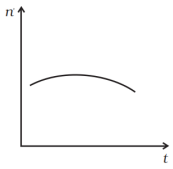
KD EDUCATION ACADEMY [9582701166]

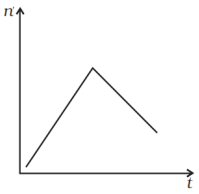
Time : 6 Hour | **STD 11 Science Physics** | **Total Marks : 350**

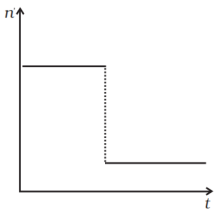
kd 90+ ch-14 waves

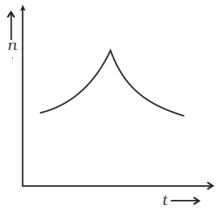
*** Choose The Right Answer From The Given Options.[1 Marks Each]** **[28]**

1. A train whistling at constant frequency is moving towards a station at a constant speed V. The train goes past a stationary observer on the station. The frequency n′ of the sound as heard by the observer is plotted as a function of time t Identify the expected curve:

(A) 

(B) 

(C) 

(D) 

2. Equation of a plane progressive wave is given by $y = 0.6 \sin 2\pi\left(t - \frac{x}{2}\right)$. On reflection from a denser medium its amplitude becomes 2/3 of the amplitude of the incident wave. The equation of the reflected wave is:

(A) $y = 0.6 \sin 2\pi\left(t + \frac{x}{2}\right)$ (B) $y = -0.4 \sin 2\pi\left(t + \frac{x}{2}\right)$

(C) $y = 0.4 \sin 2\pi\left(t + \frac{x}{2}\right)$ (D) $y = -0.4 \sin 2\pi\left(t - \frac{x}{2}\right)$

3. A particle has displacement y given by $y = 3\sin(5\pi t + \phi)$, where y is in metre and t is in second. What are frequency and period of motion?

(A) 0.4Hz, 2.5s (B) 2.5Hz, 0.4s

(C) 2.5Hz, 2.5s (D) 0.4Hz, 0.4s

4. The transverse displacement of a string (clamped at its both ends) is given by $y(x, t) = 0.06 \sin(1\pi x/3)\cos(120\pi t)$. All the points on the string between two consecutive nodes vibrate with

(A) Same frequency. (B) Same phase.

(C) Same energy. (D) Different amplitude.

5. A sound wave is passing through air column in the form of compression and rarefaction. In consecutive compressions and rarefactions:

(A) Density remains constant. (B) Boyle's law is obeyed.

(C) Bulk modulus of air oscillates. (D) There is no transfer of heat.

6. The whistle of a railway engine is heard in winter at much longer distances. This is due to:

(A) Decrease in velocity of sound in winter.

(B) Decrease in the density of air w.r.t. height from the surface of the earth.

(C) Cold air absorbs much smaller energy from sound waves.

(D) Increase in the density of air w.r.t. height from the surface of the earth.

7. If equation of sound wave is $y = 0.0015\sin(62.4x + 316t)$, then its wavelength will be:
(A) 0.2 unit (B) 0.3 unit (C) 0.1 unit (D) 2 unit

8. 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. The wavelength of the wave is:
(A) 18cm (B) 9cm (C) 36cm (D) 6cm

9. A transverse wave propagating along X-axis is represented by $y(x,t) = 8.0\sin\left(0.5\pi x - 4\pi t - \frac{\pi}{4}\right)$ where x is in metre and t is in seconds. The speed of the wave is:
(A) $8m/s$ (B) $4\pi m/s$ (C) $0.5\pi m/s$ (D) $\frac{\pi}{4}m/s$

10. To increase the frequency from 100Hz to 400Hz the tension in the string has to be changed by:
(A) 4 times. (B) 16 times.
(C) 2 times. (D) None of these.

