Ch. 16 Prob. 57

Top of earth's atmosphere $I = \bar{S} = 1.4 \times 10^3 \frac{W}{m^2}$

a) Find the ~~amplitude~~ amplitude of the electric field oscillation and magnetic field oscillation

$I = \bar{S} = \frac{1}{2}\frac{E_0 B_0}{\mu_0}$ and $c = \frac{E_0}{B_0}$, so $E_0 = cB_0$

sub into Intensity equation gives

$$I = \frac{1}{2}\frac{B_0}{\mu_0}(cB_0) = \frac{cB_0^2}{2\mu_0} \rightarrow B_0^2 = \frac{2\mu_0 I}{c}$$

$$B_0 = \sqrt{\frac{2\left(4\pi \times 10^{-7}\frac{Tm}{A}\right)\left(1.4\times10^3\frac{W}{m^2}\right)}{\left(3.0\times10^8 m/s\right)}} = \sqrt{1.17\times10^{-11}\left(\frac{Tm}{A}\right)\left(\frac{W}{m^2}\right)\left(\frac{s}{m}\right)}$$

$$\boxed{B_0 = 3.42 \times 10^{-6}\ T}$$

$$E_0 = cB_0 = \left(3.0\times10^8 m/s\right)\left(3.42\times10^{-6} T\right) = \boxed{1030\ \frac{V}{m}}$$

b) Find the Power of the sun.

since intensity goes as $I = \frac{P}{4\pi r^2}$ (energy radiated equally in all directions)

$P = 4\pi r^2 I$

The earth-sun distance is $r = 1.50\times10^{11} m$

$$P_{sun} = 4\pi\left(1.50\times10^{11} m\right)^2\left(1.4\times10^3\frac{W}{m^2}\right)$$

$$\boxed{P_{sun} = 3.96 \times 10^{26} W}$$