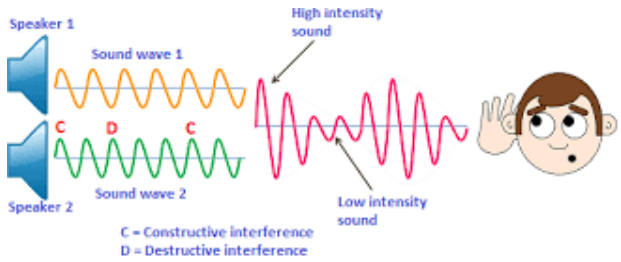
Beats

Definitions

When waves of the same type occupy the same point in space, they will the overall effect is an algebraic summation of the waves. For this effect to be visible (in the case of light) or audible (in the case of sound) the waves must be of closely similar frequencies or the same frequency. If the waves are similar but not the same, you will get beats as opposed to interference. This can be heard when you are tuning a guitar.

Equations/Diagrams



Questions

SUPERPOSITION OF SOUND WAVES (2021;1)

Two loudspeakers are connected to the same signal generator, which is set to make the loudspeakers vibrate at a frequency of 8.95×10^2 Hz (corresponding to a wavelength of 0.381 m in air).

The teacher wants to demonstrate beats. With Speaker 1 making a sound of frequency 8.95×10^2 Hz, she connects Speaker 2 so that it makes an equally loud sound of frequency 8.90×10^2 Hz.

(i) Explain why the students hear a note that regularly changes in loudness and determine the frequency of this beat.

(ii) Describe the changes to the frequency of beats the students will hear as the teacher slowly increases the frequency of Speaker 2 from 8.90×10^2 Hz to 9.00×10^2 Hz. Speaker 1 remains at a frequency of 8.95×10^2 Hz.

Terms

Beat: A kind of interference. It occurs when two sets of waves have slightly different frequencies.

Beat frequency: Difference between the frequencies of two similar waves.

Tips

- The only formula you need for beats is not given to you – you have to remember it:

$$|f_B| = f_1 - f_2$$

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Answers

(i) The beat frequency = 895 – 890 = 5 Hz. They hear beats because the waves from the two sources have slightly different frequencies, so they are regularly moving between being **in phase** (making **loud sounds** due to **constructive interference**) and **out of phase** (making **quieter sounds due** to **destructive interference**).

(ii) The initial beat frequency will be 5 Hz. But as the teacher increases the frequency of Speaker 2, the **beat frequency will decrease** until **no beats are heard, when the frequencies are the same.** Further increasing the frequency to 900 Hz will result in beats being formed again, and **becoming more frequent**, reaching 5 Hz when f_2 = 900 Hz.