# 4 Interference and Diffraction

8/19: 1) Young and Freedman (2019): Problem 35.9.

Two slits spaced 0.450 mm apart are place 75.0 cm from a screen. What is the distance between the second and third dark lines of the interference pattern on the screen when the slits are illuminated with coherent light with a wavelength of 500 nm?

2) Young and Freedman (2019): Problem 35.20.

Two slits spaced 0.072 0 mm apart are 0.800 m from a screen. Coherent light of wavelength $\lambda$ passes through the two slits. In their interference pattern on the screen, the distance from the center of the central maximum to the first minimum is 3.00 mm. If the intensity at the peak of the central maximum is 0.060 0 W/m$^2$, what is the intensity at points on the screen that are

(a) 2.00 mm from the center of the central maximum;

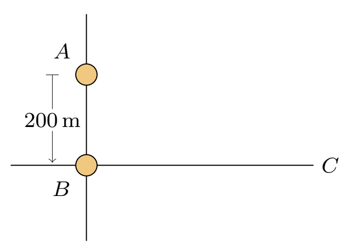
(b) 1.50 mm from the center of the central maximum?

3) Young and Freedman (2019): Problem 35.39.

Suppose you illuminate two thin slits by monochromatic coherent light in air and find that they produce their first interference *minima* at $\pm 35.20°$ on either side of the central bright spot. You then immerse these slits in a transparent liquid and illuminate them with the same light. Now you find that the first minima occur at $\pm 19.46°$ instead. What is the index of refraction of this liquid?

4) Young and Freedman (2019): Problem 35.41.

Two radio antennae radiating in phase are located at points $A$ and $B$, 200 m apart (see the following figure). The radio waves have a frequency of 5.80 MHz. A radio receiver is moved out from point $B$ along a line perpendicular to the line connecting $A$ and $B$ (line $BC$ shown in the following figure). At what distances from $B$ will there be *destructive* interference? (Note: The distance of the receiver from the sources is not large in comparison to the separation of the sources.)




5) Young and Freedman (2019): Problem 35.45.

White light reflects at normal incidence from the top and bottom surfaces of a glass plate ($n = 1.52$). There is air above and below the plate. Constructive interference is observed for light whose wavelength in air is 477.0 nm. What is the thickness of the plate if the next longer wavelength for which there is constructive interference is 540.6 nm?

6) Young and Freedman (2019): Problem 36.1.

Monochromatic light from a distant source is incident on a slit 0.750 mm wide. On a screen 2.00 m away, the distance from the central maximum of the diffraction pattern to the first minimum is measured to be 1.35 mm. Calculate the wavelength of the light.

7) Young and Freedman (2019): Problem 36.14.

   Monochromatic light of wavelength $\lambda = 620\,\text{nm}$ from a distant source passes through a slit $0.450\,\text{mm}$ wide. The diffraction pattern is observed on a screen $3.00\,\text{m}$ from the slit. In terms of the intensity $I_0$ at the peak of the central maximum, what is the intensity of the light at the screen the following distances from the center of the central maximum:

   (a) $1.00\,\text{mm}$.

   (b) $3.00\,\text{mm}$.

   (c) $5.00\,\text{mm}$.

8) Young and Freedman (2019): Problem 36.26.

   Monochromatic light is at normal incidence on a plane transmission grating. The first-order maximum in the interference pattern is at an angle of $11.3°$. What is the angular position of the fourth-order maximum?

9) In an experiment, light of wavelength $\lambda$ falls on three slits evenly spaced a distance $d$ apart, and an interference pattern is observed on a distant screen. If the intensity at $0°$ with two adjacent slits open (and the third slit covered) is $I_2$, what is the intensity at $0°$ when all three slits are open, $I_3$?