LAKSHYA

MHTCET 2025

Physics | Lecture - 05

Superposition of Waves

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Topics *to be covered*

1. Characteristics Of Sound ✓
2. Musical Instrument ✓

Characteristics of Sound

Home work.

Musical instruments

Home work.

QUESTION

When an air column in a pipe closed at one end vibrates such that three nodes are formed in it, the frequency of its vibrations is _____ times the fundamental frequency.

A 2

B 3

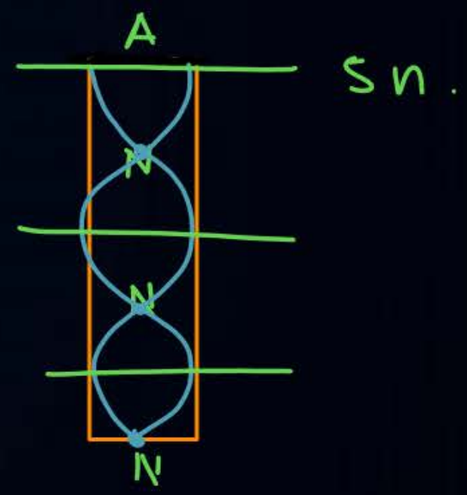
C 4

D 5

for pipe closed at one end

$$n = \frac{V}{4L}$$

$n, 3n, 5n, 7n$



5n.

QUESTION

If two open organ pipes of length 50 cm and 51 cm sounded together produce 7 beats per second, the speed of sound is _____.

A 307 m/s

B 327m/s

C 350m/s

D 357m/s

$n = \frac{V}{2L}$

$N = n_1 - n_2$

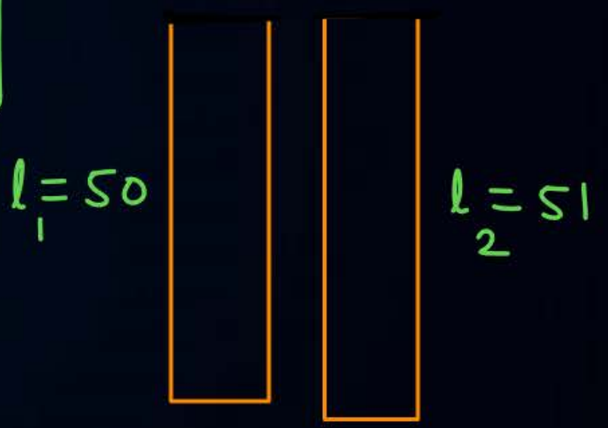
$7 = \frac{V}{2L_1} - \frac{V}{2L_2}$

$7 = \frac{V}{2}\left[\frac{1}{50} - \frac{1}{51}\right]$

$14 = V\left[\frac{1}{50 \times 51}\right]$

$V = 14 \times 50 \times 51$

$= 700 \times 51$



$\therefore \quad V = 700 \times 51$

$V = 35700 \text{ cm/s}$

$\boxed{V = 357 \text{ m/s}}$

QUESTION

The tension in a piano wire is increased by 25%. Its frequency becomes ____ times the original frequency.

A. 0.8

B. 1.12

C. 1.25

D. 1.56

$n = \frac{1}{2l}\sqrt{\frac{T}{m}}$.

$n \propto \sqrt{T}$

$\frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}}$

$n_1 = n$

$T_1 = T$

$T_2 = \frac{125}{100} T$

$T_2 = \frac{5}{4} T$

$n_2 = n_1 \sqrt{\frac{T_2}{T_1}}$

$= n \sqrt{\frac{5T}{4T}}$

$n_2 = \sqrt{5/4}\, n$

$n_2 = \frac{\sqrt{5}}{2} n = 1.12\, n$.

