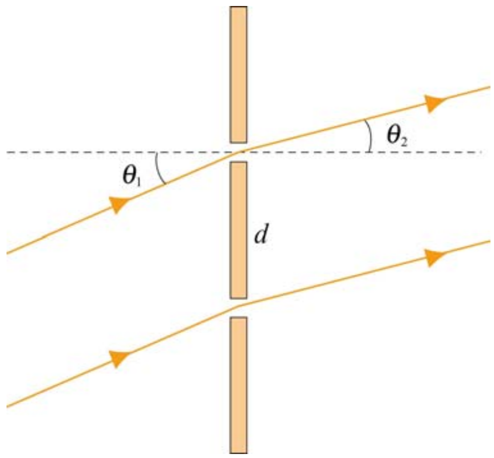
Interference
Challenge Problems

Problem 1:

Coherent light rays of wavelength λ are illuminated on a pair of slits separated by distance d at an angle θ_1, as shown in the figure below.



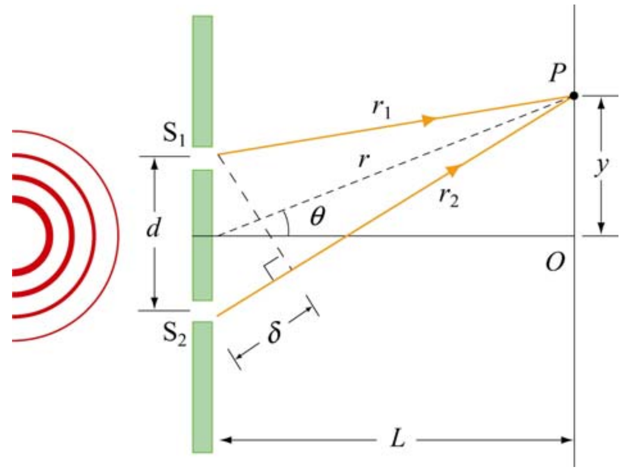
If an interference maximum is formed at an angle θ_2 far from the slits, find the relationship between θ_1, θ_2, d and λ.

Problem 2:

In the Young's double-slit experiment, suppose the separation between the two slits is d=0.320 mm. If a beam of 500-nm light strikes the slits and produces an interference pattern. How many maxima will there be in the angular range $-30.0° < \theta < 30.0°$?

Problem 3:

In the double-slit interference experiment shown in the figure, suppose $d = 0.100\,\text{mm}$ and $L = 1.20\,\text{m}$, and the incident light is monochromatic with a wavelength λ=600 nm.



(a) What is the phase difference between the two waves arriving at a point P on the screen when $\theta = 0.800°$?

(b) What is the phase difference between the two waves arriving at a point P on the screen when $y = 4.00\,\text{mm}$?

(c) If the phase difference between the two waves arriving at point P is ϕ=1/3 rad, what is the value of θ?

(d) If the path difference is $\delta = \lambda / 4$, what is the value of θ?

(e) In the double-slit interference experiment, suppose the slits are separated by $d = 1.00\,\text{cm}$ and the viewing screen is located at a distance $L = 1.20\,\text{m}$ from the slits. Let the incident light be monochromatic with a wavelength λ=500 nm. Calculate the spacing between the adjacent bright fringes on the viewing screen.

(f) What is the distance between the third-order fringe and the center line on the viewing screen?

Problem 4:

Let the intensity on the screen at a certain point in a double-slit interference pattern be 64.0% of the maximum value.

(a) What is the minimum phase difference (in radians) between sources that produces this result?

(b) Express this phase difference as a path difference for 486.1-nm light.