PHY385H1F – "Introductory Optics"
Practicals Day 10 – Presentations on Optics
December 5, 2011

Group Number: ____.

Facilitator Name:________________________________.

Record-Keeper Name:__________________________________. [Turn this sheet in for marks]

Time-keeper:______________________________.

Computer/Wiki-master:________________________________.

NOTE: The roles for the above must be *different* than last week!

Activity 10.0 – Presentation to your Peers

[6 points based on quality of presentation] All groups must do ***all*** 6 problems below for marks on this worksheet. However, your team must give a short presentation on ***one*** of the problems in this Theory Module (the one with the number corresponding to your group). You should talk at the white-board to the entire class. The presentation should not be more than about 5 minutes, and should convey how you got the answer to the problem.

For Marker:

Presentation [audibility, use of white-board]	______/ 2
Clarity [was explanation understandable?]	______/ 2
Accuracy [correct and complete answer?]	______/ 2
Total	______

Activity 10.1 – Fresnel Equations

[4 points] – Group 6 must present answer on white-board first (about 3:30).

Calculate the percent reflectance for the TM mode of light in air incident at 50° on a glass surface of index of refraction 1.60. [Recall that TM waves are linear polarized, and have electric fields that oscillate *parallel* to the plane of incidence.]

Activity 10.2 – The Lensmaker's Formula

[4 points] – Group 5 must present answer on white-board 2nd (about 3:40).

A bi-convex thin lens with index of refraction 1.50 has a focal length of +30.0 cm in air. When immersed in a certain transparent liquid, it becomes a negative lens with a focal length of −188 cm. Determine the index of refraction of the liquid.

HINTS:

- In going from Eq.5.14 to Eq.5.15, Hecht makes the assumption that the surrounding medium is air. You can adapt Eq.5.14, combined with 5.17 to obtain the power of the lens $1/f$ when $n_m \neq 1$. Or, if you google-search "Lensmaker's Formula" there is a page at http://hyperphysics.phy-astr.gsu.edu that gives the power when the surrounding medium is not air.
- Note that $\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ is the same no matter what the lens is dipped in.

Activity 10.3 – Retarders

[4 points] – Group 4 must present answer on white-board 3rd (about 3:50).
A thin plate of calcite is cut with its Optical Axis (OA) parallel to the plane of the plate. What minimum thickness is required to produce a quarter-wave path difference for sodium light whose wavelength in a vacuum is 589 nm?
[Note the ordinary and extraordinary indices of refraction for calcite: $n_o = 1.6584$, $n_e = 1.4864$.]

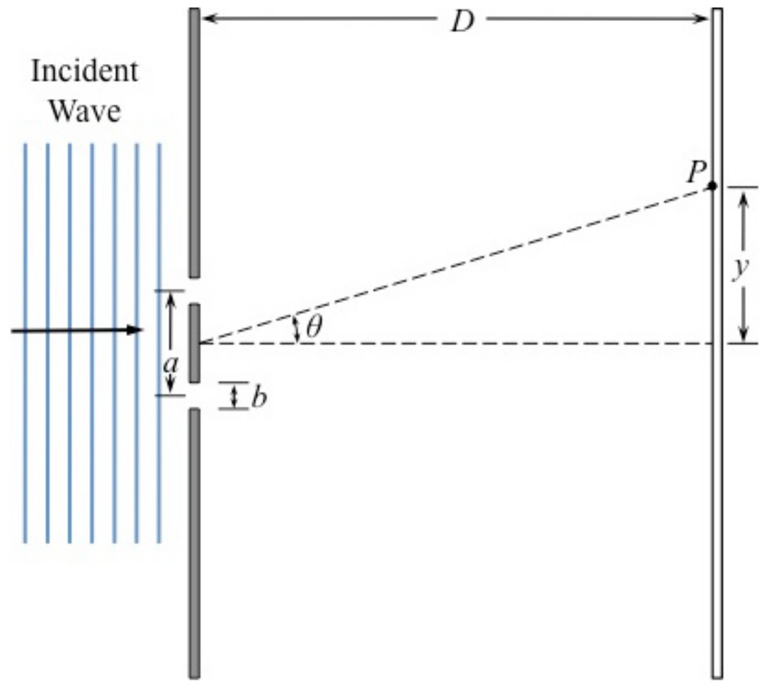
Activity 10.4 – Fresnel Number

[4 points] – Group 3 must present answer on white-board 4th (about 4:00).

