PH213 - Chapter 32 Homework Solutions

5) $Q = CV$ $\qquad \frac{d}{dt}(Q) = \frac{d}{dt}(CV) \qquad I_D = C\frac{dV}{dt}$

7) Gauss's Law of Magnetism would be altered to

$$\oint \vec{B}\cdot d\vec{A} = \frac{Q_m(\text{enclosed})}{(1/\mu_0)} = \mu_0 Q_m(\text{enclosed}).$$

Faraday's Law of Induction would be altered to

$$\oint \vec{E}\cdot d\vec{l} = -\frac{d}{dt}\left(\Phi_M - \mu_0 Q_M\right) = \mu_0\frac{dQ_M}{dt} - \frac{d\Phi_M}{dt}$$

8) $E = Bc = (17.5\times10^{-9})(3.00\times10^{+8}) = (1.75)(3.00) = 5.25\,\frac{N}{C}$

$= 5.25\,\frac{V}{m}$

11) Direction of $\vec{E} = +\hat{i}$

Direction of $\vec{S} = -\hat{k}$ since $(kz+\omega t)$

(a) $B = B_0\cos(kz+\omega t) = \frac{E_0}{c}\cos(kz+\omega t) = \frac{E}{c}$

Direction of $\vec{B} = -\hat{j}$ by RHR

(b) The direction of propagation $= -\hat{k}$ as above.

12) $v = c = \lambda f \qquad f = \frac{c}{\lambda} = \frac{3.00\times10^{8}}{1.80\times10^{-2}} = 1.67\times10^{10}\text{ Hz}$

14) $f = \frac{c}{\lambda} = \frac{3.00\times10^{8}}{(850\times10^{-9})} = 3.53\times10^{14}\text{ Hz}$

Since $\lambda > 700\text{nm}$, this is in the infrared part of the spectrum.

16) $1 \text{ light-year} = \left(3.00\times10^{8}\ \frac{m}{sec}\right)(1\text{year}) = (3.00\times10^{8})(365.25)(86{,}400)$

$1 \text{ light-year} = 9.47\times10^{15} \text{ meters}$

25) $P = IA = I(4\pi R_{se}^{2})$ R_{se} = distance from Sun to Earth.

$P = (1350)(4\pi)(1.50\times10^{11})^{2} = 3.82\times10^{26}\ W$

42) $P = IA$ $I = S = \frac{P}{A} = \frac{P}{4\pi R^{2}}$

$S = \frac{EB}{\mu_0} = \frac{(Bc)(B)}{\mu_0} = \frac{B^{2}c}{\mu_0}$ $B = \sqrt{\frac{S\mu_0}{c}}$

$B = \sqrt{\frac{P\mu_0}{4\pi R^{2}c}} = \left(\frac{(100)(4\pi\times10^{-7})}{4\pi(2.00)^{2}(3\times10^{8})}\right)^{1/2} = 9.13\times10^{-8}\ T$

$E = cB = (3.00\times10^{8})(9.13\times10^{-8}) = 27.4\ \frac{N}{C} = 27.4\ \frac{V}{m}$

44) $\hat{B}$ = west , $\hat{E}$ = south , $\hat{S}$ = down by RHR

$S = I = 500\ W/m^{2}$

$B = \sqrt{\frac{S\mu_0}{c}} = \left(\frac{(500)(4\pi\times10^{-7})}{(3\times10^{8})}\right)^{1/2} = 1.45\times10^{-6}\ T = 1.45\ \mu T$

$E = cB = (3.00\times10^{8})(1.45\times10^{-6}) = 4{,}340\ \frac{N}{C} = 4{,}340\ \frac{V}{m}$.