Phy114: Electromagnetism, Waves and Radiation for the Sports Science
Homework Problems
Set #11: Due Monday, May 9, 2011

Note: Students are encouraged to work together and discuss the problems. However, each student must arrive at her/his own final answers. Show all your work. Simply copied homework will result in zero.

1. (5 points) EM radiation having a wavelength of 0.20 µm (200 nm) is classified as ultraviolet radiation. What is its frequency?

2. (5 points) What is the smallest possible detail observable (in theory) with a microscope that uses X-ray having a frequency of $1.5 \times 10^{17}$ Hz?

3. (10 points) (a) Calculate the energy in electron volts of an infrared photon of frequency $7.5 \times 10^{12}$ Hz. (b) Calculate the energy in electron volts of an ultraviolet photon of frequency $5.5 \times 10^{16}$ Hz. (c) Compare both of these energies with the 5.0 eV needed to disrupt a certain compound and comment on their likely effect.

4. (10 points) The smallest details observable using EM radiation as a probe have a size of about one wavelength. (a) What is the smallest detail observable with x-ray photons of energy 60 KeV? (b) What is the smallest detail observable with γ-ray photons of energy 300 MeV?

5. (10 points) (a) Calculate the kinetic energy in electron volts of an electron ejected from a material with a work function $\phi = 1.6$ eV by a photon of wavelength 400 nm. (b) What is the speed of the ejected electron in m/s, given its mass to be $9.11 \times 10^{-31}$ Kg?

6. (10 points) How many x-ray photons are emitted per second by an x-ray tube that puts out 3.0 W of 60-keV x-rays?