Sunday, March 31, 2019 9:26 PM

General Two Source Interference

Foundation Stage (GI.2.L0)

Lecture 0
Introduction and Two Source Interference

Textbook Chapters (* Calculus version)

- **BoxSand** :: KC videos (Optics)
- **Knight** (College Physics : A strategic approach 3rd) ::
- ***Knight** (Physics for Scientists and Engineers 4th) ::
- **Giancoli** (Physics Principles with Applications 7th) ::

Warm up

GI.2.L0-1:

Description:

Learning Objectives: [?] - Can you identify the objectives from the previous lecture, and this lecture, that this question is relevant to?

Problem Statement: Consider the following terms. For each, discuss with your neighbors whether the term describes constructive or destructive interference.

(a) Bright

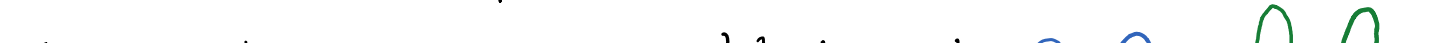
(b) Loud

(c) Soft

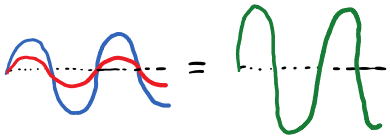
(d) Dark

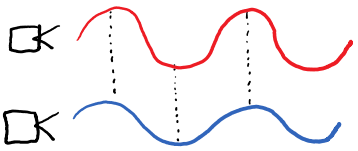
(e) Quiet

Interference - caused by waves entering same space at same time



Space at same time

Superposition – waves add linearly 



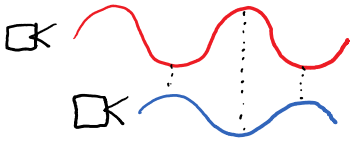
"in phase"

PLD = 0

constructive interference

sound – louder

light – brighter



"out of phase"

PLD = $\frac{1}{2}\lambda$

Conditions for Const. & Destructive Int.

Path Length Diff. PLD

Const. if $PLD = |PL_1 - PL_2| = m\lambda$, $m = 0, 1, 2, 3 \ldots$

Dest. if $PLD = |PL_1 - PL_2| = \left(m + \frac{1}{2}\right)\lambda$, $m = 0, 1, 2, 3 \ldots$

Selected Learning Objectives

1. Coming soon to a lecture template near you.

Key Terms

- Path length difference
- Coherent
- Constructive
- Destructive

Key Equations

Constructive	Destructive
PLD = m λ	PLD = (m + $\frac{1}{2}$) λ

Key Concepts

- Coming soon to a lecture template near you.

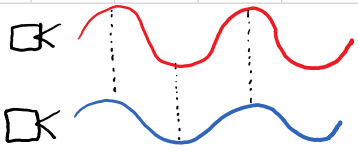
Questions

Act I: Coherence

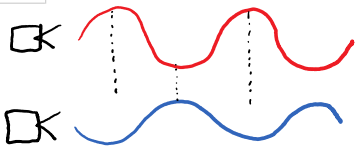
GI.2.L0-2:

Problem Statement: Which of these sets of speaker is "in phase"?

(a)



(b)



GI.2.L0-3:

Problem Statement: A speaker is producing 440 Hz sound. Four other nearby speakers are producing sound. Which of the following speakers are said to be "coherent" with the first speaker?

(a) Speaker A producing 400 Hz sound

(b) Speaker B producing 220 Hz sound

(c) Speaker C producing 440 Hz sound

(d) Speaker D producing sound with a wavelength of 78 cm

GI.2.L0-4:

Problem Statement: Many everyday objects produce multiple waves at the same time. These sources are said to be coherent if the waves they produce all have the same frequency. Which of the following can produce coherent waves?

(a) The sun

(b) **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation

(c) Incandescent Lightbulbs

(d) Monochromatic LEDs

(e) Two speakers hooked to the same amplifier

(f) Speaker and tuning fork playing the same frequency

Act II: Path Length Difference

GI.2.L0-4:

Problem Statement: When considering the interference between two spatially separated sources, what is the most important thing to consider?

(a) The **P**ath **L**ength **D**ifference (PLD)

(b) Anything else

GI.2.L0-5:

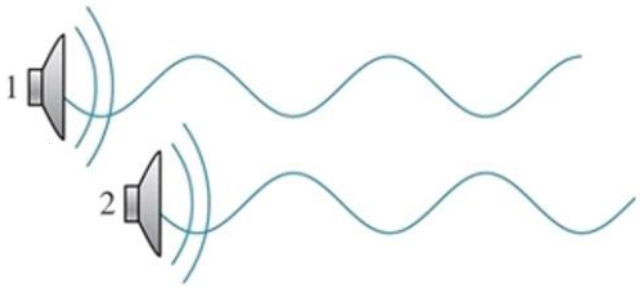
Problem Statement: Are the pictured speakers producing completely destructive interference, completely constructive interference, or somewhere in between?