11. A transverse wave propagating along X-axis is represented by $y\ (x, t) = 8.0\sin(0.5\pi x - 4\pi t - \frac{\pi}{4})$ where x is in metre and t is in seconds. The speed of the wave is:
(A) $8m/s$ (B) $4\pi m/s$ (C) $0.5\pi m/s$ (D) $\frac{\pi}{4}m/s$

12. The time period of mass suspended from a spring is T. If the spring is cut into four equal parts and the same mass is suspended from one of the parts, then the new time period will be:
(A) $\frac{T}{4}$ (B) T (C) $\frac{T}{2}$ (D) $2T$

13. The displacement of the wave given by equation $y\ (x, t) = a\sin(kx - \omega t + \phi)$, where $\phi = 0$ at point x and t = 0 is same as that at point:
(A) $x + 2n\pi$ (B) $x + \frac{2n\pi}{k}$
(C) $kx + 2n\pi$ (D) Both (a) and (b)

14. A steel wire has linear mass density $6.9 \times 10^{-3} kgm^{-1}$. If the wire is under a tension of 60N, then the speed of the transverse waves on the wire is:
(A) $63ms^{-1}$ (B) $75ms^{-1}$ (C) $73ms^{-1}$ (D) $93ms^{-1}$

15. A string of mass 2.5kg is under a tension of 200N. The length of the stretched string is 20.0m. If the transverse jerk is struck at one end of the string, the disturbance will reach the other end in:
(A) One second (B) 0.5 second
(C) 2 seconds (D) Data given is insufficient.

16. A siren placed at a railway platform is emitting sound of frequency 5kHz. A passenger sitting in a moving train A records a frequency of 5.5kHz, while the train approaches the

siren. During his return journey in a different train B, he records a frequency of 6.0kHz. while approaching the same siren. The ratio of the velocity of train B to that of train A is:

(A) $\frac{242}{252}$ (B) 2 (C) $\frac{5}{6}$ (D) $\frac{11}{6}$

17. Two sound waves of slightly different frequencies propagating in the same direction produce beats due to:

(A) Interference. (B) Diffraction.

(C) Reflection. (D) Refraction.

18. Two pulses having equal and opposite displacements moving in opposite directions overlap at t =t_1s. The resultant displacement of the wave at t = t_1s is:

(A) Twice the displacement of each pulse. (B) Half the displacement of each pulse.

(C) Zero. (D) Either (a) or (c).

19. Two sound waves with wavelength 5.0m and 5.5m respectively, each propagate in a gas with velocity 330m/s. We expect the following number of beats/sec:

(A) 6 (B) 12 (C) 0 (D) 1

20. In a longitudinal wave, the elastic property of the constituents of the medium that determines the stress under compressional strain is:

(A) Young's modulus (Y). (B) Bulk modulus (B).

(C) Shear modulus (S). (D) Either (b) or (C).

21. Water waves produced by a motor boat sailing in water are:

(A) Neither longitudinal nor transverse.

(B) Both longitudinal and transverse.

(C) Only longitudinal.

(D) Only transverse.

22. Which of the following statements is true?

(A) Both light and sound waves can travel in vacuum.

(B) Both light and sound waves in air are transverse.

(C) The sound waves in air are longitudinal, while the light waves are transverse.

(D) Both light and sound waves in air are longitudinal.

23. Speed of sound waves in a fluid depends upon:

(A) Directty on density of the medium.

(B) Square of Bulk modulus of the medium.

(C) Inversly on the square root of density.

(D) Directly on the square root of bulk modulus of the medium.

24. Which of the following statements are true for a stationary wave?

(A) Every particle has a fixed amplitude which is different from the amplitude of its nearest particle.

(B) All the particles cross their mean position at the same time.

(C) There is no net transfer of energy across any plane.

(D) There are some particles which are always at rest.

