Ch 16 Prob. 45

~~$\vec{E} = \left(5.00\frac{V}{m}\right)\cos\left[kx - \left(6.00\times10^{9}\frac{rad}{s}\right)t\right]\hat{j}$~~ $+0.40$

$$\vec{E} = \left(5.00\frac{V}{m}\right)\cos\left[kx - \left(6.00\times10^{9}\frac{rad}{s}\right)t + 0.40\right]\hat{j}$$

a) Amplitude $A = E_0 = \boxed{5.00\frac{V}{m}}$

b) frequency $\omega = 6.00\times10^{9}\frac{rad}{s}$

$$f = \frac{\omega}{2\pi} = \boxed{9.55\times10^{8}\ Hz}$$

c) wavelength $c = 3.0\times10^{8}\ m/s$ and $f\cdot\lambda = c$

$$\text{so } \lambda = \frac{c}{f} = \frac{3.0\times10^{8}\ m/s}{9.55\times10^{8}\ Hz} = \boxed{0.314\ m}$$

d) direction of the wave

There is not enough information given.

∴ we will assume it is traveling in the $\boxed{+x \text{ direction}}$

e) Find the magnetic field wave

By the cross product, the direction of the B field is $+\hat{k}$ ∴ $\vec{E}\times\vec{B} \rightarrow \hat{j}\times\hat{k} = \hat{i}$

where $\hat{i}$ is the direction of travel of the wave.

The magnitude of the wave is $c = \frac{E}{B} \rightarrow B = \frac{E}{c}$

$$B = \frac{5.00\frac{V}{m}}{3.0\times10^{8}\ m/s} = 1.67\times10^{-8}\ T$$

$$\text{so } \boxed{\vec{B} = \left(1.67\times10^{-8}\ T\right)\cos\left[kx - \left(6.00\times10^{9}\frac{rad}{s}\right)t + 0.40\right]\hat{k}}$$