(a) Completely Constructive

(a) Completely Constructive

(b) Completely Destructive

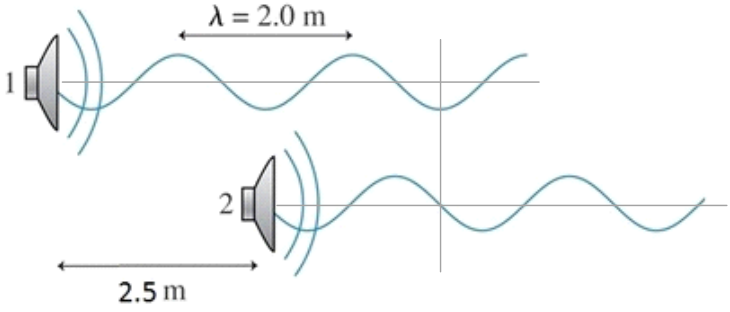
(c) Somewhere in-between



GI.2.L0-6:

Problem Statement: Two loudspeakers emit (l = 2.0 m) waves that are in phase with each other. Speaker 2 is 2.5 m in front of speaker 1. What, if anything, must be done to cause completely constructive interference between the two waves?

1. Move speaker 1 forward (to the right) 0.5 m.
2. Move speaker 1 backward (to the left) 1.0 m.
3. Move speaker 1 forward (to the right) 1.0 m.
4. Move speaker 2 backward (to the left) 0.5 m.
5. Move speaker 2 forward (to the right) 0.5 m.
6. Move speaker 2 forward (to the right) 1.0 m.
7. Move speaker 2 forward (to the right) 1.5 m.
8. Nothing. The situation shown already causes constructive interference.



GI.2.L0-7:

Problem Statement: What would need to be done in order to produce completely destructive interference?

GI.2.L0-8:

Problem Statement: Two sources separated in space …blah …blah …blah. Interference question.

(a) Density of the medium

(b) Ratio of the path lengths

(c) Path Length Difference

(d) 42 Hz

(e) Depends on what the wave tastes like

Act III: Two Source Interference

GI.2.L0-9:

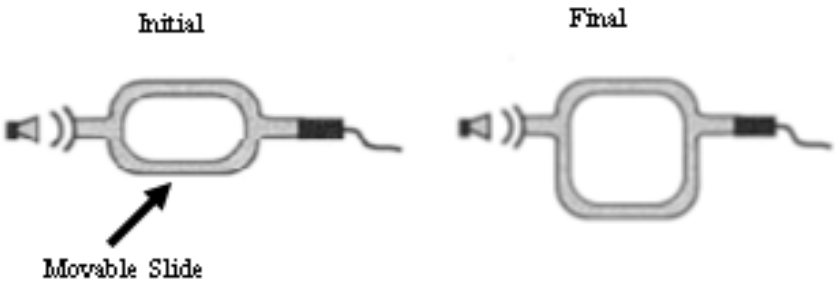
Problem Statement: Two speakers, 4 m apart, produce identical 343 Hz sound waves. Mark with an X, one location along the line that connects them, where constructive interference occurs.

GI.2.L0-10:

Problem Statement: How many constructive interference points exist between the two speakers?

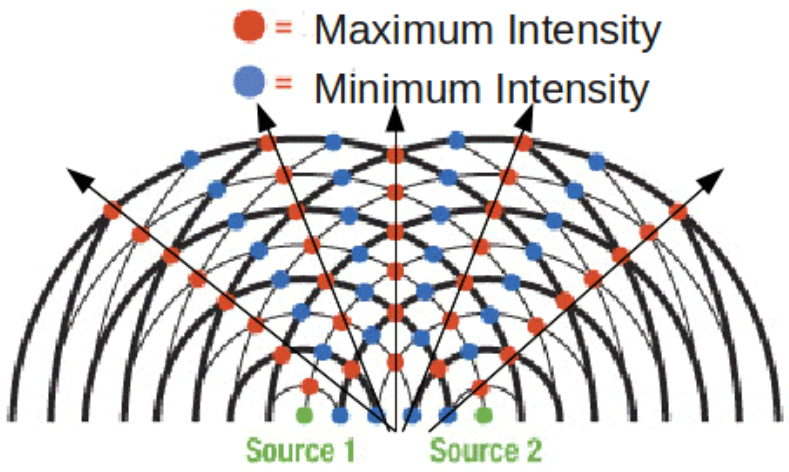
GI.2.L0-11:

Problem Statement: A speaker generates a continuous tone of 1240 Hz. In the drawing, sound travels into a tube which splits into two segments, one fixed in length, and one with a movable slide like a trombone. The sound waves recombine before being detected by a microphone. The tube is initially at a state the produces a loud sound, and the speed of sound in air is 343 m/s. While slowly sliding the moveable segment out it is noticed that the sound gets soft and then loud again 10 times. How far has the slide been moved out during this action?



GI.2.L0-12:

Problem Statement: Two sources produce identical spherical waves. In the 2D plane that intersects the two sources, there is a line along which all points will display constructive interference. Draw that line on the figure below.



Conceptual questions for discussion

1. Coming soon to a lecture template near you.

Hints

GI.2.L0-1: No hints.