25. Two sine 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 be:

(A) A (B) 2A (C) 4A (D) $\sqrt{2}A$

26. 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) ν (B) 2ν (C) 4ν (D) $\frac{\nu}{4}$

27. Equation of progressive wave is $y = a\sin\left(10\pi x + 11\pi t + \frac{\pi}{3}\right)$ The wavelength of the wave is:

(A) 0.2 unit (B) 0.1 unit (C) 0.5 unit (D) 1 unit

28. The displacement y of a wave travelling in x-direction is given by $y = 10^{-4}\sin\left(600t - 2x + \frac{\pi}{3}\right)$ where x and y are in metre and t is in seconds. The speed of wave motion in s^{-1} is:

(A) 300 (B) 600 (C) 1200 (D) 200

*** Given Section consists of questions of 3 marks each. [108]**

29. A travelling harmonic wave on a string is described by $y(x, t) = 7.5\sin\left(0.0050x + 12t + \frac{\pi}{4}\right)$ Locate the points of the string which have the same transverse displacements and velocity as the x = 1cm point at t = 2s, 5s and 11s.

30. A stone dropped from the top of a tower of height 300m splashes into the water of a pond near the base of the tower. When is the splash heard at the top given that the speed of sound in air is 340m s^{-1}? (g = 9.8m s^{-2})

31. A string of mass 2.50kg is under a tension of 200N. The length of the stretched string is 20.0m. If the transverse jerk is struck at one end of the string, how long does the disturbance take to reach the other end?

32. A SONAR system fixed in a submarine operates at a frequency 40.0 kHz. An enemy submarine moves towards the SONAR with a speed of 360km h^{-1}. What is the frequency of sound reflected by the submarine? Take the speed of sound in water to be 1450m s^{-1}.

33. A hospital uses an ultrasonic scanner to locate tumours in a tissue. What is the wavelength of sound in the tissue in which the speed of sound is 1.7km s^{-1}? The operating frequency of the scanner is 4.2 MHz.

34. A bat emits ultrasonic sound of frequency 1000 kHz in air. If the sound meets a water surface, what is the wavelength of (a) the reflected sound, (b) the transmitted sound? Speed of sound in air is 340m s^{-1} and in water 1486m s^{-1}.

35. A steel wire has a length of 12.0m and a mass of 2.10kg. What should be the tension in the wire so that speed of a transverse wave on the wire equals the speed of sound in dry air at 20°C = 343m s^{-1}.

36.

i. If the successive overtones of vibrating string are 280Hz and 350Hz, what is the frequency of the fundamental note?

ii. If the amplitude of a sound wave is tripled, by how many dB will the intensity level increases?

37. A policeman on duty detects a drop of 15% in the pitch of the horn of a motor car as it crosses him. If the velocity of sound is 330m/sec, calculate the speed of the car.

38. A stone dropped from the top of a tower of height 300m splashes into the water of a pond near the base of the tower. When is the splash heard at the top given that the speed of sound in air is 340m s^{-1}? (g = 9.8m s^{-2})

39. A string of mass 2.50kg is under a tension of 200N. The length of the stretched string is 20.0m. If the transverse jerk is struck at one end of the string, how long does the disturbance take to reach the other end?

40. A standing wave is represented by $y = 2A \sin kx \cos \omega t$. If one of the component waves is $y_1 = A \sin(\omega t - kx)$, what is the equation of the second component wave?

41. A hospital uses an ultrasonic scanner to locate tumours in a tissue. What is the wavelength of sound in the tissue in which the speed of sound is 1.7km s^{-1}? The operating frequency of the scanner is 4.2 MHz.

42. A progressive and a stationary wave have frequency 300Hz and the same wave velocity 360m/s. Calculate.
    i. The phase difference between two points on the progressive wave which are 0.4m apart,
    ii. The equation of motion of progressive wave if its amplitude is 0.02m,
    iii. The eugation of the stationary wave if its amplitude is 0.01m and
    iv. The distance between consecutive nodes in the stationary wave.

43. A transverse harmonic wave travelling on a string is described by $y(x, t) = 3.0 \sin\left[(36t + 0.018x) + \frac{\pi}{4}\right]$ where x and y are in cm and t in sec. The positive direction of x is from left to right.
    i. What is its amplitude and frequency?
    ii. What is the initial phase at the origin?
    iii. What is the least distance between to successive crest in the wave?

44. What is the nature of sound waves in air? How is the speed of sound waves in atmosphere affected by the:
    i. Humidity.
    ii. Temperature?

