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General Physics II, Final 2
PHYS10400, Class year 99
06-23-2011

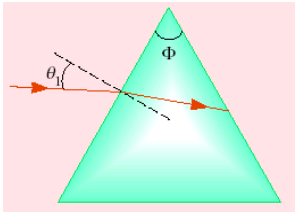
SN:_____, Name:_____

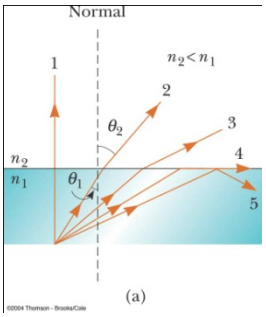
ABSOLUTELY NO CHEATING!

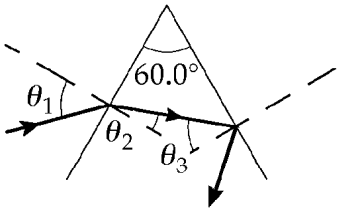
Note: This is a close-book examine. You can use pencil or any pen in answering the problems. Dictionary and Calculators are allowed.

Problems (6 Problems, total 100 points)

1. **Snell's law and Prism:** (20%)A triangular glass prism with apex angle **Φ** = 60.0° has an index of refraction n = 1.50 (Figure below on the left). What is the smallest angle of incidence θ_1 for which a light ray can emerge from the other side? Note the figure on the bottom center is drawn for your reference. The smallest angle of incidence θ_1 for which a light ray can emerge from the other side means θ_3 is a critical angle for light to emerge from the other side. When is a critical angle, all rays emerge parallel to the interface as shown in the ray #4 in the right figure. (20%)
   Note: $\sin^{-1}\left(\frac{1.0}{1.5}\right) = 41.8°$, and $1.5\sin 18.2° = 0.468$



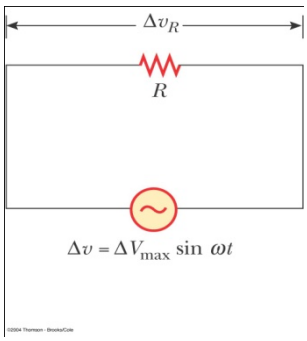




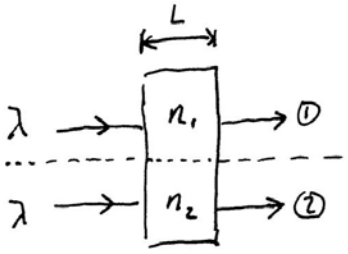
2. **Yang's Interference:** (20%) In a double-slit experiment, the wavelength λ of the light source is 405 nm, the slit separation ***d*** is 19.44 μm, and the slit width ***a*** is 4.050 μm. Consider the interference of the light from the two slits and also the diffraction of the light through each slit. (a) How many bright interference fringes are within the central peak of the diffraction envelope? (10%) (b) How many bright fringes are within either of the first side peaks of the diffraction envelope? (4%) (c) Draw the interference plus the diffraction fringes for the center peak and the two side peaks next to the center peak (6%).

3. **Diffraction:** (20%) A parallel beam of blue light (420 nm) is incident on a small aperture. After passing through the aperture, the beam is no longer parallel but diverges at 1° to the incident direction. What is the diameter of the aperture? Note: for small angle ***θ***, sinθ ≅ θ. (10%)

4. **AC Circuit:** (10%) In a simple AC circuit as shown in the figure to the right, a resistor is connected to an AC voltage of $\Delta V = \Delta V_{\max} Sin\varpi t$. What is the average power gives up by the resistor?



5. **Phase difference:** (10%) Refer to the figure on the right, a monochromatic light of wavelength λ incident normally on to a composite material having two different index of refraction $\mathbf{n_1}$ and $\mathbf{n_2}$, respectively, as shown in this figure. (a)What is the phase difference of the two beams (the upper beam#1 and the lower beam #2)? (b) If $\mathbf{n_1}$=1.5, and $\mathbf{n_2}$=1. **L**=10λ, what is the phase difference?



6. **Light Pressure:** (20%) Many people giving presentations use a laser pointer to direct the attention of the audience to information on the screen. If a time-averaged 3 mW pointer creates a spot on a screen that is 2.0 mm in diameter, determine the radiation pressure on a screen that reflects 100% of the light that strikes it. (10%)