Phys 251 Fall 200 9

Sample Test 3

Questions (5 points each) Please blacken the letter of the best answer for each question.

Q1 Total internal reflection can occur when light passes from

a) Vacuum into glass.
b) Glass into vacuum.
c) Either of the above.
d) None of the above.

Q2 In a series RLC circuit, which of the following occurs at resonance?

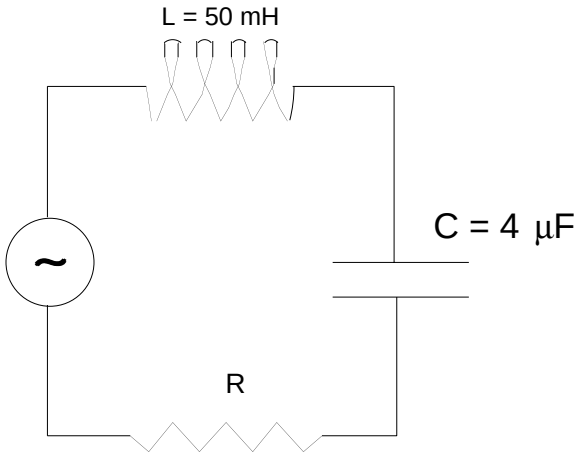
a) The impedance is a maximum.
b) The power factor is zero.
c) The frequency is a minimum.
d) The phase is zero.
e) None of the above.

This exam contains four problems, only three may be graded. You may choose to solve any three. Please indicate which three problems you would like us to grade. We will grade only the problems you select.

Questions	/10
Problem ___	/30
Problem ___	/30
Problem	/30
Total	/100

Problems (30 points each). **Please show your work and circle your answers**. Missing or incorrect reasoning will earn no credit.

P1 In the circuit shown at right, an inductor a capacitor and a resistor are connected in series with an ac source. The values of the inductor and the capacitor are as shown. The source produces current $I = I_{max}\cos(2500t)$ and $V = 15\cos(2500t+\pi/4)$.



Please find

a) The resistance, R.
b) The RMS voltage at the source.
c) The impedance
d) The power factor

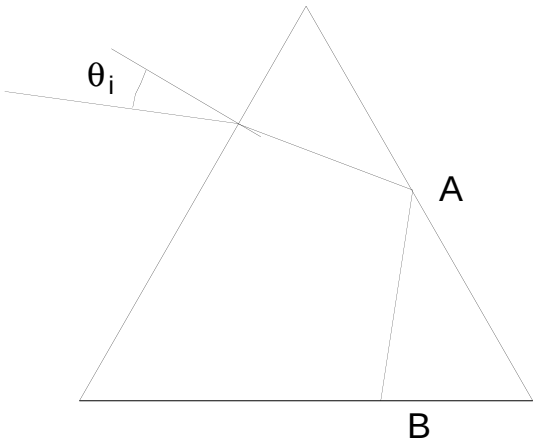
P2 An linearly polarized electromagnetic plane wave in vacuum has an electric field described by the equation:

$$\vec{E}(y,t) = 10^4 \hat{k} \sin(10^{14} t + ky)$$

Please answer each of the following questions:

a) What is the wavelength of this wave?
b) What is the angular frequency of this wave?
c) What is the direction of motion of this wave?
d) What is the B field associated with this wave
e) If this wave were to enter a piece of glass with index of refraction 1.55, what would be the wavenumber of the wave in glass?

P3 Light enters an equilateral triangular prism at an angle θ_i to the normal. The index of refraction of the glass is n = 1.5. The refracted beam undergoes total internal reflection at point A then exits the prism at point B. Please find.



a) The angle between the exiting beam and the normal to the bottom face if $\theta_i = 20°$.

b) The maximum value of θ_i.

P4 A lens with f = -30 cm is placed 45 cm to the right of a plane mirror. An object is placed between them, 20 cm from the lens. A viewer on the right will see two images. Please answer each of the following.

a) Is this a converging or a diverging lens?
b) What is the focal length of the mirror?
c) How far from the lens is each of the images?
d) Are the images both real, both virtual or one of each?