45. An underwater swimmer sends a sound signal to the surface. It produces 5 beats per second when compared with the fundamental note of a pipe 20cm long closed at one end. What is the wavelength of sound in water? Given velocities of sound in air and water are 360ms^{-1} and 1500ms^{-1} respectively.

46. Calculate the velocity of sound in a gas, in which two wavelengths 2.04m and 2.08m produce 20 beats in 6 seconds.

47. A sound wave travelling along a string is described by $y(x, t) = 5 \times 10^{-3} \sin(80x - 3t)$ in which numerical constants are in S.I. unit. Calculate.
    i. The amplitude.
    ii. The wave length.

iii. The period and frequency of the wave.

48. The following equation represents standing wave set up in medium, $y = 4\cos\frac{\pi x}{5}\sin 40\pi t,$ where x and y are in cm and t in sec. Find out the amplitude and the velocity of the two component waves and calculate the distance between adjacent nodes. What is the velocity of a medium particle at x = 3cm at time $\frac{1}{8}\sec$?

49. Two sound waves originating from the same source, travel along different paths in air and then meet at a point. If the source vibrates at a frequency of 1kHz and one path is 83cm longer than the other, what will be the nature of interference? The speed of sound in air is 332m/s.

50. Find the temperature at which the speed of sound in oxygen will be the same as that in nitrogen at 20°C. Given that molar masses of oxygen and nitrogen are 32 and 28 respectively. Both gases are assumed to be ideal.

51. A steel wire has a length of 12.0m and a mass of 2.10kg. What should be the tension in the wire so that speed of a transverse wave on the wire equals the speed of sound in dry air at 20°C = 343m s^{-1}.

52. List the differences between a progressive and a stationary wave.

53. A set of 65 turning forks is so arranged that each gives 3 beats per second with the previous one and the last sounds the octave of first. Find the frequency of first and last forks?

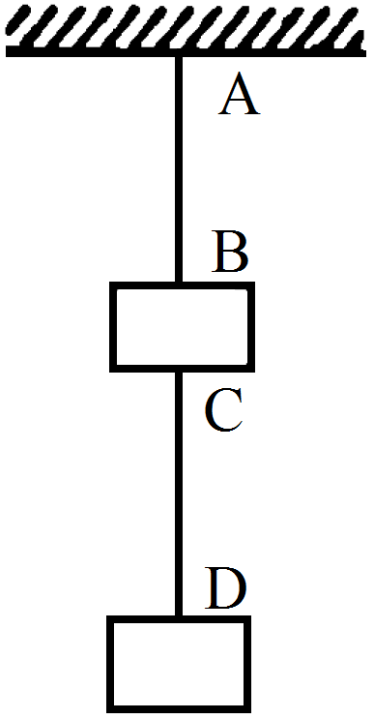
54. A bat emits ultrasonic sound of frequency 100KHz in air. If this sound meets a water surface, what is the wave length of (a) the reflected sound, (b) transmitted sound? Speed of sound in air = 340ms^{-1} and in water = 1486ms^{-1}.

55. A set of 25 tuning forks is arranged in order of decreasing frequency. Each fork gives 3 beats with succeeding one. The first fork is octave of the last. Calculate the frequency of the first and 16^{th} fork.

56. Calculate the speed of sound in a gas in which two waves of wavelengths 1.00m and 1.01m produce 10 beats in 3 seconds.

57. An open pipe is suddenly closed at one end with the result that the frequency of sound harmonic of the closed pipe is found to be higher by 100Hz than the fundamental frequency of the open pipe. Calculate the fundamental frequency of the open pipe.

58. Two blocks each having a mass of 3.2kg are connected by a wire CD and the system is suspended from the ceiling by another wire AB figure, The linear mass delity of the wire AB is 10g/m and that of CD is 8g/m. Find the speed of a transverse wave pulse produced



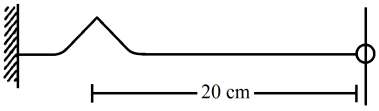
in AB and in CD.

