PHY138 – Waves, Lecture 6

Today's overview

- Constructive and Destructive Interference
- Interference Patterns
- Beats

Reading Assignment

- Next week's reading is Knight **Chapter 23**, Sections 23.1 – 23.6. There is a pre-class quiz on **www.masteringphysics.com** for this material due on Monday morning. It is the *last* pre-class quiz of 2007.
- Waves Quarter **Written Team Problem Set** is due Friday by 5:00 PM in T.A. drop box. – You must work in the teams you've been assigned to in tutorial.

Message from Dr. Savaria….(again)

- If you have a conflict at 6:00-7:30 PM on Dec.4 and wish to write Test 2 at an alternate time:
  - Send an email to phy138y@physics.utoronto.ca confirming that you wish to re-register, if you registered for the alternate sitting of Test 1.

  or

  - Visit April Seeley in MP129 or MP302 to register for the first time you will write in an alternate time.
- The deadline for confirming / registering is Nov.26 by 5:00PM.

"Lasers": Standing Waves for Light

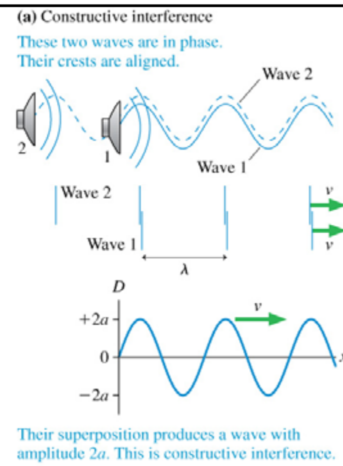
- Light Amplified by Stimulated Emission Radiation
- Eye surgery: corneal transplants, vision correction
- Heart surgery
- Laser imaging for diagnosis
- Laser dentistry

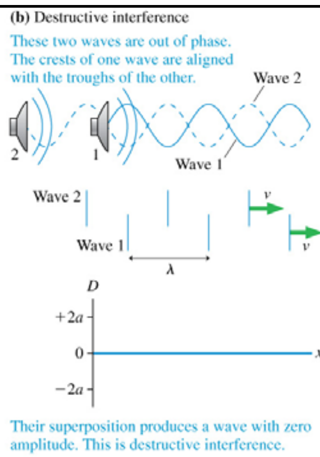
Wave Interference

- Two waves moving in the same direction with the same amplitude and same frequency form a new wave with amplitude:

$$A = \left| 2a\cos\left(\frac{\Delta\phi}{2}\right) \right|$$

where a is the amplitude of either of the individual waves, and $\Delta\phi$ is their phase difference.

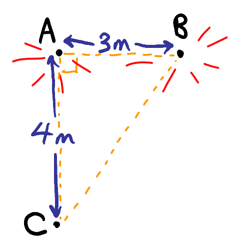




Two speakers, A and B, are "in phase" and emit a pure note with a wavelength 2 m. The speakers are side-by-side, 3 m apart. Point C is 4 m directly in front of speaker A.

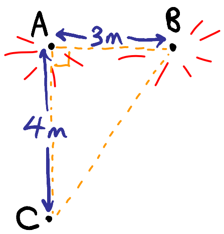
How many wavelengths are between Speaker A and Point C?

A. 0.5
B. 1.0
C. 1.5
D. 2.0
E. 2.5



Two speakers, A and B, are “in phase” and emit a pure note with a wavelength 2 m. The speakers are side-by-side, 3 m apart. Point C is 4 m directly in front of speaker A.

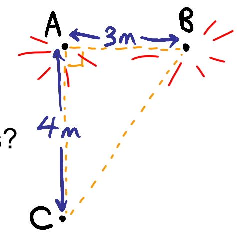
How many wavelengths are between Speaker B and Point C?



A. 0.5
B. 1.0
C. 1.5
D. 2.0
E. 2.5

Two speakers, A and B, are “in phase” and emit a pure note with a wavelength 2 m. The speakers are side-by-side, 3 m apart. Point C is 4 m directly in front of speaker A.

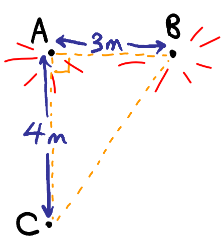
At point C, what is the path difference between the sounds received from speakers A and B, as measured in wavelengths?



A. 0.5 B. 1.0 C. 1.5
D. 2.0 E. 2.5

Two speakers, A and B, are “in phase” and emit a pure note with a wavelength 2 m. The speakers are side-by-side, 3 m apart. Point C is 4 m directly in front of speaker A.

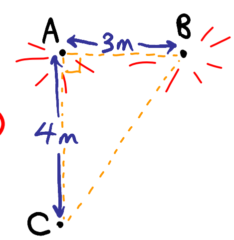
At point C, what is the phase difference between the sounds received from speakers A and B?



