HW 23

(1)

$$f = \frac{1}{T} = \frac{c}{\lambda} = \frac{3\times10^{8}\,m.s^{-1}}{2.7\times10^{-2}\,m} \doteq \underline{\underline{11.1\ GHz}}$$

(2)

$$I = \frac{1}{2}\varepsilon_0 c\, E_0^2 = \frac{1}{2}\varepsilon_0 c\,(cB_0)^2 = \frac{1}{2}\varepsilon_0 c^3 . B_0^2$$

$$= \frac{1}{2}\varepsilon_0 c^3 . (B_x^2 + B_y^2) \doteq \underline{\underline{2161.1\ W/m^2}}$$

(3)

$$\vec{S} = \frac{1}{\mu_0}\overbrace{\vec{E}\times\vec{B}}^{\sim(-\hat{k})} = \frac{1}{\mu_0}(cB_0).B_0(-\hat{k}) = -\frac{c}{\mu_0}B_0^2 . \hat{k}$$

$$S_z = -\frac{c}{\mu_0}(B_x^2 + B_y^2) \doteq \underline{\underline{-4322\ W/m^2}}$$

Our wave goes in negative z direction.

(4)

$$\vec{E} = E.\hat{E} = (cB).(\hat{B}\times(-\hat{k})) = cB.(\hat{k}\times\hat{B}) =$$

$$= c(\hat{k}\times\vec{B}) = c.\hat{k}\times(B_x.\hat{\imath} + B_y.\hat{\jmath}).\cos(\underbrace{k.0+\omega.0}_{0})$$

$$= cB_x\underbrace{(\hat{k}\times\hat{\imath})}_{+\hat{\jmath}} + cB_y.\underbrace{(\hat{k}\times\hat{\jmath})}_{-\hat{\imath}}$$

$$= \underbrace{-c.B_y}_{E_x}.\hat{\imath} + \underbrace{cB_x}_{E_y}\hat{\jmath}$$

$$\therefore\quad E_x = -cB_y = \underline{\underline{-960\ V/m}}$$

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$S'_{\parallel z} > 0$ and magnitude $S_{\parallel z}$ =

= magnitude S_z

The sign of S_z is determined by direction of propagation of the wave. In case $\parallel$, the wave is propagating in the positive z direction. Consequently $S_{\parallel z}$ must be positive. The magnitude of S_z is determined by the magnitude of ~~of~~ the magnetic field. The magnitude of the magnetic field in case $\parallel$ is the same as the magnitude of the magnetic field in the original case.