Physics II

EM Spectrum

$c=3.00\times10^8$ m/s	Speed of light in vacuum
$c=\lambda f$	Fundamental equation of electromagnetic waves
$B=E/c$	Relation between electric and magnetic field in an E.M.W.

Problem 1.- Visible light has a narrow range of wavelengths (400nm for violet to 700nm for red). Would you be able to see an electromagnetic wave of frequency $f=1.5\times10^{15}$ Hz? How would you call such a wave?

Solution: The wavelength of the light is: $\lambda = \frac{c}{f} = \frac{3\times10^8\,\text{m/s}}{1.5\times10^{15}\,\text{Hz}} = 200\text{nm}$

This is ultraviolet light, which invisible to human beings.

Problem 2.- Non-invasive measurement of the oxygen content in hemoglobin is sometimes done with "near infrared spectroscopy". What wavelengths are we referring to with "near infrared"?

Solution: Infrared corresponds to wavelengths longer than 700nm and "near" means they are close to the visible range.

Problem 3.-
a) Would you be able to see an electromagnetic wave of frequency $f=3.75\times10^{14}$ Hz? How would you call such a wave?

b) If the amplitude of the electric field of an EM wave is 5.5 V/m, calculate the amplitude of the magnetic field.

Solution:

a) $c=\lambda f \rightarrow \lambda = \frac{c}{f} = \frac{3\times10^8}{3.75\times10^{14}} = 800\text{ nm}$

Since 800nm is longer than 750nm this wave is invisible. It is called infrared.

b) $B=E/c=5.5/3\times10^8=$**1.83×10^{-8} tesla**

Problem 4.- Are the wavelengths of TV transmissions shorter or longer than those of visible light?

Solution: TV broadcast transmissions are done at longer wavelengths than those of visible light.