Exam 4 – white version

Physics 2760

SP 2013

Last Name_____

First Name_____

ID # _____ Lab Section # _____

This is a closed book exam. I understand, pursuant to University Regulations on academic honesty, that I am not to use any notes or information other than what is in the official, non-annotated formula sheet.

Signature_____

For multiple choice questions, please make sure that you circle the letter for the answer which you believe to be correct and only that answer. If more than one answer is circled for the same problem, you will not receive credit for it. Don't get hung up on questions. They should take only one or two minutes each. If you find yourself spending more than a few minutes on a multiple choice question you are probably looking at it the wrong way. You should skip it for now and come back to it later.

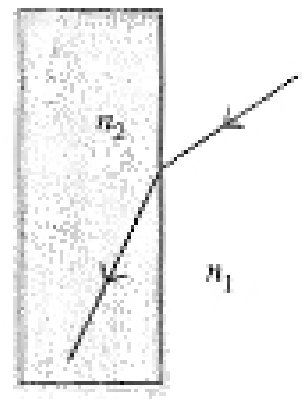
For full credit show your work for solutions to questions that require calculations. Explain from where you start to solve the problem and show your math flowing from it for full credit. **No shown work, no credit!**

During the exam, if you have questions please raise your hand and the TA or the instructor will come to you and provide help.

The last page is the formula sheet. Feel free to tear it off. You may keep the formula sheet after the exam.

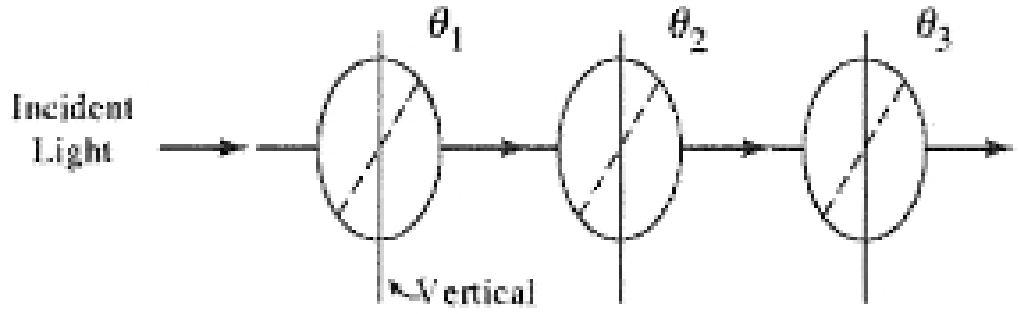
W

1. (5 points) A ray of light goes from one transparent material into another, as shown in the figure. What can you conclude about the indices of refraction of these two materials?



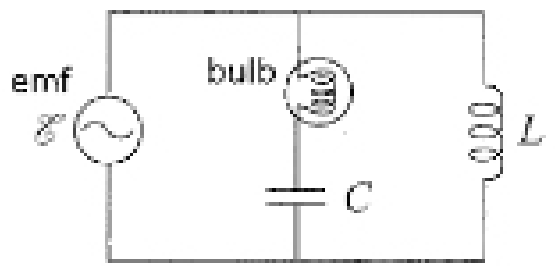
A) $n_1 \geq n_2$ (B) $n_1 > n_2$ C) $n_1 = n_2$ D) $n_2 \geq n_1$ E) $n_2 > n_1$

2. (5 points) In the figure, the orientation of the transmission axis for each of three polarizing sheets is labeled relative to the vertical direction. A beam of light, polarized in the vertical direction, is incident on the first polarized with an intensity of 1000 W/m^2. What is the intensity of the beam after it has passed through the three polarizing sheets when $\theta_1 = 30°$, $\theta_2 = 30°$ and $\theta_3 = 60°$?