59. A string of linear mass density 0.5g/cm and a total length 30cm is tied to a fixed wall at one end and to a frictionless ring at the other end figure, The ring can move on a vertical rod. A wave pulse is produced on the string which moves towards the ring at a speed of 20cm/s. The pulse is symmetric about its maximum which is located at a distance of 20cm from the end joined to the ring.

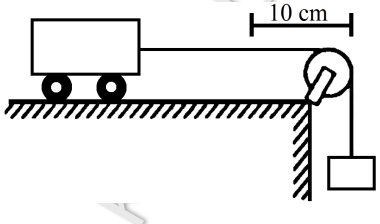
a. Assuming that the wave is reflected from the ends without loss of energy, find the time taken by the string to regain its shape.

b. The shape of the string changes periodically with time. Find this time period.

c. What is the tension in the string?

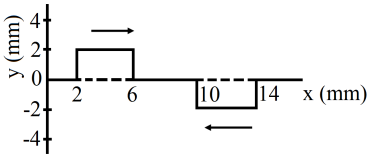


60. A heavy string is tied at one end to a movable support and to a light thread at the other end as shown in figure, The thread goes over a fixed pulley and supports a weight to produce a tension. The lowest frequency with which the heavy string resonates is 120Hz. If the movable support is pushed to the right by 10cm so that the joint is placed on the pulley, what will be the minimum frequency at which the heavy string can



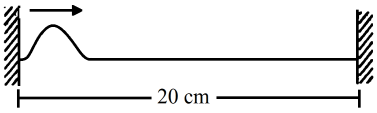
resonate?

61. Figure shows two wave pulses at t = 0 travelling on a string in opposite directions with

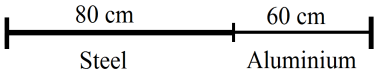


the same wave speed 50cm/s. Sketch the shape of the string at t = 4ms, 6ms, 8ms, and 12ms.

62. A string of length 20cm and linear mass density 0.40g/cm is fixed at both ends and is kept under a tension of 16N. A wave pulse is produced at t = 0 near an end as shown in figure, which travels towards the other end.
    a. When will the string have the shape shown in the figureagain
    b. Sketch the shape of the string at a time half of that found in part (a).



63. Figure, shows an aluminium wire of length 60cm joined to a steel wire of length 80cm and stretched between two fixed supports. The tension produced is 40N. The cross-sectional area of the steel wire is 1.0mm^2 and that of the aluminium wire is 3.0 mm^2. What could be the minimum frequency of a tuning fork which can produce standing waves in the system with the joint as a node? The density of aluminium is 2.6g/cm^3 and that of steel is 7.8g/cm^3.



64. The equation of a wave travelling on a string is:
$y = (0.10\text{mm}) \sin\left[(31.4\text{m}^{-1})x + (314\text{s}^{-1})t\right]$.
    a. In which direction does the wave travel?
    b. Find the wave speed, the wavelength and the frequency of the wave.
    c. What is the maximum displacement and the maximum speed of a portion of the string?

*** Given Section consists of questions of 5 marks each. [210]**

65. A wire stretched between two rigid supports vibrates in its fundamental mode with a frequency of 45Hz. The mass of the wire is 3.5 × 10^{-2}kg and its linear mass density is 4.0 × 10^{-2}kg m^{-1}. What is
    a. The speed of a transverse wave on the string,
    b. The tension in the string?

66. A travelling harmonic wave on a string is described by
$y(x, t) = 7.5 \sin\left(0.0050x + 12t + \frac{\pi}{4}\right)$ What are the displacement and velocity of oscillation of a point at x = 1cm, and t = 1s? Is this velocity equal to the velocity of wave propagation?

67. A wire stretched between two rigid supports vibrates in its fundamental mode with a frequency of 45Hz. The mass of the wire is 3.5 × 10^{-2}kg and its linear mass density is 4.0 × 10^{-2}kg m^{-1}. What is
    a. The speed of a transverse wave on the string,
    b. The tension in the string?

68. A pipe 20cm long is closed at one end. Which harmonic mode of the pipe is resonantly excited by a 430Hz source? Will the same source be in resonance with the pipe if both ends are open? (speed of sound in air is 340m s^{-1}).

