Physics 115 Homework #7 Solutions

1) $\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$ $\quad \vec{a} = \frac{\vec{F}}{m}$

$$\frac{m_p}{m_e} \sim 1800 \Rightarrow \frac{a_e}{a_p} \sim \frac{1}{1800}$$

2) (a) Light is scattered when air molecules are accelerated by $\vec{E}$ field. The sun's light is unpolarized, or randomly polarized = linear combinations of vertical and horizontal polarization. Looking up, $\vec{a}_\perp = 0$ for vertical $\vec{E}_{sun}$, but $\vec{a}_\perp \neq 0$ for horizontal $\vec{E}_{sun}$. Thus, we see only horizontal $\vec{E}$

(b) N-S because ↗

3) $$\text{Energy flux} = \frac{\text{Energy}}{\Delta A \, \Delta t} = \frac{1}{\mu_0} EB = \epsilon_0 c E^2$$

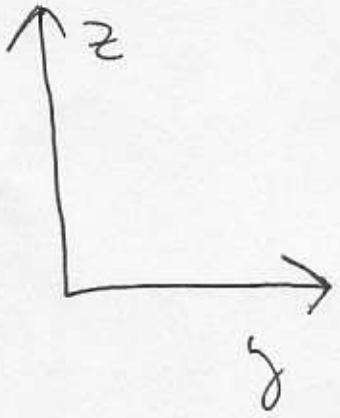
$$= \frac{100\,W}{\pi (0.2m)^2} = \epsilon_0 c E^2$$

$$\Rightarrow E = \sqrt{\frac{100\,W}{\pi (0.2m)^2} \frac{1}{\epsilon_0 c}} = 547 \frac{V}{m} \text{ or } \frac{N}{C}$$

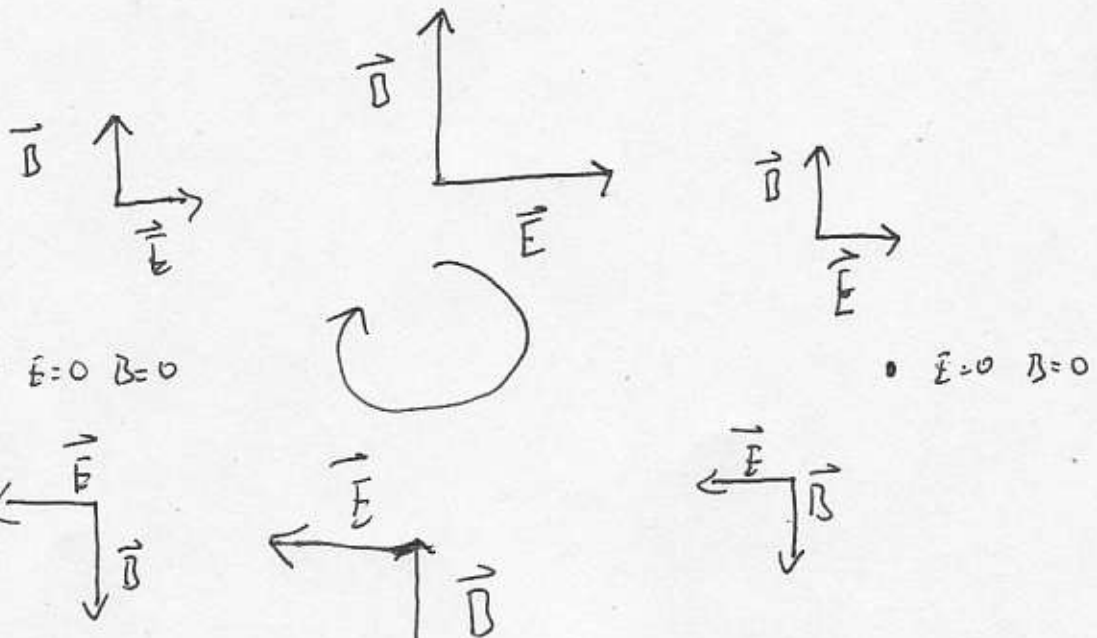
4) (a) Electric dipole antennae generate $\vec{E}$ field that oscillates as e^-'s move back and forth. But, of course, $\vec{B}$ is also generated by oscilating current.

Magnetic dipole antennae generate $\vec{B}$ field that oscillates as current oscillates. But, of course, $\vec{E}$ is also generated by oscilating e^-'s.

(b)



from P looking at antennae



(c) Same as (b)

5) (a) $\vec{E}$ points along resistor in direction of $\vec{I}$.

$\vec{B}$ points around $\vec{I}$.

$\Rightarrow$ $\vec{E} \times \vec{B}$ points into resistor, $\perp$ to surface. $\Rightarrow$ $\vec{S} \perp$ surface

(b) $\vec{S} = \frac{1}{\mu_0} \vec{E} \times \vec{B}$

$E = \frac{\Delta V}{l} = \frac{IR}{l}$ $\quad B = \frac{\mu_0}{2\pi} \frac{I}{a}$ at surface

$\Rightarrow \int \vec{S} \cdot d\vec{A} = \frac{EB}{\mu_0} 2\pi a l = \frac{\frac{IR}{l} \frac{\mu_0}{2\pi} \frac{I}{a}}{\mu_0} 2\pi a l$

$= I^2 R$ ✓

6) $\Delta p = \frac{\text{energy}}{c} = \frac{(\text{Intensity})(\text{area})(\text{time})}{c}$

$= \frac{(1.1 \times 10^3 \ \text{W m}^{-3})(1.3 \ \text{m}^2)(2.5^h \times 3600^s/_h)}{3 \times 10^8 \ \text{m s}^{-1}} = 4.3 \times 10^{-2} \ \text{kg m s}^{-1}$