A) 141 W/m^2
B) 316 W/m^2
C) 433 W/m^2
(D) 563 W/m^2
E) 188 W/m^2

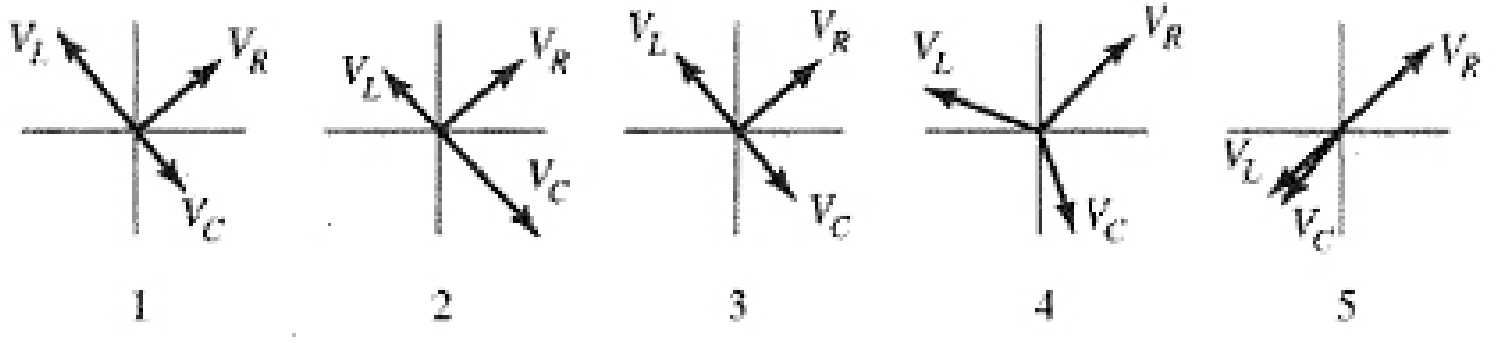
3. (5 points) The light bulb has a resistance R, and the emf drives the circuit with a frequency ω. The light bulb glows most brightly at



A) very low frequencies
(B) very high frequencies

C) the frequency $\omega = 1/\sqrt{LC}$

4. (5 points) Which one of the phasor diagrams shown below best represents a series LRC circuit driven at resonance?



A) 1
B) 2
(C) 3
D) 4
E) 5

5. (5 points)) In the figure, the current in a solenoid having no appreciable resistance is flowing from b to a and is decreasing at a rate of 9.6 A/s. Which point, a or b is at higher potential?

(A) a B) b

Problem 6.

(a) The electric field in the electromagnetic wave is given by $\vec{E}(y,t) = (3\times10^5\ \text{V/m})\,\hat{k}\,\sin[\,(10^6/m)\,y - (2\times10^{12}\,rad/s)\,t]$

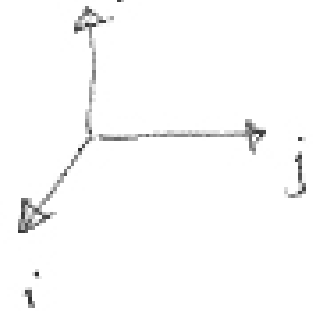
(i) (5 points) In which direction is the wave traveling? $+y$ or $\hat{j}$

(ii) (5 points) Calculate the magnetic-field amplitude B_{max} of the wave.

$$B_{max} = \frac{E_{max}}{c} = \frac{3\times10^5}{3\times10^8} = 10^{-3}\ (T)$$

(iii) (6 points) Write the vector equation for the magnetic field $\vec{B}(y,t)$.

$$\vec{B} = (10^{-3}\ T)\ \hat{i}\ \sin\left[(10^6/m)\,y - (2\times10^{12}\ rad/s)\,t\right]$$



(b) (9 points) A ray of light traveling in air strikes the surface of a plastic slab at 63.0° with respect to the normal in air. It travels in the plastic slab at a 30.6° angle with respect to the normal. Find the index of refraction of the plastic.

Snell's law, $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$$n_{air}\sin\theta_{air} = n_{plastic}\sin\theta_{plastic}$$

$$(1)\quad \sin(63^\circ) = n_{plastic}\sin(30.6^\circ)$$

$$n_{plastic} = \frac{\sin 63^\circ}{\sin 30.6^\circ} = 1.75$$