

Print your name **neatly**:

Last name:

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

First name:

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Sign your name: _____

Please fill in your Student ID number (UIN): _____-_____-_____

IMPORTANT

Read these directions carefully:

- There are 6 problems totaling 100 points. Check your exam to make sure you have all the pages. Work each problem on the page the problem is on. You may use the back. If you need extra pages, I have plenty up front.
- **Indicate what you are doing!** I cannot give full credit for merely writing down the answer. **Neatness counts!** I will give generous partial credit **if** I can tell that you are on the right track. This means you must be *neat* and organized.
- Each problem with its associated figure is self explanatory. If you *must* ask a question, then come to the front, being as discrete as possible so as not to disturb others.
- Put your name on each page it is asked for. You will lose credit if you fail to print your name on each page it is asked for.

Print your name: _____

Physics 221: Optical and Thermal Physics, Exam 2

Problem 1. 10 points.

Indicate which of the following is *not* one of Maxwell's Equations, and write the correct form of that equation.

(a) $\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$

(b) $\oint \vec{B} \cdot d\vec{A} = 0$

(c) $\oint \vec{E} \cdot d\vec{l} = -\frac{d\Phi_B}{dt}$

(d) $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$

If you work **neatly** I will find more partial credit for you!

Print your name: _____

Physics 221: Optical and Thermal Physics, Exam 2

Problem 2. 20 points.

A light bulb emits light isotropically in all directions. The total radiated power is 20 W.

(a) Calculate the amplitude of the oscillating electric field at a distance of 2.00 m from the bulb. Include the units.

(b) Suppose a small sheet of material with surface area of 7.54 cm^2 is aligned so that its surface normal is toward the bulb. Suppose that the material is “black” so that all of the light that hits the sheet is absorbed. Calculate the force (in Newtons) on the sheet due to radiation pressure. Be careful of units.

Print your name: _____

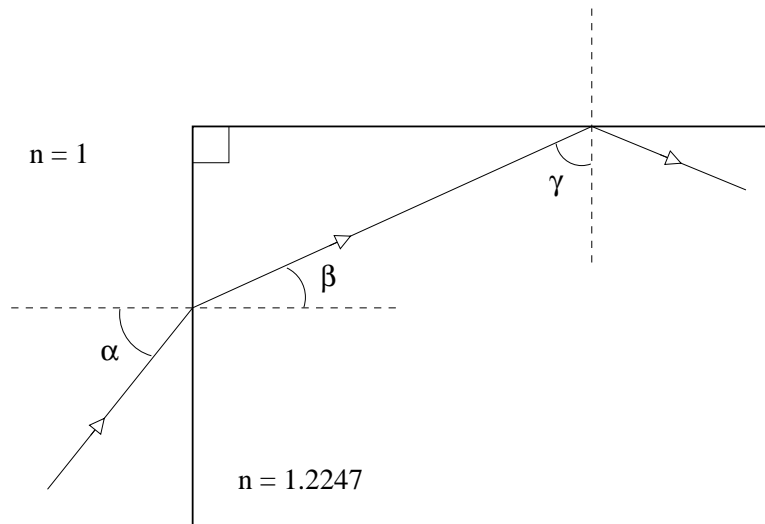
Physics 221: Optical and Thermal Physics, Exam 2

Problem 3. 15 points.

Scientists have invented a new material with index of refraction $n = \sqrt{3/2} \approx 1.2247$. Suppose a beam of light is incident on a rectangular piece of this material at an angle α from the normal. Assume the index of refraction outside the material is 1.

The light is refracted, and hits the perpendicular surface at angle γ such that γ is the critical angle for total internal reflection inside the material.

This is shown in the Figure:



Calculate the angle α .

You must be neat. Neatness will count as part of the grade on this problem.

Print your name: _____

Physics 221: Optical and Thermal Physics, Exam 2

Problem 4. (20 points)

Coherent light of wavelength 500 nm passes through two narrow slits as in Young's double slit experiment. The separation of the slits is unknown. An interference pattern forms on a screen that is 1.00 m from the slits. The distance between dark bands near the center of the interference pattern is found to be 1.00 mm.