QUESTION

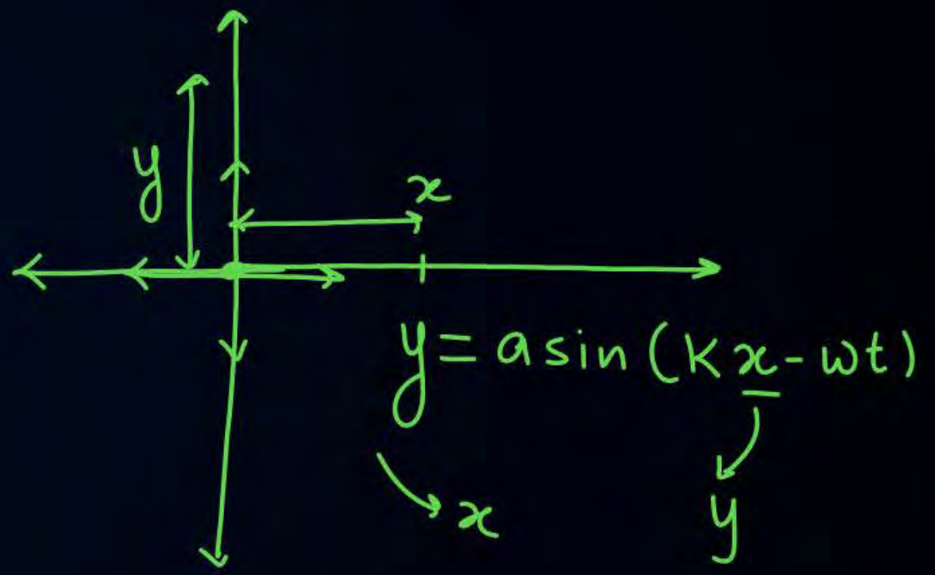
Which of the following equations represents a wave travelling along the y-axis?

A $x = A \sin(ky - \omega t)$

B $y = A \sin(kx - \omega t)$

C $y = A \sin(ky) \cos(\omega t)$

D $y = A \cos(ky) \sin(\omega t)$



QUESTION

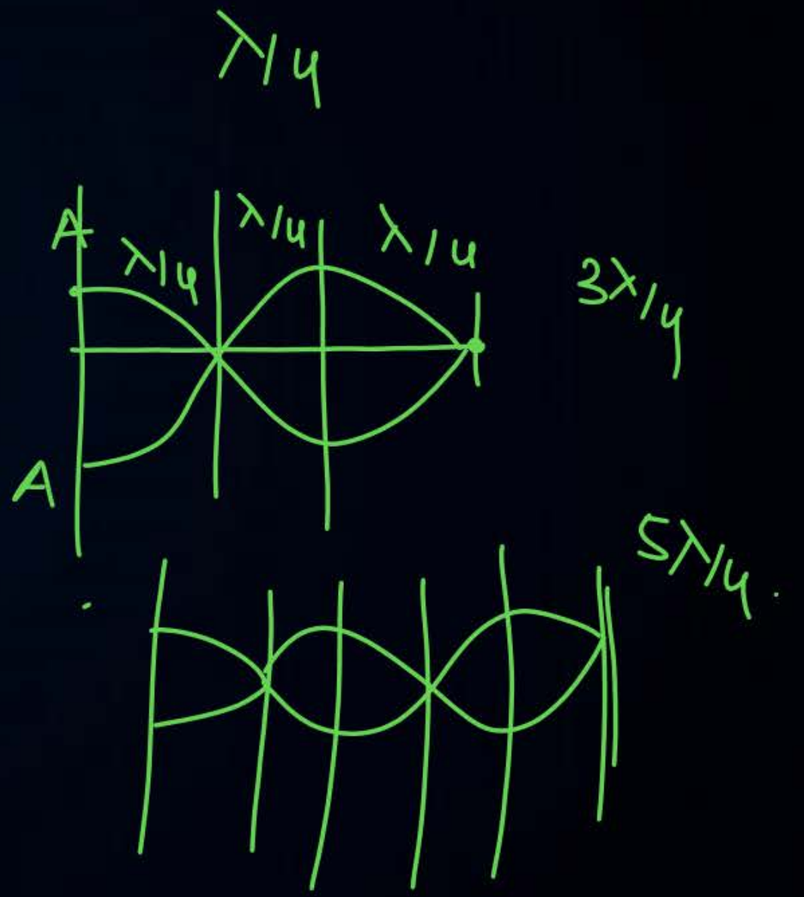
A standing wave is produced on a string fixed at one end with the other end free. The length of the string _____.

