Phys 121, Fall 2021, Rocket Science, Module 5

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

$\hat{y}$ $\hat{z}$ $\hat{x}$

2) $|\vec{E}||\vec{B}|\sin\theta = \vec{E}\times\vec{B}$

θ - angle between $\vec{E}$ & $\vec{B}$.

$\theta = 90°$

$|\vec{E}||\vec{B}| = |E_0\cos(\omega t)||B_0\cos(\omega t)|$

$= |E_0 B_0 \cos(\omega t)\cos(\omega t)|$

$\cos^2(\omega t) = \frac{1}{2}(\cos(2\omega t)+1)$

$\left\langle \frac{1}{2}(\cos(2\omega t)+1)\right\rangle = \frac{1}{2}\langle\cos(2\omega t)\rangle + \langle\frac{1}{2}(1)\rangle$

$= \frac{1}{2}\underbrace{\langle\cos(2\omega t)\rangle}_{0} + \frac{1}{2}\underbrace{\langle 1\rangle}_{\frac{1}{2}}$

$\text{Avg} = \frac{\sum X_i}{\text{Total}\ \sum 1}$

Pg 3)

Q1) $c = \frac{\ell}{\Delta t} \Rightarrow \Delta t = \frac{\ell}{c}$

2) $P = \frac{E_*}{\Delta t} = \frac{E_* c}{\ell}$

3) $S = \frac{P}{A} = \frac{P\ell}{V} = \frac{E_* c \ell}{\ell V} = \frac{E_* c}{V}$

4) $\vec{S} = \vec{P}c^2 = \frac{E_* c}{V} \Rightarrow P = \frac{E_*}{cV} = \frac{E_* c}{c E_*}$

Discuss: $\mathcal{P} = \frac{\left(\frac{E_*}{c}\right)}{V}$ $\Longrightarrow$ momentum density (momentum over volume)

$$p = \frac{E_*}{c}$$

Pg. 4) Discuss: ~~a)~~ a)

Discuss: Frequency of light ↓.
Energy of light ↓
Momentum of light ↓

Red Shift ≡ loss of momentum