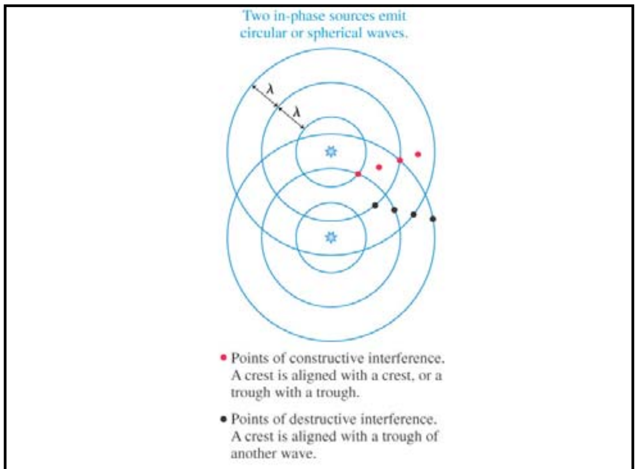
A. 0.5π B. π C. 1.5 π
D. 2.0 π E. 2.5 π

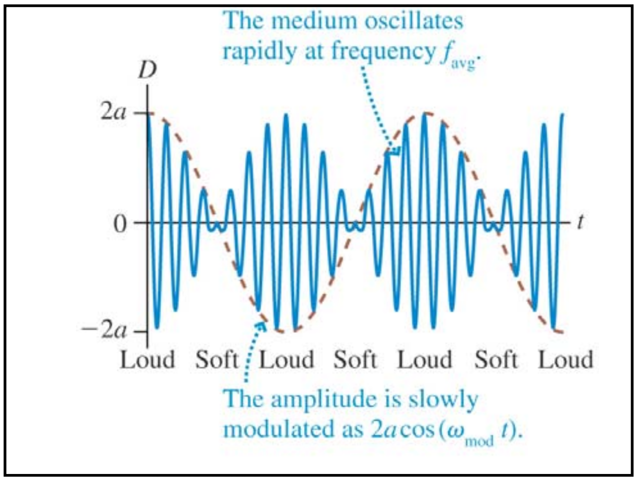
Two speakers, A and B, are “in phase” and emit a pure note with a wavelength 2 m. The speakers are side-by-side, 3 m apart. Point C is 4 m directly in front of speaker A.

At point C, there will be



A. Perfect constructive interference (A_C=2A)
B. Perfect destructive interference (A_C=zero)
C. Intermediate interference ($0 < A_C < 2A$)





Beat frequency

- Beats are loud sounds separated by soft sounds
- The beat frequency is the difference of the frequencies of the two waves that are being added:

$$f_{beat} = 2 f_{\mathrm{mod}} = \left| f_1 - f_2 \right|$$

- The frequency of the actual sound is the average of the frequencies of the two waves that are being added:

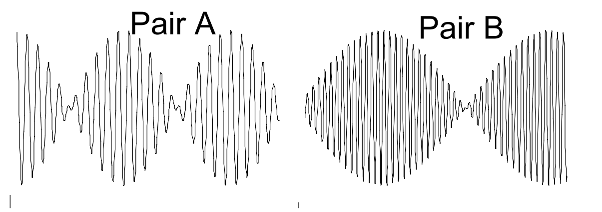
$$f_{avg} = \frac{f_1 + f_2}{2}$$

Two pure notes are played simultaneously. One is A, with a frequency of 440 Hz, the other is C, with a frequency of 520 Hz. What is the beat frequency when these two notes are played together?

A. 40 Hz
B. 80 Hz
C. 160 Hz
D. 480 Hz
E. No beats can be heard.

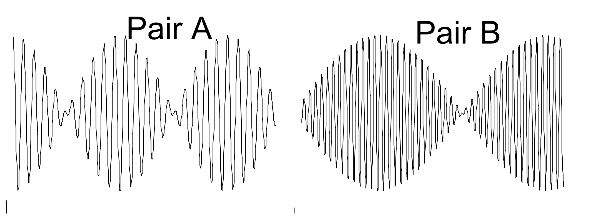
Two pure notes are played simultaneously. One is A, with a frequency of 440 Hz, the other is an out of tune A, with a frequency of 439 Hz. What is the beat frequency when these two notes are played together?

A. 0.5 Hz
B. 1 Hz
C. 2 Hz
D. 439.5 Hz
E. No beats can be heard.



The traces above show beats that occur when two different pairs of waves are added. For which of the two is the *difference* in frequency of the original waves greater?

A. Pair A
B. Pair B
C. The frequency difference is the same for both.



The traces above show beats that occur when two different pairs of waves are added. For which of the two is the *average* frequency of the original waves greater?

A. Pair A
B. Pair B
C. The frequency average is the same for both.