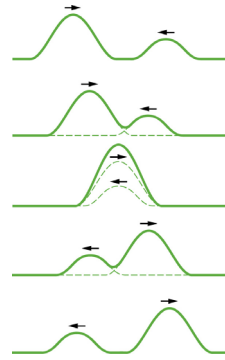


Physics 2A

Superposition and Standing Waves

[Interference](#)
[Beats](#)
[Standing Waves on a String](#)

Interference

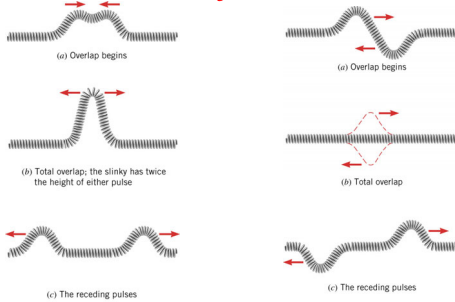


⇒ If two waves exist at the same point in space at the same time, they will interfere with each other.

[animations](#)



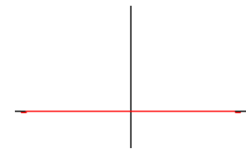
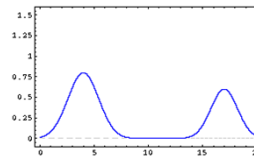
Interference



The Principle of Linear Superposition : When two or more waves are present simultaneously at the same place, the resultant disturbance is the sum of the disturbances from the individual waves.



Superposition Principle for Waves



⇒ Overlapping waves do not alter the travel of the other wave.

⇒ The individual waves move independently of one another.



Interference

The diagram illustrates two types of wave interference. In the first case, two waves in phase are added together, resulting in a wave with double the amplitude, labeled "Reinforcement" and "Constructive Interference". In the second case, two waves out of phase are added together, resulting in a flat line, labeled "Cancellation" and "Destructive Interference".

Constructive Interference

Destructive Interference

Interference

⇒ Sound waves, like any waves, can interfere with each other.

The diagram shows sound waves represented as longitudinal waves. For constructive interference, two waves in phase overlap to form a wave with a larger amplitude. For destructive interference, two waves out of phase overlap to form a wave with zero amplitude.

Constructive Interference

Destructive Interference

Interference

The diagram shows two speakers emitting sound waves. Red dots represent regions of constructive interference where wave crests overlap. Blue dots represent regions of destructive interference where a crest overlaps with a trough. A distance of "1 wavelength" is indicated between two consecutive constructive regions.

