c) Finally, let's find the radiation pressure on the metal plate, and its time-averaged value?

$$P = 2 \times \frac{\text{incident momentum}}{\text{time}} \times \frac{1}{\text{Area}}$$

$$= 2 \times \frac{\text{incident momentum}}{\text{volume}} \times \text{speed}$$

$$= 2 \frac{|\bar{S}|}{c} \leftarrow \text{(from previous chapter)}$$

$$= \frac{2}{\mu_0 c} |\bar{E}_i \times \bar{B}_i| \leftarrow \text{\{So I need to calculate this cross product. Here goes :)}}$$

$$\bar{E}_i \times \bar{B}_i = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ E_{ix} & E_{iy} & 0 \\ B_{ix} & B_{iy} & 0 \end{vmatrix} = \hat{z}\left[E_{ix}B_{iy} - E_{iy}B_{ix}\right]$$

$$|\bar{E}_i \times \bar{B}_i| = E_{ix}B_{iy} - E_{iy}B_{ix} \leftarrow \text{This is the magnitude of the cross product.}$$

$$= \left[E_0 \cos(\omega t - kz)\right]\left[\frac{E_0}{c}\cos(\omega t - kz)\right] + \left[2E_0 \cos\left(\omega t - kz - \frac{\pi}{2}\right)\right]\left[\frac{2E_0}{c}\cos\left(\omega t - kz - \frac{\pi}{2}\right)\right]$$

- Here I have used the fact that $B_{iy} = \frac{E_{ix}}{c}$ and $-B_{ix} = +\frac{E_{iy}}{c}$

- So $$P = \frac{2}{\mu_0 c^2}\left\{E_0^2 \cos^2(\omega t - kz) + 4E_0^2 \cos^2\left(\omega t - kz - \frac{\pi}{2}\right)\right\}$$

- At the location of the metal plate, $z = 0$, so

$$P = \frac{2E_0^2}{\mu_0 c^2}\left\{\cos^2(\omega t) + 4\cos^2\left(\omega t - \frac{\pi}{2}\right)\right\}$$