CH 34

(3) $V = \frac{1}{\sqrt{K \mu_0 \epsilon_0}} = \frac{1}{\sqrt{(1.78)(4\pi E-7)(8.85E-12)}} = 2.25 \times 10^8 \, m/s$

$K = 1.78$

(5) (a) $c = \lambda f$ $\quad f = \frac{3.0 \times 10^8 \, m/s}{50.0 \, m} = 6 \times 10^6 \, Hz$

(b) $\frac{E}{B} = c$ $\quad \frac{22.0 \, V/m}{3.0 \times 10^8 \, m/s} = B_{max} = -73.3 \times 10^{-9} \, T$

z direction

(c) $K = \frac{2\pi}{\lambda} = .126 \, m^{-1}$

$\omega = 2\pi f = 3.77 \times 10^7 \, rad/s$

$\vec{B} = B_{max} \cos(Kx - \omega t)$

(7) $\frac{E}{B} = c$ $\quad \frac{100}{3.0 \times 10^8 \, m/s} = .333 \, \mu T$

$\lambda = \frac{2\pi}{K} = \frac{2\pi}{1.00 \times 10^7} = .628 \, \mu m$

$f = \frac{c}{\lambda} = \frac{\omega}{2\pi} = 4.77 \times 10^{14} \, Hz$

(8) $E = E_0 \cos(Kx - \omega t)$

$\frac{\partial^2}{\partial x^2}(E) = -K^2 E_0 \cos(kx - \omega t)$

$\frac{\omega^2}{K^2} = \frac{(2\pi f)^2}{\left(\frac{2\pi}{\lambda}\right)^2} = (\lambda f)^2 = c^2$

$= \frac{\partial^2}{\partial t^2}(E) = -\omega^2 E_0 \cos(Kx - \omega t)$

$\partial_x^2 E = c^2 \partial_t^2 E$

same steps for B field

(12) $S = \dfrac{\bar{P}}{4\pi r^2} = \dfrac{4\times10^3\,W}{4\pi\,(4\times1609\,m)^2} = 7.68\,\mu W/m^2$

$E_{max} = \sqrt{2\mu_0 c S} = .0761\ V/m$

$\Delta V_{max} = E_{max}\, l = 49.5\ mV$ amplitude

(15) sun $\rightarrow$ $1000\,W/m^2$

available power: $1000\,w\,(30\%) = 300\ W/m^2$

$1\,MW = 300\,\frac{W}{m^2}\,(\text{Area})$

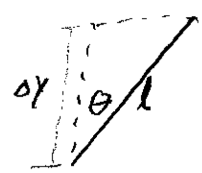
$\text{Area} = 3.33\times10^3\,m^2$

(33) $h = \frac{1}{4}\lambda$ $\lambda = \frac{c}{f}$ $\dfrac{3.0\times10^8\,m/s}{560\,kHz} = 536\,m \rightarrow h = 134\,m$

$\dfrac{3.0\times10^8}{1600\,kHz} = 188\,m \rightarrow h = 47\,m$

(34) $P = \dfrac{V^2}{R}$

$\Delta V = -E_y\cdot\Delta y$



$= E_y\, l\cos\theta$

$P = \dfrac{E_y^2\, l^2\cos^2\theta}{R}$

$P \propto \cos^2\theta$

$\theta = 0$ $P = 100\%$ P_{max}

$\theta = 15^\circ$ $P = 93.3\%$

$\theta = 45^\circ$ $P = 50\%$

$\theta = 90^\circ$ $P = 0$

(43) $\Delta t = 4.00 \times 10^{-4}\,s$

$V = c$

$2\,\Delta x = V\,\Delta t$

$\Delta x = 60.0\,Km$

(44) $\dfrac{100\,Km}{3.0 \times 10^{8}\,m/s} = 3.33 \times 10^{-4}\,s$

listeners far away hear it first.

$\dfrac{3\,m}{343\,m/s} = 8.75 \times 10^{-3}\,s$

Questions:

3. Energy moves, matter does not. The electric and magnetic fields vary in time. You could say that the fields move, or that they stay in place with varying amplitude.

5. Electromagnetic radiation is a result of accelerating charge.

10. The Poynting vector describes the energy flow associated with an electromagnetic wave. The direction of the vector gives the direction of the energy flow, and the magnitude gives the amount of energy per unit time flowing through a unit area perpendicular to the Poynting vector.

12. Broadcasting antenas are at different locations relative to your house. To get the best reception the rabbit ears should be perpendicular to the direction of the wave and the electric field of the wave. Various surroundings can change the polarization of the signal before it reaches the antena.