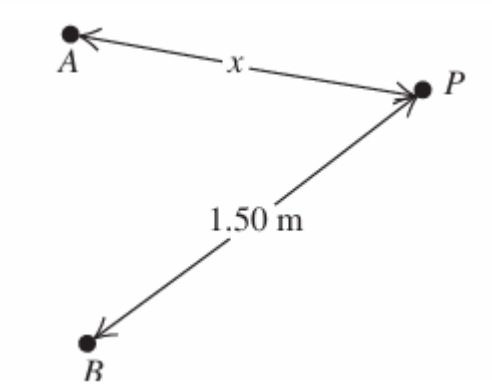
Chapter 35 Tutorial

Optics - III

Interference

Question 1:
Two small stereo speakers *A* and *B* that are 1.40 m apart are sending out sound of wavelength 34 cm in all directions and all in phase. A person at point *P* starts out equidistant from both speakers and walks so that he is always 1.50 m from speaker *B*. For what values of x will the sound this person hears be

(a) maximally reinforced
(b) cancelled? Limit your solution to the cases where $x \leq 1.50$ m.



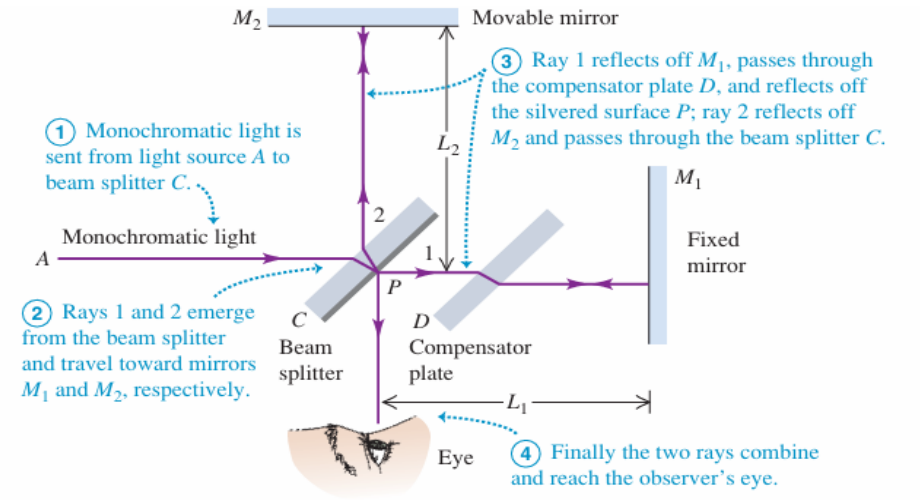
Question 2:
Young's experiment is performed with light from excited helium atoms ($\lambda = 502$ nm). Fringes are measured carefully on a screen 1.20 m away from the double slit, and the center of the 20th fringe (not counting the central bright fringe) is found to be 10.6 mm from the center of the central bright fringe. What is the separation of the two slits?

Question 3:
Consider two antennas separated by 9.00 m that radiate in phase at 120 MHz. A receiver placed 150m from both antennas measures an intensity I_0. The receiver is moved so that it is 1.8 m closer to one antenna than to the other.

(a) What is the phase difference ϕ between the two radio waves produced by this path difference?
(b) In terms of I_0, what is the intensity measured by the receiver at its new position?

Question 4:

How far must the mirror M_2 of the Michelson interferometer be moved so that 1800 fringes of $\mathrm{He-Ne}$ laser light ($\lambda = 633$ nm) move across a line in the field of view?


M_2
Movable mirror
3 Ray 1 reflects off M_1, passes through the compensator plate D, and reflects off the silvered surface P; ray 2 reflects off M_2 and passes through the beam splitter C.
1 Monochromatic light is sent from light source A to beam splitter C.
L_2
M_1
2
Monochromatic light
A
1
Fixed mirror
P
2 Rays 1 and 2 emerge from the beam splitter and travel toward mirrors M_1 and M_2, respectively.
C
Beam splitter
D
Compensator plate
L_1
Eye
4 Finally the two rays combine and reach the observer's eye.