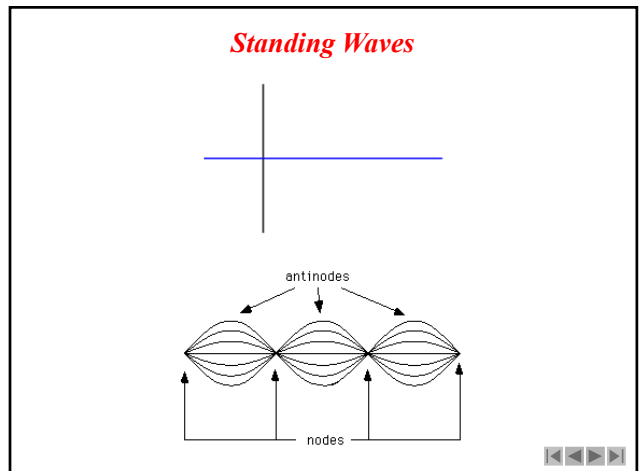
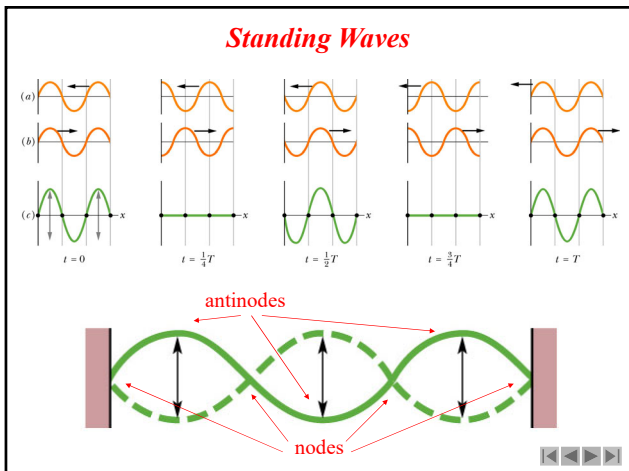
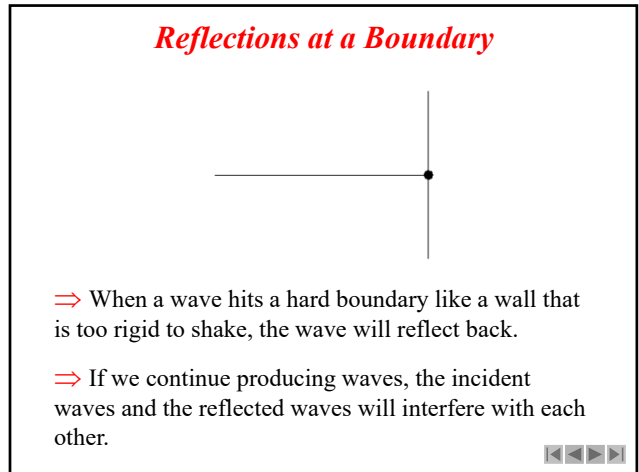
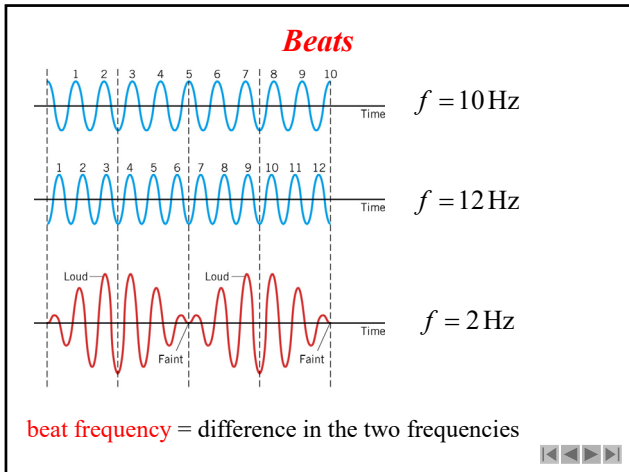
⇒ **Constructive interference** occurs when the condensations (or the rarefactions) from two sound waves overlap.

⇒ **Destructive interference** occurs if the condensation from one sound wave overlaps the rarefaction from another sound wave.

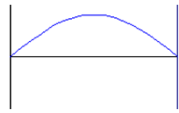
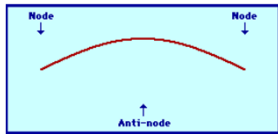
Beats

The diagram shows two tuning forks: one at 440 Hz and another at 438 Hz. A small piece of putty is placed between them. The resulting sound wave shows a periodic variation in amplitude, with labels for "Destructive" and "Constructive" interference occurring at regular intervals.

⇒ If two sound waves with slightly different frequencies overlap, the interference of the two sound waves produce **beats**.



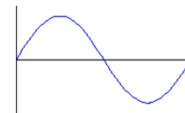
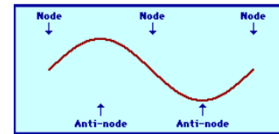
Standing Waves



fundamental mode or first harmonic



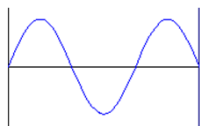
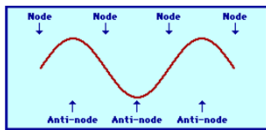
Standing Waves



second harmonic



Standing Waves



third harmonic