The slits are then carried to another laboratory where they are illuminated by coherent light of an unknown wavelength. In this laboratory, the distance to the screen is 1.50 m. The distance between dark bands near the center of the interference pattern is found to be 2.25 mm.

Find the unknown wavelength of the light source in the second lab.

Print your name: _____

Physics 221: Optical and Thermal Physics, Exam 2

Problem 5. (15 points)

Consider a Michelson interferometer as shown in your book in Figure 35-24.

How far must the mirror M_1 be moved if 750 fringes of light with wavelength 589 nm are to pass by a reference line?

Don't forget to be neat. Neatness helps!

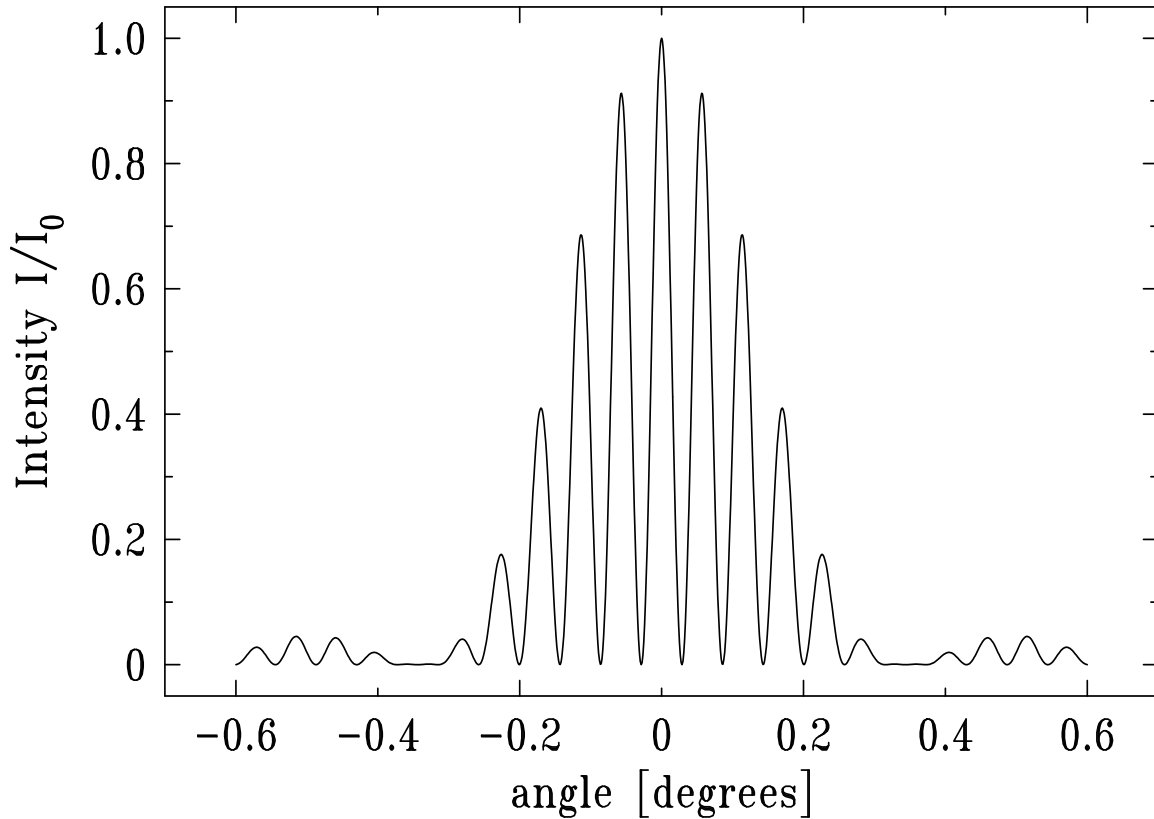
Print your name: _____

Physics 221: Optical and Thermal Physics, Exam 2

Problem 6. (20 points)

Consider a standard Young's double-slit setup, illuminated by coherent monochromatic light of wavelength λ . Each slit has width a and the centers of the two slits are separated by a distance d .

Far from the slit, the interference pattern as a function of the diffraction angle looks θ is plotted below:



Calculate the following ratios:

(a) (10 points) Calculate d/a .

(b) (10 points) Calculate d/λ .

Present your work neatly and clearly.