A must be an odd integral multiple of $\lambda/4$

B must be an odd integral multiple of $\lambda/2$

C must be an odd integral multiple of λ

D must be an even integral multiple of λ



QUESTION

Answer in brief

A wave is represented by an equation $y = A \sin (Bx + Ct)$. Given that the constants A, B and C are positive, can you tell in which direction the wave is moving?

a) $+x$

b) $-x$

c) $+y$

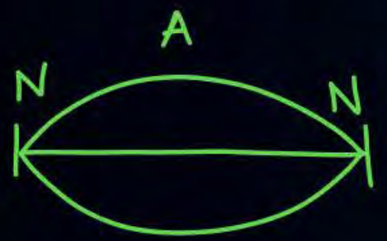
d) $-y$.

$y = A \sin (Kx - \omega t) \longrightarrow +x$

$y = A \sin (Bx + Ct) \longrightarrow -x$

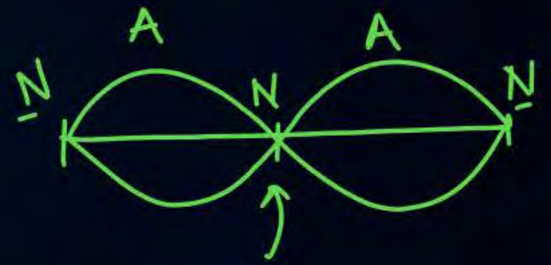
QUESTION

A string is fixed at the two ends and is vibrating in its fundamental mode. It is known that the two ends will be at rest. Apart from these, is there any position on the string which can be touched so as not to disturb the motion of the string? What will be the answer to this question if the string is vibrating in its first and second overtones?

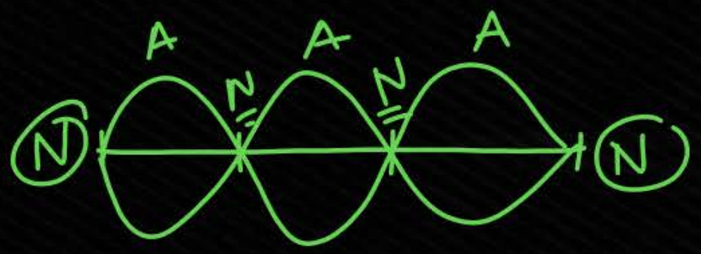


fundamental Mode

i) No other point in this mode.



ii) In this mode one point will be there.



ii) In this mode two other points are there.

QUESTION

The amplitude of a wave is represented by $y = 0.2\sin 4\pi\left[\frac{t}{0.08} - \frac{x}{0.8}\right]$ in SI units. Find (a) wavelength, (b) frequency and (c) amplitude of the wave.

$y = \underset{A}{0.2} \sin 4\pi\left[\frac{t}{0.08} - \frac{x}{0.8}\right]$

$\lambda = ?$

$f = ?$

$A = ?$

Equating with Std eqn of wave.

$y = A\sin(kx - \omega t)$

$y = 0.2 \sin\left[\frac{4\pi t}{0.08} - \frac{4\pi x}{0.8}\right]$

$A = 0.2\ m$

$k = \frac{4\pi}{0.8}$

$$\frac{2\pi}{\lambda} = \frac{4\pi^2}{0.8}$$

$$\lambda = \frac{0.8}{2} = 0.4\,m.$$

$$f = \frac{1}{T}$$

$$\omega = \frac{4\pi}{0.08}$$

$$2\pi f = \frac{4\pi^2}{0.08}.$$

$$f = \frac{200}{8}$$

$$f = 25\ Hz.$$

Homework

1) Revise today's Numericals.


धन्यवाद