Honors Physics Optics HW, Ch. 24 (Homework)

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1.
In a Young's double-slit experiment, a set of parallel slits with a separation of 0.150 mm is illuminated by light having a wavelength of 557 nm and the interference pattern observed on a screen 4.00 m from the slits.
(a) What is the difference in path lengths from each of the slits to the screen location of a 3rd order bright fringe?
(b) What is the difference in path lengths from each of the slits to the screen location of a 3rd order dark fringe?

2.
A pair of narrow, parallel slits separated by 0.270 mm are illuminated by the green component from a mercury vapor lamp (λ = 546.1 nm). The interference pattern is observed on a screen 1.27 m from the plane of the parallel slits. Calculate the distance
(a) from the central maximum to the first bright region on either side of the central maximum and
(b) between the first and second dark bands in the interference pattern.

3.
A riverside warehouse has two open doors, as in Figure P24.4. A boat on the river sounds its horn. To person *A* the sound is loud and clear. To person *B* the sound is barely audible. The principal wavelength of the sound waves is 3.00 m. Assuming person *B* is at the position of the first minimum, determine the distance between the doors, center to center.

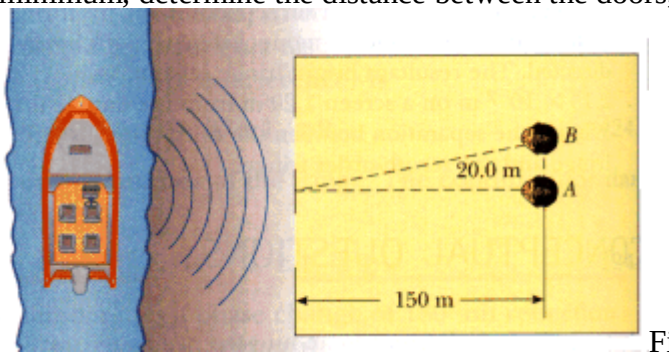

Figure P24.4.

4.
Two radio antennas separated by d = 285 m, as shown in Figure P24.8, simultaneously transmit identical signals of the same wavelength. A radio in a car traveling due north receives the signals.

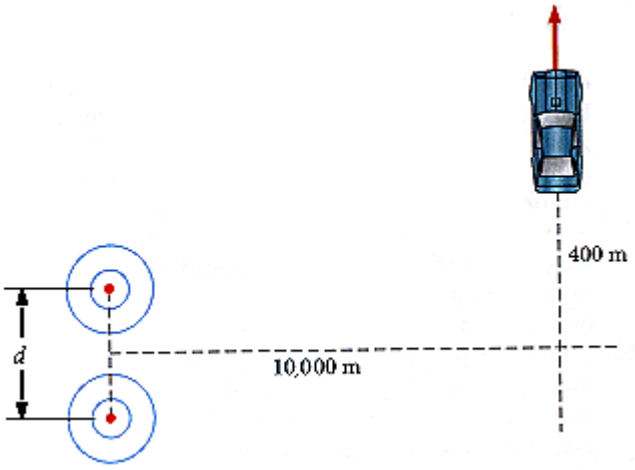

Figure P24.8.

(a) If the car is at the position of the second maximum, what is the wavelength of the signals?
(b) How much farther must the car travel to encounter the next minimum in reception?

5.
The waves from a radio station can reach a home receiver by two different paths. One is a straight-line path from the transmitter to the home, a distance of 31.0 km. The second path is by reflection from a storm cloud. Assume that this reflection takes place at a point midway between receiver and transmitter. If the wavelength broadcast by the radio station is 375 m, find the minimum height of the storm cloud that will produce destructive interference between the direct and reflected beams. (Assume no phase changes on reflection.)

6.
Determine the minimum thickness of a soap film (n = 1.331) that will result in constructive interference of
(a) the red H_α line (λ = 656.3 nm);
(b) the blue H_γ line (λ = 434.0 nm).

7.
Light of wavelength 600 nm falls on a 0.39 mm wide slit and forms a diffraction pattern on a screen 1.7 m away.
(a) Find the position of the first dark band on each side of the central maximum.
(b) Find the width of the central maximum.