Physics 173
Spring Quarter 1983
May 27, 1983
George Williams

THIRD MIDTERM

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Name: _____

Discussion Instructor (CIRCLE ONE): Abbott Galler Giddings

Discussion Section # _____ Leaver Saffer Stone

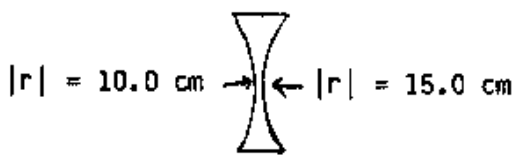
All numbers to 3 significant figures!

(a) Find the critical angle for total internal reflection for an oil-air interface if $n_{oil} = 1.25$.

(b) Find the thickness of a quarter wave plate for yellow light (λ = 589 nm), if $n_s = 1.5678$ and $n_f = 1.5123$ for the material of the plate.

(c) A sugar solution has $n_R = 1.34500$ and $n_L = 1.34400$. Find the angle through which the plane of polarization is rotated, if plane polarized light of wavelength λ = 589 nm passes 10.0 cm through this solution.

(d) Find the focal length for the lens shown.
The lens is in air. (n = 1.55)



(e) The third interference maximum from the center is found at 6.75 cm from the center of the screen in a two-slit interference pattern. If the light is green (λ = 500 nm) and the distance to the screen is 3.75 m, find the slit separation.

= 309.
= 6.0
$\bar{x}$ = 17.7

Problem 1. 3 MT Spring 1983 Grader. Lin. Williams 307 J 5p.

(a). $\theta_c = \sin^{-1}\frac{1}{1.25} \simeq 53.1^\circ \simeq 0.927\ (\text{rad})$.

(b). $(n_s - n_f)\,\Delta l = (4k \pm 1)\frac{\lambda}{4}$ $k = 0, 1, 2, \ldots$ ($k=0$, take only "+")

$$\Delta l = \frac{(4k\pm1) \times 589\ (\text{nm})}{4 \times (1.5678 - 1.5123)} \simeq (4k \pm 1) \times 2.65\ (\mu\text{m}).$$

$$\simeq (10.6\,k \pm 2.65)\ \mu\text{m}.$$

$k=0$: $\Delta l \simeq 2.65\ \mu\text{m}$.

$k=1$: $\Delta l \simeq 13.2\ \mu\text{m}$, $7.95\ \mu\text{m}$

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(c). $\delta = \frac{(n_R - n_L)\,\Delta l}{\lambda}\pi = \frac{(1.345 - 1.344) \times 0.1}{589 \times 10^{-9}}\pi$

$\simeq 533$ rad $\simeq (3.06 \times 10^4)^\circ \simeq 84.9\,(\text{rel})$, or observable: 320°

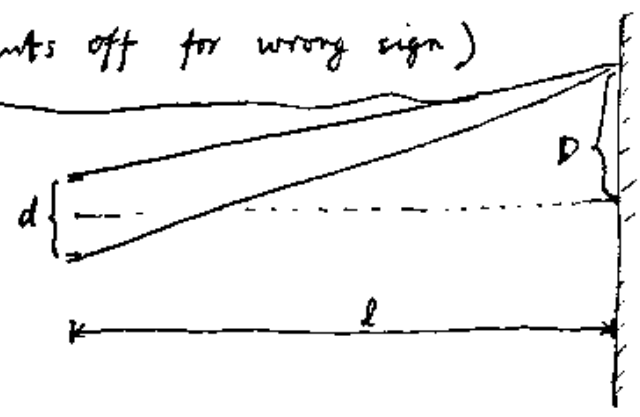
(d) $\frac{1}{f} = (n-1)\left(\frac{1}{r'} - \frac{1}{r''}\right) = 0.55\left(\frac{1}{-10} - \frac{1}{15.0}\right) = \frac{-0.55 \times 25}{150}$

$f \simeq -10.9\ (\text{cm})$ (2 points off for wrong sign)

(e). $d = \frac{n\lambda l}{D}$

$= \frac{3 \times 500 \times 3.75}{0.0675}\ (\text{nm})$

$\simeq 83.3\ (\mu\text{m})$



(e).