Physics 173-1,2
Spring Quarter 1985
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George Williams

average = 23.6

3

3RD MIDTERM

Name (Print) Solution Name (Sign) Marlon Luty

Discussion Instructor (CIRCLE ONE): Crelly Kao Luty McDonald

Discussion Section #: _____ Pollard Saffer

SHOW ALL WORK!! Report all numbers to three significant figures!
Use the conversion constants and data given on the front page.

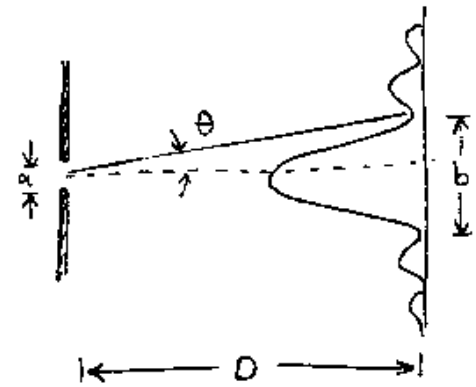
A single slit diffraction pattern is observed in air using red light of $\lambda = 650$ nm. The first minima on either side of the center maximum are observed on a screen 6.50 m from the slit to be 1.25 cm apart.

(a) Calculate the slit width.
(b) Calculate the separation of the same two minima, if the experiment is repeated under water (n = 1.33) with the slit width and the screen distance the same.

(+10) a) $a\sin\theta = m\lambda$ $m = 1, 2, 3, \ldots$ (+3)

(for minima)

$a = \frac{m\lambda}{\sin\theta} = \frac{\lambda}{\sin\theta}$ (first minima) (+2)



Using small angle approximation:

$\sin\theta \approx \tan\theta = \frac{\frac{1}{2}b}{D} = \frac{b}{2D}$ (+3)

$$\boxed{a = \frac{2\lambda D}{b}} = 6.76 \times 10^{-4}\ \text{m}$$ (+2)

(+15) b) If we are in a medium with index of refraction n, the wavelength changes from λ to $\frac{\lambda}{n}$. Nothing else changes! (+5)

$a\sin\theta' = m\frac{\lambda}{n}$ $\sin\theta' = \frac{m\lambda}{na} = \frac{\lambda}{na}$ (first minima again) (+5)

$\sin\theta' \approx \tan\theta' = \frac{b'}{2D} = \frac{\lambda}{na}$ (+3)

$$\boxed{b' = \frac{2\lambda D}{na}} = 9.40 \times 10^{-3}\ \text{m}$$ (+2)