PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Fall Semestre 2015**

College of Sciences

Section 1 **Quiz 12** **18 December 2015**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: Vahdet Ünal **Student ID:** **Signature:**

Consider electromagnetic waves propagating in air. Take $c = 3\times10^8\, m/s$.

a) Determine the frequency of a wave with a wavelength of
(i) 5 km,
(ii) 5 μm,
(iii) 5 nm.

b) What is the wavelength (in meters and nanometers) of
(i) gamma rays of frequency $6.5\times10^{21}\, Hz$ and
(ii) an AM station radio wave of frequency 590 kHz.?

a.) $f = \frac{c}{\lambda}$

i.) $f = \frac{3\times10^8\ m/s}{5\times10^3\ m} = 6\times10^4\ s^{-1} = 6\times10^4\ Hz$

ii.) $f = \frac{3\times10^8\ m/s}{5\times10^{-6}\ m} = 6\times10^{13}\ s^{-1} = 6\times10^{13}\ Hz$

iii.) $f = \frac{3\times10^8\ m/s}{5\times10^{-9}\ m} = 6\times10^{16}\ s^{-1} = 6\times10^{16}\ Hz$

b.) $\lambda = \frac{c}{f}$

i.) $\lambda = \frac{3\times10^8\ m/s}{6.5\times10^{21}\ Hz} = 4.6\times10^{-14}\ m$

ii.) $\lambda = \frac{3\times10^8\ m/s}{590\times10^3\ Hz} = 5.08\times10^2\ m$

PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Fall Semestre 2015**

College of Sciences

Section 3 **Quiz 12** **18 December 2015**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

An electromagnetic wave with frequency 60 Hz travels in an insulating magnetic material that has dielectric constant 3.5 and relative permeability 4.6 at this frequency. Electric field has amplitude $7.5\times10^{-3} V/m$.

a) What is the speed of propagation of the wave?
b) What is the wavelength of the wave?
c) What is the amplitude of the magnetic field?

a.) $n = \sqrt{K K_m} = \sqrt{3.5 \times 4.6} = 4.0$

$$v = \frac{c}{n} = \frac{3\times10^8 \text{ m/s}}{4.0} = 7.5\times10^7 \text{ m/s}$$

b.) $$\lambda = \frac{v}{f} = \frac{7.5\times10^7 \text{ m/s}}{60 \text{ Hz}} = 1.25\times10^6 \text{ m}$$

c.) $$B_{max} = \frac{E_{max}}{v} = \frac{7.5\times10^{-3} \text{ V/m}}{7.5\times10^7 \text{ m/s}} = 1.0\times10^{-10} \text{ T}$$

PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Fall Semestre 2015**

College of Sciences

Section 2 **Quiz 12** **18 December 2015**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

The electric field of a sinusoidal electromagnetic wave obeys the equation
$E = (375\,V/m)\cos\left[(2\times10^{7}\,rad/m)x + (6\times10^{15}\,rad/s)t\right]$
Take $\pi = 3$.

a) What are the amplitudes of the electric and magnetic fields of this wave?
b) What are the frequency, wavelength and period of the wave? Is this light visible to humans?
c) What is the speed of the wave?

b.) $f = \frac{\omega}{2\pi} = \frac{6\times10^{15}\ rad/s}{2\times\ rad} = 1\times10^{15}\ Hz$

$\lambda = \frac{2\pi}{k} = \frac{2\times\ rad}{2\times10^{7}\ rad/m} = 3\times10^{-7}\ m = 300\ nm$

$T = \frac{2\pi}{\omega} = \frac{1}{f} = 1\times10^{-15}\ s$

Visible light is in 380 nm - 750 nm wavelenght range. This light is not visible.

c.) $v = \lambda f = (3\times10^{-7}\ m)(1\times10^{15}\ Hz) = 3\times10^{8}\ m/s$

a.) $E_{max} = 375\ V/m$

$B_{max} = \frac{E_{max}}{v} = \frac{375\ V/m}{3\times10^{8}\ m/s} = 1.25\times10^{-6}\ T$