi A$ (D) $\lambda = \frac{1}{4}\pi A$

33. The equation of a wave is represented by $y = 10^{-4}\sin\left[100t - \frac{x}{10}\right]$. The velocity of the wave will be

(A) 100 *m/s* (B) 250 *m/s*

(C) 750 *m/s* (D) 1000 *m/s*

34. A wave travelling in positive X-direction with $A = 0.2$m has a velocity of 360*m/sec*. if $\lambda = 60$m, 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) $y = 0.2\sin\left[\pi\left(6t - \frac{x}{60}\right)\right]$

35. The equation of a wave motion (with t in seconds and x in *metres*) is given by $y = 7\sin\left[7\pi t - 0.4\pi x + \frac{\pi}{3}\right]$. The velocity of the wave will be

(A) 17.5 *m/s* (B) 49π *m/s*

(C) $\frac{49}{2\pi}$ m/s (D) $\frac{2\pi}{49}$ m/s

36. 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

37. 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*

38. Which of the following is not true for this progressive wave $y = 4\sin 2\pi\left(\frac{t}{0.02} - \frac{x}{100}\right)$ where y and x are in cm & t in *sec*

(A) Its amplitude is 4 *cm*

(B) Its wavelength is 100 *cm*

(C) Its frequency is 50 *cycles/sec*

(D) Its propagation velocity is 50×10^3 *cm/sec*

39. 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 sec, then the correct statement is

(A) $\lambda = 1/6\text{m}, v = 250\text{m/s}$

(B) $a = 0.07\text{m}, v = 300\text{m/s}$

(C) $n = 1500, v = 200\text{m/s}$

(D) None

40. The equation of the propagating wave is $y = 25\sin(20t + 5x)$, where y is displacement. Which of the following statement 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

Interference and Superposition of Waves

41. 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

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

(A) 1 : 16 (B) 1 : 4

(C) 4 : 1 (D) 2 : 1

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

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

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

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

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

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

(A) Source 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)

44. 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

45. 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

46. 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

47. 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) $|A_1 + A_2|$

48. If the ratio of amplitude of wave is 2 : 1, then the ratio of maximum and minimum intensity is

(A) 9 : 1 (B) 1 : 9
(C) 4 : 1 (D) 1 : 4

49. 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

50. 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

Beats

51. 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

52. A tuning fork whose frequency as given by manufacturer is 512 *Hz* is being tested with an accurate oscillator. It is found that the fork produces a beat of 2 *Hz* when oscillator reads 514 *Hz* but produces a beat of 6 *Hz* when oscillator reads 510 *Hz*. The actual frequency of fork is

(A) 508 *Hz* (B) 512 *Hz*
(C) 516 *Hz* (D) 518 *Hz*

53. A tuning fork of frequency 480 *Hz* produces 10 beats per second when sounded with a vibrating sonometer string. What must have been the frequency of the string if a slight increase in tension produces lesser beats per second than before

(A) 460 *Hz* (B) 470 *Hz*
(C) 480 *Hz* (D) 490 *Hz*

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

(A) 250 *Hz* (B) 253 *Hz*
(C) 259 *Hz* (D) 262 *Hz*

55. A source of sound gives five beats per second when sounded with another source of frequency $100\,s^{-1}$. The second harmonic of the source together with a source of frequency $205\,s^{-1}$ gives five beats per second. What is the frequency of the source

(A) $105\,s^{-1}$ (B) $205\,s^{-1}$

(C) $95\,s^{-1}$ (D) $100\,s^{-1}$

56. When two sound waves are superimposed, beats are produced when they have
(A) Different amplitudes and phases
(B) Different velocities
(C) Different phases
(D) Different frequencies

57. Two tuning forks *A* and *B* give 4 beats per second. The frequency of *A* is 256 *Hz*. On loading *B* slightly, we get 5 beats in 2 seconds. The frequency of *B* after loading is
(A) 253.5 *Hz* (B) 258.5 *Hz*
(C) 260 *Hz* (D) 252 *Hz*

58. A tuning fork *A* of frequency 200 *Hz* is sounded with fork *B*, the number of beats per second is 5. By putting some wax on *A*, the number of beats increases to 8. The frequency of fork *B* is
(A) 200 *Hz* (B) 195 *Hz*
(C) 192 *Hz* (D) 205 *Hz*

59. Two tuning forks, *A* and *B*, give 4 *beats per second* when sounded together. The frequency of *A* is 320 *Hz*. When some wax is added to *B* and it is sounded with *A*, 4 *beats per second* are again heard. The frequency of *B* is
(A) 312 *Hz* (B) 316 *Hz*
(C) 324 *Hz* (D) 328 *Hz*