69. A travelling harmonic wave on a string is described by
$y(x, t) = 7.5 \sin\left(0.0050x + 12t + \frac{\pi}{4}\right)$ What are the displacement and velocity of

oscillation of a point at x = 1cm, and t = 1s? Is this velocity equal to the velocity of wave propagation?

70. Earthquakes generate sound waves inside the earth. Unlike a gas, the earth can experience both transverse (S) and longitudinal (P) sound waves. Typically the speed of S wave is about 4.0km s^{-1}, and that of P wave is 8.0km s^{-1}. A seismograph records P and S waves from an earthquake. The first P wave arrives 4 min before the first S wave. Assuming the waves travel in straight line, at what distance does the earthquake occur?

71. The earth has a radius of 6400km. The inner core of 1000km radius is solid. Outside it, there is a region from 1000km to a radius of 3500km which is in molten state. Then again from 3500km to 6400km the earth is solid. Only longitudinal (P) waves can travel inside a liquid. Assume that the P wave has a speed of 8km s^{-1} in solid parts and of 5km s^{-1} in liquid parts of the earth. An earthquake occurs at some place close to the surface of the earth. Calculate the time after which it will be recorded in a seismometer at a diametrically opposite point on the earth if wave travels along diameter?

72. A progressive wave is given by $y(x, t) = 8\cos(300t - 0.15x)$ where x in m, y in cm and t in second. What is the-
    i. Direction of propagation?
    ii. Wavelength?
    iii. Frequency?
    iv. Wave speed?
    v. Phase difference between two points 0.2m apart?

73. A source of frequency 250Hz produces sound waves of wavelength 1.32m in a gas at STP. Calculate the change in the wavelength, when temperature of the gas is 40°C.

74. A man standing in front of a mountain at a certain distance beats a drum at regular intervals. The drumming rate is gradually increased, and he finds that the echo is not heard distinctly, when the rate becomes 40 per minute. He then moves nearer to the mountain by 90 metres, and finds what the echo is again not heard when the drumming rates becomes 60 per minute. Calculate
    i. The distance between the mountain and the initial position of the man.
    ii. The velocity of sound.

75. Discuss the various factors influencing velocity of sound. A sonometer wire of length 110cm is stretched with a tension T and fixed at its ends. The wire is divided into three segments by placing two bridges below it. Where should the bridges be placed so that the fundamental frequencies of the segments are in the ratio 1: 2: 3?

76. A simple harmonic wave is expressed by equation:
    $y = 7 \times 10^{-6} \sin\left(800\pi t - \frac{\pi}{42.5}x\right)$ where y and x are in cm. and t in seconds.
    Calculate the following:
    i. Amplitude.
    ii. Frequency.
    iii. Wavelength.
    iv. Wave velocity.
    v. Phase difference between two particles separated by 17.0cm.

77. An incident wave and a reflected wave are represented by: $\xi_1 = a\sin\frac{2\pi}{\lambda}(\nu t - x)$ $\xi_2 = a\sin\frac{2\pi}{\lambda}(\nu t + x)$ Derive the equation of the stationary wave and calculate the

position of the nodes and antinodes.

78. A drop of water, 2mm in diameter, falling from a height of 50cm in a bucket generates sound which can be heard from the 5m distance. Take all the gravitational energy difference as going into the sound form, the transformation being spread in time over 0.2s. Deduce the average intensity and the amplitude of vibration at the listener's end. Given: density of air = 1.3kg m^{-3}, frequency of wave = 1000Hz and c = 350ms^{-1}?

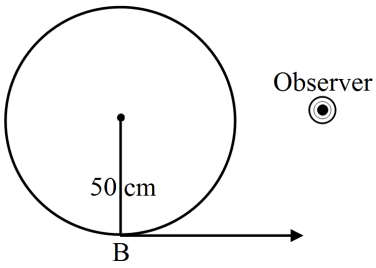
79. Explain Doppler effect in sound. Obtain an expression for apparent frequency of sound when source moves and listener is at rest.

