Physics 4C PRACTICE Mid-Term Exam 1 Name:

Instructions : There are six multiple choice questions and two longer problems. Read everything *carefully* and give the best answer based on the material presented during lecture and in the text. The multiple choice is worth 60% and the problems are worth 40%

(1) A light ray initally traveling in glycerin (with $n = 1.473$) passes into the surface of a diamond (with $n = 2.42$) at an angle of 60 degrees with respect to the normal. What is the angle of refraction, in degrees? (a) 20 (b) 60 (c) 32 (d) 64 (e) 15

(2) What is the critical angle for light going from diamond ($n = 2.4$) into air ($n = 1.0$) ?
(a) 65.4 (b) 24.6 (c) 2.4 (d) 76.3 (e) there is no critical angle

(3) A lens is made of glass with $n = 1.5$. Its front surface is convex, with a radius of curvature of 0.20 m. Its back surface is flat. What is the focal length of the lens, in meters?
(a) 0.20 (b) 0.30 (c) 0.40 (d) 0.10 (e) 0.50

(4) A light ray with a frequency of $6{\times}10^{14}$ Hz in a vacuum is incident on water ($n = 1.33$). The wavelength of the light after it enters the water is (in nanometers):
(a) 798 (b) 500 (c) 665 (d) 484 (e) 376

(5) "Stealth" aircraft are nearly invisible to radar because they are coated with an anti-reflective plastic film. Suppose that radar waves have a wavelength of 3.00 cm, and the index of refraction of the film is $n = 1.50$. The index of refraction of the body of the aircraft, under the film, is very large ($n \approx \infty$), so that there is a 180-degree phase change from the reflection at the bottom of the film, in the same way as there is a 180-degree phase change from the reflection at the top of the film. What is the minimum thickness (t) that the film should have to give destructive interference for the reflected radiation? (a) 0.5 cm (b) 1.0 cm (c) 1.5 cm (d) 2.0 cm (e) 3.0 cm

(6) Two slits are illuminated with red light ($\lambda = 650$ nm). The slits are 0.25 mm apart and the distance to the screen is 1.25 m. What fraction of the maximum intensity on the screen is the intensity measured at a distance 3.0 mm from the central maximum?
(a) 0.94 (b) 0.92 (c) 0.96 (d) 0.98 (e) 0.99

Problems.

Box your final answer. No work = No credit on this part.

(A) A laser of frequency 4.6×10^{14} Hz is traveling in the positive x direction. The magnetic part of the laser light has a maximum amplitude of 6.67×10^{-7} T, and oscillates in the z direction. Assume that the electric field magnitude for the laser light can be written as $E = E_{max} \cos(kx - \omega t)$

(i) What are E_{max}, k and ω **in MKS** units?

(ii) What is the full Poynting vector for this wave, including magnitude and direction? I want the t and x dependent Poynting vector, NOT the time-averaged Poynting vector. Everything except t and x should be written out numerically.

(B) A dedicated sports car enthusiast polishes the inside and outside surfaces of a hubcap that is a section of a sphere.

(a) She holds the hubcap 0.25 m from her face, and looks into the inside surface of the hubcap, which has a radius of curvature of +0.60 m.

(i) She sees her image reflected by the inside surface of the hubcap. What is the image distance of this image?

(ii) What is the magnification of this image?

(iii) Is this a real or a virtual image? Is this image upright or inverted?

(b) She now flips the hubcap around, so that she looks into the outside surface of the hubcap. Again, she holds the hubcap 0.25 m from her face. The outside surface of the hubcap has a radius of curvature of -0.60 m.

(i) She sees her image reflected by the outside surface of the hubcap. What is the image distance of this image?

(ii) What is the magnification of this image?

(iii) Is this a real or a virtual image? Is this image upright or inverted?