UCA Department of Physics and Astronomy

PHYS 3345: OPTICS

Quiz 04: Chapter 03

Spring 2008

Answer each of the questions below, showing your work. Each question is worth 4 points. Work on the front and back of this page, attaching additional sheets if necessary.

1. Problem 3.4

$$\vec{E} = \vec{E}_o \cos(kx - \omega t)$$

$$\vec{B} = \vec{B}_o \cos(kx - \omega t)$$

$$\frac{\partial E}{\partial x} = -\frac{\partial B}{\partial t}$$

$$\frac{\partial E}{\partial x} = -E_o k \sin(kx - \omega t)$$

$$-\frac{\partial B}{\partial t} = -B_o \omega \sin(kx - \omega t)$$

$$E_o k \sin(kx - \omega t) = B_o \omega \sin(kx - \omega t)$$

$$E_o = \frac{\omega}{k} B_o = \frac{\left(\frac{2\pi}{\tau}\right)}{\left(\frac{2\pi}{\lambda}\right)} B_o = \left(\frac{\lambda}{\tau}\right) B_o = cB_o$$

2. Problem 3.8

$$E = \frac{Q}{\varepsilon_o A} \qquad C = \frac{\varepsilon_o A}{d} \qquad U = \frac{Q^2}{2C}$$

$$u = \frac{U}{V} = \frac{U}{Ad}$$

$$u = \frac{\left(\frac{Q^2}{2C}\right)}{Ad} = \frac{1}{2}\left[\frac{Q^2}{Ad\left(\frac{\varepsilon_o A}{d}\right)}\right] = \frac{1}{2}\varepsilon_o\left[\frac{Q^2}{(\varepsilon_o A)^2}\right] = \frac{1}{2}\varepsilon_o E^2$$

3. Problem 3.16

$$I = \frac{P}{A} = \frac{P}{4\pi r^2} = \frac{E_o^2}{2c\mu_o}$$

$$E_o^2 = \frac{2c\mu_o P}{4\pi r^2}$$

$$E_o = \sqrt{\frac{2\left(3\times10^8 \frac{\text{m}}{\text{s}}\right)\left(4\pi\times10^{-7} \frac{\text{T}\cdot\text{m}}{\text{A}}\right)\left(3.9\times10^{26}\text{W}\right)}{4\pi\left(1.5\times10^{11}\text{m}\right)^2}}$$

$$E_o = 1.02\times10^3 \frac{\text{V}}{\text{m}}$$

4. Problem 3.22: answer in the back of the book (p 660)
5. Problem 3.24: answer in the back of the book (p 660)
6. Problem 3.31: answer in the back of the book (p 660)