60. Two tuning forks have frequencies 380 and 384 *Hz* respectively. When they are sounded together, they produce 4 beats. After hearing the maximum sound, how long will it take to hear the minimum sound
(A) $\frac{1}{2}\,sec$ (B) $\frac{1}{4}\,sec$
(C) $\frac{1}{8}\,sec$ (D) $\frac{1}{16}\,sec$

61. A tuning fork vibrates with 2 beats in 0.04 second. The frequency of the fork
(A) 50 *Hz* (B) 100 *Hz*
(C) 80 *Hz* (D) None of these

62. Two sound sources when sounded simultaneously produce four beats in 0.25 second. the difference in their frequencies must be
(A) 4 (B) 8
(C) 16 (D) 1

63. A tuning fork of known frequency 256 *Hz* makes 5 beats per second with the vibrating string of a piano. The beat frequency decreases to 2 beats per second when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was
(A) 256 + 5 *Hz* (B) 256 + 2*Hz*
(C) 256 – 2 *Hz* (D) 256 – 5*Hz*

64. When temperature increases, the frequency of a tuning fork
(A) Increases
(B) Decreases
(C) Remains same
(D) Increases or decreases depending on the material

65. Two strings *X* and *Y* of a sitar produce a beat frequency 4 *Hz*. 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*

Stationary Waves

66. A wave represented by the given equation $y = a\cos(kx - \omega t)$ is superposed with another wave to form a stationary wave such that the point *x* = 0 is a node. The equation for the other wave is
(A) $y = a\sin(kx + \omega t)$
(B) $y = -a\cos(kx + \omega t)$
(C) $y = -a\cos(kx - \omega t)$

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

67. 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

68. 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*

69. 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

70. 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

71. 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

72. 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 speed of incident (and reflected) wave are

(A) 40 *m/s* (B) 20 *m/s*
(C) 10 *m/s* (D) 5 *m/s*

73. $y = a\cos(kx + \omega t)$ superimposes on another wave giving a stationary wave having node at $x = 0$. What is the equation of the other wave

(A) $-a\cos(kx + \omega t)$
(B) $a\cos(kx - \omega t)$
(C) $-a\cos(kx - \omega t)$
(D) $-a\sin(kx + \omega t)$

74. 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) $\frac{n}{10}$

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

(A) Stationary
(B) Progressive
(C) Transverse
(D) Electromagnetic

76. The stationary wave produced on a string is represented by the equation $y = 5\cos(\pi x/3)\sin 40\pi t$. Where x and y are in *cm* and t is in seconds. The distance between consecutive nodes is

(A) 5 *cm* (B) π cm
(C) 3 *cm* (D) 40 *cm*

77. 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 0.5 *s*, the wavelength of the waves is

(A) 25 *m* (B) 20 *m*
(C) 15 *m* (D) 10 *m*

78. "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

79. 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) $\frac{n}{8}$

80. Stationary waves

(A) Transport energy
(B) Does not transport energy
(C) Have nodes and antinodes
(D) Both (B) and (C)

Vibration of String

81. 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) 4*n*
(C) 2*n* (D) *n*

82. A device used for investigating the vibration of a fixed string or wire

(A) Sonometer (B) barometer
(C) Hydrometer (D) None of these

83. 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*

84. 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*

85. To 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

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

(A) $\frac{3}{8}$ (B) $\frac{2}{3}$
(C) $\frac{8}{9}$ (D) $\frac{9}{4}$

87. 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*

88. 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

(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 $\frac{3l}{4}$

89. 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) $\sqrt{2}:1$

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

(A) 25 *kg* (B) 5 *kg*

(C) 12.5 *kg* (D) 1/25 *kg*

91. 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

92. 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

93. In Melde's experiment in the transverse mode, the frequency of the tuning fork and the frequency of the waves in the strings are in the ratio

(A) 1 : 1 (B) 1 : 2

(C) 2 : 1 (D) 4 : 1

94. 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*

95. Three similar wires 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) $\frac{1}{n^1} = \frac{1}{n_1^2} + \frac{1}{n_2^2} + \frac{1}{n_3^2}$

Organ Pipe (Vibration of Air Column)

96. 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

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

(A) 185.5 *cm* (B) 94.9 *cm*

(C) 90 *cm* (D) 80 *cm*

98. 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) $\frac{\rho_A}{\rho_A}$ (D) $\frac{\left(\rho_A+\frac{1}{2}\rho_0\right)}{\left(\rho_A-\frac{1}{2}\rho_0\right)}$

99. Two closed pipe produce 10 beats per second when emitting their fundamental nodes. If their length are in ratio of 25:26. Then their fundamental frequency in *Hz*, are