In a double-slit experiment as shown in the figure, the viewing screen is at a distance $D = 4.00$ m, and point P lies at a distance $y = 20.5$ cm from the centre of the pattern. Each slit has a width of $b = 1.0$ µm, the centre-to-centre separation of the slits is $a = 4.0$ µm, and the wavelength of the light is 580 nm.

Look up "Fresnel Number" on Wikipedia. What is the appropriate Fresnel number for one of the slits in this situation?

Can the interference pattern be accurately modelled using the Fraunhofer diffraction approximations, or must we use Fresnel Diffraction?

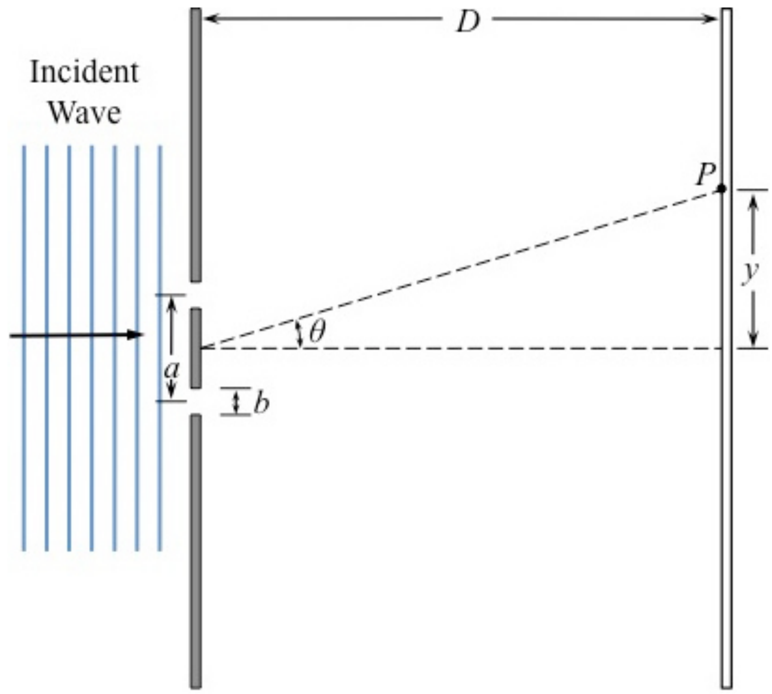


Activity 10.5 – Double-Slit with Finite Width Interference Pattern

[4 points] – Group 2 must present answer on white-board 5th (around 4:10).

In a double-slit experiment as shown in the figure, the viewing screen is at a distance $D = 4.00$ m, and point P lies at a distance $y = 20.5$ cm from the centre of the pattern. Each slit has a width of $b = 1.0$ µm, the centre-to-centre separation of the slits is 4.0 µm, and the wavelength of the light is 580 nm.

Assuming Fraunhofer diffraction, what is the ratio of the irradiance I_P at point P to the irradiance I_{cen} at the centre of the pattern?



Activity 10.6 – Grating Equation

[4 points] – Group 1 must present answer on white-board last (around 4:20).

Sunlight impinges on a transmission grating that is formed with 3000 lines per centimetre. Does the third-order visible spectrum overlap the second-order visible spectrum? Take the limits of the visible spectrum to be 400 nm to 700 nm.

HINTS:

- The grating equation is eq.10.32 on page 462 of Hecht.
- a is the spacing between adjacent lines in the grating.
- m is the order number.
- You want to find θ_2 for $\lambda = 400$ nm and 700 nm, and find θ_3 for $\lambda = 400$ nm and 700 nm, and compare the two ranges of angles.