Homework 33.5

What inductance must be connected to a 17 pF capacitor in an oscillator capable of generating 550 nm (i.e., visible) electromagnetic waves? Comment on your answer.

$$\omega L = \frac{1}{\omega C}$$

$$\omega = \frac{1}{\sqrt{LC}}$$

$$= 2\pi f$$

$$v = \lambda f = 3 \times 10^8$$

$$f = \frac{3 \times 10^8}{550 \times 10^{-9}}$$

$$\omega = 2\pi f = \frac{2\pi 3}{550} \times 10^{17} = 34.27 \times 10^{14}$$

$$= \frac{1}{\sqrt{LC}} = \omega$$

$$LC = \frac{1}{\omega^2}$$

$$L = \frac{1}{\omega^2 \times 17 \times 10^{-12}} = \frac{1}{(34.27 \times 10^{14})^2\, 17 \times 10^{-12}}$$

$$\boxed{L = 5.01 \times 10^{-21}\ H}$$

Homework 33.7

What is the intensity of a traveling plane electromagnetic wave if B_m is 1.0 x 10^{-4} T?

$$I = \frac{BE}{2\mu_0}$$

$$E = Bc$$

$$I = \frac{cB^2}{2\mu_0} = \frac{3\times10^8 * (1.0\times10^{-4})^2}{2\times4\pi\times10^{-7}}$$

$$I = 1.2\times10^6 \ \mathrm{W/m^2}$$

Homework 33.11

A plane electromagnetic wave traveling in the positive direction of an x axis in vacuum has components $E_x = E_y = 0$ and $E_z = (2.0\ \text{V/m})\cos((\pi \times 10^{15}\ \text{s}^{-1})(t - x/c))$. (a) What is the amplitude of the magnetic field component? (b) Parallel to which axis does the magnetic field oscillate? (c) When the electric field component is in the positive direction of the z axis at a certain point P, what is the direction of the magnetic field component there?

$$\frac{E_m}{B_m} = c$$

$$E_m = 2$$

$$B_m = \frac{2}{c} = \frac{2}{3\times10^8} = 0.667\times10^{-8}\ \text{T}$$

$$= 6.7\ \text{nT}$$

a)

b) Poynting vector is in the direction of propagation $\vec{S} = \frac{1}{\mu_0}\vec{E}\times\vec{B}$

S is in the x direction

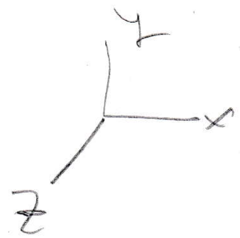
∴ B must be parallel to the

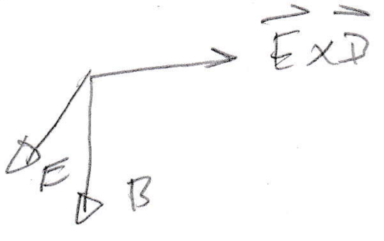
y direction

c) $\vec{E} = E_z \hat{z}$

$\vec{B} = B_y \hat{y}$

B_y must be negative for $\vec{E}\times\vec{B}$ to be in the positive x direction





Homework 33.13

Sunlight just outside Earth's atmosphere has an intensity of 1.4 kW/m^2. Calculate (a) E_m and (b) B_m for sunlight there, assuming it to be a plne wave.

$$I = 1.4 \times 10^3 = \frac{E_m B_m}{2\mu_0}$$

$$B_m = \frac{E_m}{c}$$

$$I = \frac{E_m^2}{2\mu_0 c} = \frac{c B_m^2}{2\mu_0}$$

$$E_m = \sqrt{2\mu_0 c I} = \sqrt{2 \times 4\pi \times 10^{-7} \times 3 \times 10^8 \times 1.4 \times 10^3}$$

$$E_m = 1.03 \text{ kV/m}$$

$$B_m = \frac{E_m}{c} = \frac{1.027 \times 10^3}{3 \times 10^8} = 3.42 \times 10^{-6}$$

Homework 33.33

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In Fig. 33-40, initially unpolarized light is sent into a system of three polarizing sheets whose polarizing directions make angles of $\theta_1 = 40^o$, $\theta_2 = 20^o$, and $\theta_3 = 40^o$ with the direction of the y axis. What percentage of the light's initial is transmitted by the system? (*Hint:* Be careful with the angels.)

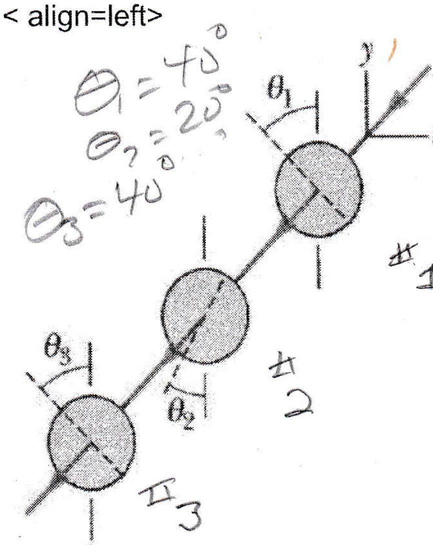

Figure 33-40.

Each sheets attenuates the Intensity by a factor of

$\frac{I_{out}}{I_{IN}} = \cos^2\theta$

where θ is the angle between the direction of polarization and the axis of the sheet.

Sheet #1 $\frac{I_1}{I_0} = \frac{1}{2}$ Unpolarized To polarized

The Light out is polarized at $\theta_1 = 40^\circ$

Sheet #2 The Light is polarized at 40°

The angle of the Sheet is $\theta_2 = 20^\circ$, clockwise from the y axis (See Figure 33-40)

The angle between the polarization and the axis of Sheet #2 is $40 - (-20) = 60^\circ$

$\frac{I_2}{I_1} = \cos^2 60^\circ = \frac{1}{4}$

For sheet #2 output Light is polarized at $\theta_2 = -20^\circ$

Sheet #3 $\frac{I_3}{I_2} = \cos^2 60^\circ = \frac{1}{4}$

$\frac{I_3}{I_0} = \frac{1}{2} * \frac{1}{4} * \frac{1}{4} = 0.031 = 3.1\%$