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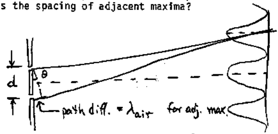
Problem 4A

Plade wavefronts of light are incident normally upon two narrow slits separated by a distance d (slit width<< d). On a very distant screen an interference pattern is observed with adjacent intensity maxima separated by a distance of 0.00500 m. The entire experiment is now repeated under water (n = 1.33). Now what is the spacing of adjacent maxima?

In air:



spacing of maxima $\propto \sin\theta = \dfrac{\lambda_{air}}{d}$

In water:

have $f_{air} = f_{water}$

$$\frac{v_{air}}{\lambda_{air}} = \frac{v_{water}}{\lambda_{water}} \Rightarrow \frac{v_{air}}{v_{water}} = \frac{\lambda_{air}}{\lambda_{water}} \approx n_{water} = 1.33$$

$$\therefore \lambda_{water} = \frac{\lambda_{air}}{n_{water}}$$

and, spacing of maxima $\propto \sin\theta = \dfrac{\lambda_{water}}{d}$

$$= \frac{1}{d}\left(\frac{\lambda_{air}}{n_{water}}\right) = \frac{1}{n_{water}}\underbrace{\left(\frac{\lambda_{air}}{d}\right)}_{\text{spacing in air}}$$

$\therefore$ spacing in water $= \dfrac{1}{n_{water}}$ (spacing in air)

$$= \frac{0.00500}{1.33} = 0.00376\ \text{m}$$