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NCERT Class 11 Physics Solutions: Chapter 15 – Waves-Part 10 (For CBSE, ICSE, IAS, NET, NRA 2022)

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Question 15.18:

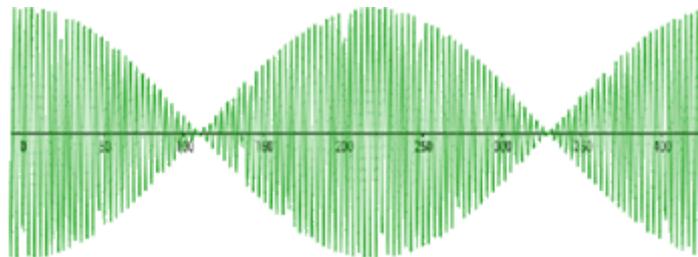
Two sitar strings A and B playing the note 'Ga' are slightly out of tune and produce beats of frequency 6 Hz. The tension in the string A is slightly reduced and the beat frequency is found to reduce to 3 Hz. If the original frequency of A is 324 Hz, what is the frequency of B?

Answer:

Frequency of string A, $f_A = 324$ Hz

Frequency of string B = f_B

Beat's frequency, $n = 6$ Hz



$$\text{Beat's frequency, } n = |f_A \pm f_B|$$

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Beat's frequency is given as:

$$n = |f_A \pm f_B|$$

$$6 = 324 \pm f_B$$

$$f_B = 330 \text{ Hz or } 318 \text{ Hz}$$

Frequency decreases with a decrease in the tension in a string. This is because frequency is directly proportional to the square root of tension. It is given as:

$$v \propto \sqrt{T}$$

Hence, the beat frequency cannot be 330 Hz

$$\therefore f_B = 318 \text{ Hz}$$

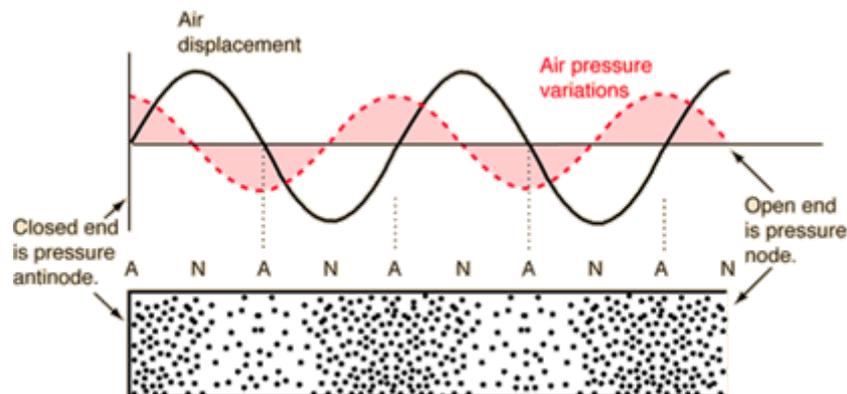
Question 15.19:

Explain why (or how) :

- (a) In a sound wave, a displacement node is a pressure antinode and vice versa,
- (b) Bats can ascertain distances, directions, nature, and sizes of the obstacles without any “eyes”
- (c) A violin note and sitar note may have the same frequency, yet we can distinguish between the two notes,
- (d) Solids can support both longitudinal and transverse waves, but only can propagate in gases, and
- (e) The shape of a pulse gets distorted during propagation in a dispersive medium.

Answer:

(a) **Explanation:**



A node is a point where the amplitude of vibration is the minimum and pressure is the maximum. On the other hand, an antinode is a point where the amplitude of vibration is the maximum and pressure is the minimum

Therefore, a displacement node is nothing but a pressure antinode, and vice versa

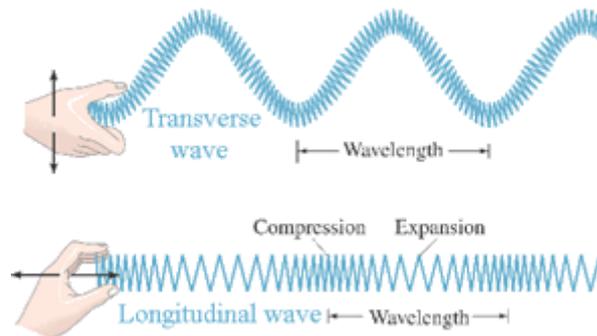
(b) Explanation:

Bats emit very high-frequency ultrasonic sound waves. These waves get reflected back toward them by obstacles. A bat receives a reflected wave (frequency) and estimates the distance, direction, nature, and size of an obstacle with the help of its brain senses.

(c) Explanation:

The overtones produced by a sitar and a violin, and the strengths of these overtones, are different. Hence, one can distinguish between the notes produced by a sitar and a violin even if they have the same frequency of vibration.

(d) Explanation:



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Solids have shear modulus. They can sustain shearing stress. Since fluids do not have any definite shape, they yield to shearing stress. The propagation of a transverse wave is such that it produces shearing stress in a medium. The propagation of such a wave is possible only in solids, and not in gases.

Both solids and fluids have their respective bulk moduli. They can sustain compressive stress. Hence, longitudinal waves can propagate through solids and fluids

(e) Explanation:

A pulse is actually is a combination of waves having different wavelengths. These waves travel in a dispersive medium with different velocities, depending on the nature of the

medium. This results in the distortion of the shape of a wave pulse.

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