Quiz 27.1B

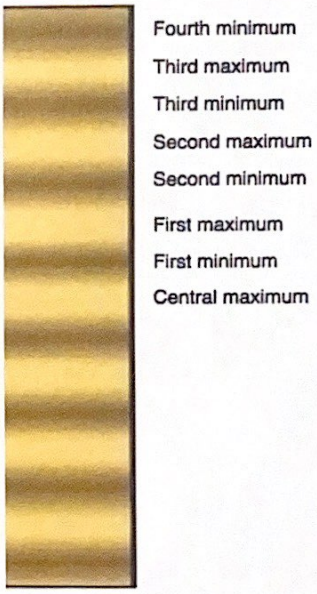
Light of wavelength 458 nm is incident on two slits separated by 0.120 mm, and the resulting interference pattern is projected on a screen 3.50 meters away. For clarity, I have labeled the minima and maxima for the top half of the pattern projected on the wall in the figure below.

a) What is the path difference, in waves, for the light rays from the two slits that strike the location of the fourth minimum?

b) What is the distance (in cm) between the central maximum and the fourth minimum?

c) If the slit separation decreases, does your answer for part (a) increase, decrease or stay the same? Assume no change in wavelength or L for this part.

d) If the slit separation decreases, does your answer for part (b) increase, decrease or stay the same? Assume no change in wavelength or L for this part.



a) 1st min: $\Delta\phi = \frac{1}{2}\lambda$

2nd min: $\Delta\phi = \frac{3}{2}\lambda$

3rd min: $\Delta\phi = \frac{5}{2}\lambda$

4th min: $\Delta\phi = \frac{7}{2}\lambda$

$\boxed{3.50\lambda}$

---

b) $\frac{dy}{L} = 3.5\lambda$

$\Rightarrow y = \frac{3.5\lambda L}{d}$

$\frac{(3.5)(458\times10^{-9})(3.50)}{.120\times10^{-3}} = 4.68\times10^{-2}\,m$

or $\boxed{4.68\ cm}$

---

c) stays the same. The 4th minimum is defined by the fact that $\Delta\phi = 3.5\lambda$.

---

d) increases. Since $y = \frac{3.5\lambda L}{d}$, $y \propto \frac{1}{d}$

so if $d\downarrow$, then $y\uparrow$