Environmental Science II

Problems Chapter 3

3.2.1 The refractive index *n* depends on the wavelength of the light according to the formula $n = A + B/\lambda^2$. For quartz n = 1.46 at 589.3 nm. If A = 1.30, calculate the value of B.

Solution

Applying the formula $n = A + B/\lambda^2$ we obtain $1.46 = 1.30 + B/(589.3\text{x}10^{-9})^2$. This gives

$B = (589.3\text{x}10^{-9})^2\ (1.46 - 1.30)\ \text{m}^2 = 5.46\text{x}10^{-14}\ \text{m}^2$.

Answer: $B = 5.46\text{x}10^{-14}\ \text{m}^2$

3.2.2 Using the above result, what is the refractive index at the He-Ne laser wavelength of 632.8 nm?

Solution

Applying the formula $n = A + B/\lambda^2$ we obtain
$n = 1.30 + 5.46\text{x}10^{-14}/(632.8\text{x}10^{-9})^2 = 1.436$

Answer: n = 1.436

3.2.2 Using the result from 2.1.1, what is the refractive index at the frequency tripled YAG laser wavelength of 354.7 nm?

Solution

Applying the formula $n = A + B/\lambda^2$ we obtain
$n = 1.30 + 5.46\text{x}10^{-14}/(354.7\text{x}10^{-9})^2 = 1.734$

Answer: n = 1.734

3.3.1 If we look at the Sun using a Polaroid the intensity *S* is reduced to the half. Calculate the electric field amplitude (E_0) after the Polaroid, if S = 1.38 kW/m^2.

Solution

Applying the formula $S_{mean} = E_0B_0/2\mu_0$ where $B_0 = E_0/c$ we get $S_{mean} = E_0E_0/2c\mu_0 = E_0^2/2c\mu_0$. This gives $1.38\text{x}10^3/2 = E_0^2/(2\text{x}3.00\text{x}10^8\text{x}4\pi\text{x}10^{-7})$ and E_0 = 721 V/m.

Answer: E_0 = 721 V/m