(A) 270, 280 (B) 260, 270
(C) 260, 250 (D) 260, 280

100. A closed organ pipe and an open organ pipe are tuned to the same fundamental frequency. What is the ratio of lengths

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

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

(A) 1 : 2 (B) 1 : 4
(C) 2 : 1 (D) 4 : 1

102. 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

103. 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

104. 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

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

(A) $y = -a\cos(\omega t + kx)$
(B) $y = -a\sin(\omega t + kx)$
(C) $y = a\sin(\omega t + kx)$
(D) $y = a\cos(\omega t + kx)$

106. 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*

107. 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 middle of the pipe

108. 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 open and another end is closed
(D) None of the above

109. 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

110. 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

Doppler's Effect

111. 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

(A) $\frac{2}{3}$v (B) v

(C) $\frac{3}{2}$v (D) $3v$

112. A sound source is moving towards a stationary observer with 1/10 of the speed of sound. The ratio of apparent to real frequency is

(A) 10/9 (B) 11/10

(C) $(11/10)^2$ (D) $(9/10)^2$

113. The speed of sound in air at a given temperature is 350*m/s*. An engine blows whistle at a frequency of 1200*cps*. It is approaching the observer with velocity 50*m/s*. The apparent frequency in *cps* heard by the observer will be

(A) 600 (B) 1050

(C) 1400 (D) 2400

114. 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*

115. A source of frequency 150 *Hz* is moving in the direction of a person with a velocity of 110*m/s*. The frequency heard by the person will be

(speed of sound in medium = 330*m/s*)

(A) 225 *Hz* (B) 200 *Hz*

(C) 150 *Hz* (D) 100 *Hz*

116. The Doppler's effect is applicable for

(A) Light waves

(B) Sound waves

(C) Space waves

(D) Both (A) and (B)

117. 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

(A) 9 : 8 (B) 8 : 9

(C) 1 : 1 (D) 9 : 10

(Speed of sound v = 340 *m/s*)

118. A source of sound S is moving with a velocity 50*m/s* 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 sound in the medium is 350 *m/s*

(A) 750 *Hz* (B) 857 *Hz*

(C) 1143 *Hz* (D) 1333 *Hz*

119. A source and listener are both moving towards each other with speed 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

120. 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 = 352 *m*/*s*)

(A) 1000 *Hz* (B) 1066 *Hz*

(C) 941 *Hz* (D) 352 *Hz*

121. A source of sound of frequency 500 *Hz* is moving towards an observer with velocity 30 *m/s*. The speed of sound is 330 *m/s*. the frequency heard by the observer will

(A) 550 *Hz* (B) 458.3 *Hz*

(C) 530 *Hz* (D) 545.5 *Hz*

122. 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*

123. A whistle of frequency 500 *Hz* tied to the end of a string of length 1.2 *m* revolves at 400*rev*/*min*. A listener standing some distance away in the plane of rotation of whistle hears frequencies in the range

(speed of sound = 340*m*/*s*)

(A) 436 to 586 (B) 426 to 574

(C) 426 to 584 (D) 436 to 674

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

(A) 18/19 (B) 1/2

(C) 2 (D) 19/18

125. 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 predicted

(D) Will not change

126. 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*

127. 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 heard by observer, if velocity of sound is 340*m*/*s*, is

(A) 240 *Hz* (B) 270 *Hz*

(C) 280 *Hz* (D) 360 *Hz*

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

(A) 242/252 (B) 2
(C) 5/6 (D) 11/6

129. 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*

130. 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*

Musical Sound

131. *A* is singing a note and at the same time *B* is singing a note with exactly one-eighth 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*

132. 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

133. 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) $T \propto V$

134. The intensity of sound from a radio at a distance of 2 *metres* from its speaker is $1\times 0^{-2}\mu\ W/m^2$. 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) $5\times 10^{-2}\mu\ W/m^2$

135. 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*

136. A musical scale is constructed by providing intermediate frequencies between a note and its octave which

(A) Form an arithmetic progression
(B) Form a geometric progression
(C) Bear a simple ratio with their neighbours
(D) Form a harmonic progression

137. In a harmonium the intermediate notes between a note and its octave form

(A) An arithmetic progression

(B) A geometric progression

(C) A harmonic progression

(D) An exponential progression

138. The power of a sound from the speaker of a radio is $20mW$. By turning the knob of the volume control, the power of the sound is increased to $400mW$. The power increase in decibels as compared to the original power is

(A) 13 dB (B) 10 dB

(C) 20 dB (D) 800 dB

139. 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%

140. 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