80. The displacement of an elastic wave is given by the function $y = 3\sin\omega t + 4\cos\omega t$ where y is in cm and t is in second. Calculate the resultant amplitude.

81.

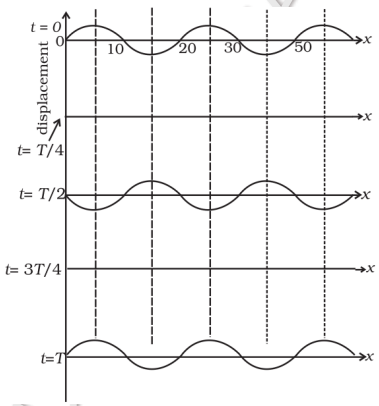
i. What is beat phenomenon?

ii.



A whistle revolve in a circle with angular velocity of o = 20 rad s^{-1}. If the frequency of the sound is 385Hz and speed is 340ms^{-1}, than find the frequency heard by the observer when the whistle is at B.

82. The wave pattern on a stretched string is shown in Interpret what kind of wave this is



and find its wavelength.

83. The transverse displacement of a string (clamped at its both ends) is given by $y(x, t) = 0.06\sin\left(\frac{2\pi}{3}x\right)\cos(120\pi\, t)$ where x and y are in m and t in s. The length of the string is 1.5m and its mass is 3.0×10^{-2}kg. Answer the following: Determine the tension in the string.

84. A narrow sound pulse (for example, a short pip by a whistle) is sent across a medium.
(a) Does the pulse have a definite,

i. frequency,
ii. wavelength,
iii. speed of propagation?

(b) If the pulse rate is 1 after every 20s, (that is the whistle is blown for a split of second after every 20s), is the frequency of the note produced by the whistle equal to 1/20 or

0.05Hz?

85. Two sitar strings A and B playing the note 'Ga' are slightly out of tune and produce beats of frequency 6Hz. The tension in the string A is slightly reduced and the beat frequency is found to reduce to 3Hz. If the original frequency of A is 324Hz, what is the frequency of B?

86. Find at what temperature the velocity of sound is air will be $1\frac{1}{2}$ times the velocity at 11°C.

87. In the given progressive wave $y = 5\sin(100\pi t + 0.4x)$ where y and x are in m, t is in s. What is the: Particle velocity amplitude.

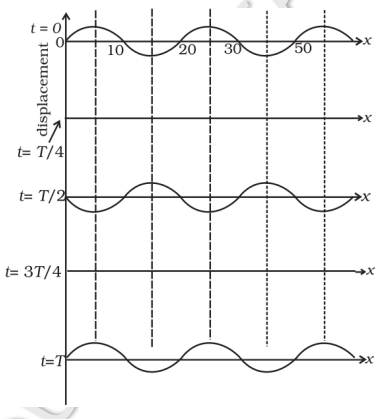
88. A steel rod 100cm long is clamped at its middle. The fundamental frequency of longitudinal vibrations of the rod are given to be 2.53 kHz. What is the speed of sound in steel?

89. Use the formula $v = \sqrt{\frac{\gamma P}{\rho}}$ to explain why the speed of sound in air: Is independent of pressure,

90. A sitar wire is under a tension of 40N and the length between the bridges is 70cm. A 5m sample of the wire has a mass of 1.0g. Deduce the speed of transverse waves on the wire, frequency of the fundamental and the frequency of the first two harmonics.

91. For the harmonic travelling wave $y = 2\cos 2\pi(10t - 0.0080x + 3.5)$ where x and y are in cm and t is second. What is the phase difference between the oscillatory motion at two points separated by a distance of: What is the phase difference between the oscillation of a particle located at x = 100cm at t = T and t = 5s?

92. The wave pattern on a stretched string is shown in Interpret what kind of wave this is



and find its wavelength.

93. Given below are some functions of x and t to represent the displacement of an elastic wave. $y = 100\cos(100\pi t + 0.5x)$

94. The displacement of an elastic wave is given by the function $y = 3\sin\omega t + 4\cos\omega t$ where y is in cm and t is in second. Calculate the resultant amplitude.

