## Chapter 28: Physical Optics: Interference and Diffraction

The figure shows two students listening to two coherent sound sources. Both students hear constructive interference.

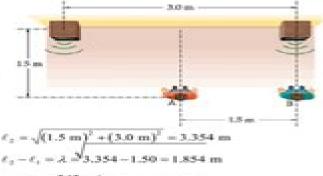
Since student A is equidistant from both speakers the difference in path lengths from each speaker is zero. For student B to also hear constructive interference (and for the wavelength to be a maximum) the path length difference between him and the two speakers must be equal to one wavelength. Calculate the distance of student B from each speaker. Set the wavelength equal to the difference in distances. Divide the speed of sound by the wavelength to calculate the frequency.

- Calculate the distance to the far speaker:
- 2. Subtract the distances:
- 3. Divide the speed of sound by the wavelength:
- 9. The image shows three people standing 3.00 m in front of two speakers that are separated by 0.800 m. The people are each standing 1.00 m apart with the middle person directly in front of the midpoint between the speakers. The speakers are oscillating in phase.

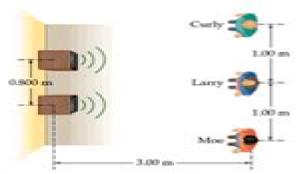
Larry, at the midpoint, is equidistant from each speaker and will hear maximum intensity at all frequencies. Moe and Curly will hear minimum intensity when the difference in their distances from each speaker is a half-integral wavelength. Use the Pythagorean theorem to determine their distances from the speakers. Set  $\Delta t = \frac{1}{2} \lambda^2$  for the lowest

frequency and  $\Delta \ell = \frac{1}{2} \lambda$  for the second lowest frequency and solve for the wavelength. Then divide the speed of sound by the wavelength to calculate the frequency.

- 1. Find Moe's distance to the near speaker:
- 2. Find Moe's distance to the far speaker:
- 3. Set the difference equal to a half wavelength:
- 4. Divide the speed by the wavelength:
- Set Δℓ = ½ λ to find λ:
- 6. Divide the speed by the wavelength:



$$f = \frac{v}{\lambda} = \frac{343 \text{ m/s}}{1.854 \text{ m}} = \boxed{0.18 \text{ kHz}}$$



$$\ell_1 = \sqrt{(1.00 \text{ m} - 0.40 \text{ m})^2 + (3.00 \text{ m})^2} = 3.059 \text{ m}$$

$$\ell_2 = \sqrt{(1.00 \text{ m} + 0.40 \text{ m})^2 + (3.00 \text{ m})^2} = 3.311 \text{ m}$$

$$\frac{1}{2}\lambda = \ell_1 - \ell_1 \implies \lambda = 2(3.311 \text{ m} - 3.059 \text{ m}) = 0.502 \text{ m}$$

$$f = \frac{v}{\lambda} = \frac{343 \text{ m/s}}{0.502 \text{ m}} = \frac{[0.68 \text{ kHz}]}{[0.68 \text{ kHz}]}$$
  
 $\frac{1}{2}\lambda = \ell_1 - \ell_1 \implies \lambda = \frac{3}{2}(3.311 \text{ m} - 3.059 \text{ m}) = 0.167 \text{ m}$ 

$$f = \frac{v}{\lambda} = \frac{343 \text{ m/s}}{0.167 \text{ m}} = [2.0 \text{ kHz}]$$

# **Chapter Interference And Diffraction**

**Ansel Alphonso Knowlton** 

## **Chapter Interference And Diffraction:**

Physics for Scientists and Engineers, Volume 1: Mechanics, Oscillations and Waves; Thermodynamics Paul A. Tipler, Gene Mosca, 2003-07-10 This is the standard text for introductory physics courses taken by science and engineering students This edition has been extensively revised with new artwork and updated examples **Physics for College Students** Ansel Physics of Oscillations and Waves Arnt Inge Vistnes, 2018-08-21 In this textbook a Alphonso Knowlton, 1928 combination of standard mathematics and modern numerical methods is used to describe a wide range of natural wave phenomena such as sound light and water waves particularly in specific popular contexts e g colors or the acoustics of musical instruments It introduces the reader to the basic physical principles that allow the description of the oscillatory motion of matter and classical fields as well as resulting concepts including interference diffraction and coherence Numerical methods offer new scientific insights and make it possible to handle interesting cases that can t readily be addressed using analytical mathematics this holds true not only for problem solving but also for the description of phenomena Essential physical parameters are brought more into focus rather than concentrating on the details of which mathematical trick should be used to obtain a certain solution Readers will learn how time resolved frequency analysis offers a deeper understanding of the interplay between frequency and time which is relevant to many phenomena involving oscillations and waves Attention is also drawn to common misconceptions resulting from uncritical use of the Fourier transform The book offers an ideal guide for upper level undergraduate physics students and will also benefit physics instructors Program codes in Matlab and Python together with interesting files for use in the problems are provided as free supplementary material *Physics for Scientists* and Engineers, Volume 2: Electricity, Magnetism, Light, and Elementary Modern Physics Paul Allen Tipler, 2004 WAVE OPTICS GARG, SURESH, GHOSH, C. K., GUPTA, SANJAY, 2011-12-24 This textbook offers a complete and rigorous presentation of the fundamentals and applications of wave optics. The material of the book covers topics on wave nature of light reflection refraction polarisation diffraction dispersion and scattering of electromagnetic waves Interference phenomenon is discussed both by division of wavefront and by division of amplitude Diffraction is classified as Fresnel diffraction and Fraunhofer diffraction The discussion on Fraunhofer diffraction has been used to explain the theory and resolving power of optical instruments The role of phenomena of dispersion and scattering of light has been lucidly explained in the field of communication of information its quality and content The last three chapters are devoted to the study of the recently developed modern topics lasers holography and fibre optics all of which have opened up immense opportunities for new applications in almost all branches of science and engineering Though the book is intended for the undergraduate students of physics both honours and general courses it will also be useful to candidates aspiring to sit the competitive examinations KEY FEATURES Presents interactive text interspersed with in text questions to enable students to shift focus on active learning Uses access devices such as expected learning outcomes and practice exercises for directed teaching

learning Includes numerous worked out examples to illustrate the concepts and provides review questions to test the students understanding of the subject Gives chapter end summary for quick revision of the important results Physics: Being an Introduction to the Study of Physical Science William Peddie, 1892 Physics Behind Music Bryan H. Suits, 2023-04-06 This engaging undergraduate text uses the performance recording and enjoyment of music to present basic principles of physics The narrative lays out specific results from physics as well as some of the methodology thought processes and interconnectedness of physics concepts results and ideas Short chapters start with basic definitions and everyday observations and ultimately work through standard topics including vibrations waves acoustics and electronics applications Each chapter includes problems some of which are suited for longer term projects and suggestions for extra reading that guide students toward a deeper understanding of the physics behind music applications To aid teaching additional review questions audio and video clips and suggestions for class activities are provided online for instructors Α Fundamentals of Physics, Part 4, Chapters 34 - 38, Enhanced Problems Manual of Physics William Peddie, 1892 **Version** David Halliday, Robert Resnick, Jearl Walker, 2003 The primary goal of this text is to provide students with a solid understanding of fundamental physics concepts and to help them apply this conceptual understanding to quantitative Practical exercises in light Reginald Stanley Clay, 1902 Physics Oscar Milton Stewart, 1924 problem solving

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