95. If c is r.m.s. speed of molecules in a gas and v is the speed of sound waves in the gas, show that c/ v is constant and independent of temperature for all diatomic gases.

96. Show that when a string fixed at its two ends vibrates in 1 loop, 2 loops, 3 loops and 4 loops, the frequencies are in the ratio 1 : 2 : 3 : 4.

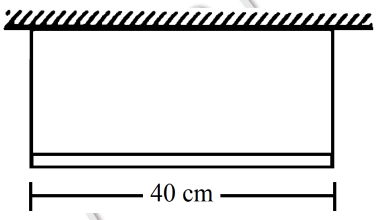
97. A sitar wire is replaced by another wire of same length and material but of three times the earlier radius. If the tension in the wire remains the same, by what factor will the

frequency change?

98. The earth has a radius of 6400km. The inner core of 1000km radius is solid. Outside it, there is a region from 1000km to a radius of 3500km which is in molten state. Then again from 3500km to 6400km the earth is solid. Only longitudinal (P) waves can travel inside a liquid. Assume that the P wave has a speed of 8km s^{-1} in solid parts and of 5km s^{-1} in liquid parts of the earth. An earthquake occurs at some place close to the surface of the earth. Calculate the time after which it will be recorded in a seismometer at a diametrically opposite point on the earth if wave travels along diameter?

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

100. A uniform horizontal rod of length 40cm and mass 1.2kg is supported by two identical wires as shown in figure, Where should a mass of 4.8kg be placed on the rod so that the same tuning fork may excite the wire on left into its fundamental vibrations and that on right into its first overtone? Take g = 10m/s^2.



101. A boy riding on his bike is going towards east at a speed. of $4\sqrt{2}\mathrm{m/s}$ At a certain point he produces a sound pulse of frequency 1650Hz that travels in air at a speed of 334m/s. A second boy stands on the ground 45° south of east from him. Find the frequency of the pulse as received by the second boy.

102. A train running at 108km/h towards east whistles at a dominant frequency of 500Hz. Speed of sound in air is 340m/s.
   a. What frequency will a passenger sitting near the open window hear?
   b. What frequency will a person standing near the track hear whom the train has just passed?
   c. A wind starts blowing towards east at a speed f 36km/h. Calculate the frequencies heard by the passenger in the train and by the person standing near the track.

103. A source of sound emitting a 1200Hz note travelg along a straight line at a speed of 170m/s. A detector is placed at a distance of 200m from the line of motion of the source.
   a. Find the frequency of sound received by the detector at the instant when the source gets closest to it.
   b. Find the distance between the source and the detector at the instant it detects the frequency 1200Hz. Velocity of sound in air = 340m/s.

104. Calculate the frequency of beats produced in air when two sources of sound are activated, one emitting a wavelength of 32cm and the other of 32.2cm. The speed of sound in air is 350m/s.

105. A sound wave of frequency 100Hz is travelling in air. The speed of sound in air is 350m/s.
   a. By how much is the phase changed at a given point in 2.5ms?

b. What is the phase difference at a given instant between two points separated by a distance of 10.0cm along the direction of propagation?

106. A boy riding on a bicycle going at 12km/h towards a vertical wall whistles at his dog on the ground. If the frequency of the whistle is 1600Hz and the speed of sound in air is 330m/s, find

a. The frequency of the whistle as received by the wall.
b. The frequency of the reflected whistle as received by the boy.

*** Case study based questions** **[4]**

107. Two submarines are approaching each other in a calm sea. The first submarine travels at a speed of 36km/h and the other at 54km/h relative to the water. The first submarine sends a sound signal (sound waves in water are also called sonar) at a frequency of 2000Hz.

a. At what frequency is this signal received by the second submarine?
b. The signal is reflected from the second submarine. At what frequency is this signal received by the first submarine. Take the speed of the sound wave in water to be 1500m/s.

----- ख़ुदी को कर बुलंद इतना कि हर तक़दीर से पहले ख़ुदा बंदे से ख़ुद पूछे बता तेरी रज़ा क्या है -----