Problem 8.2

a)

$$|\vec{E}| = \sqrt{E_0^2 \sin^2(kz - \omega t) + E_0^2 \cos^2(kz - \omega t)} = E_0$$

b)

$$|\vec{B}| = \sqrt{B_0^2 \cos^2(kz - \omega t) + B_0^2 \sin^2(kz - \omega t)} = E_0$$

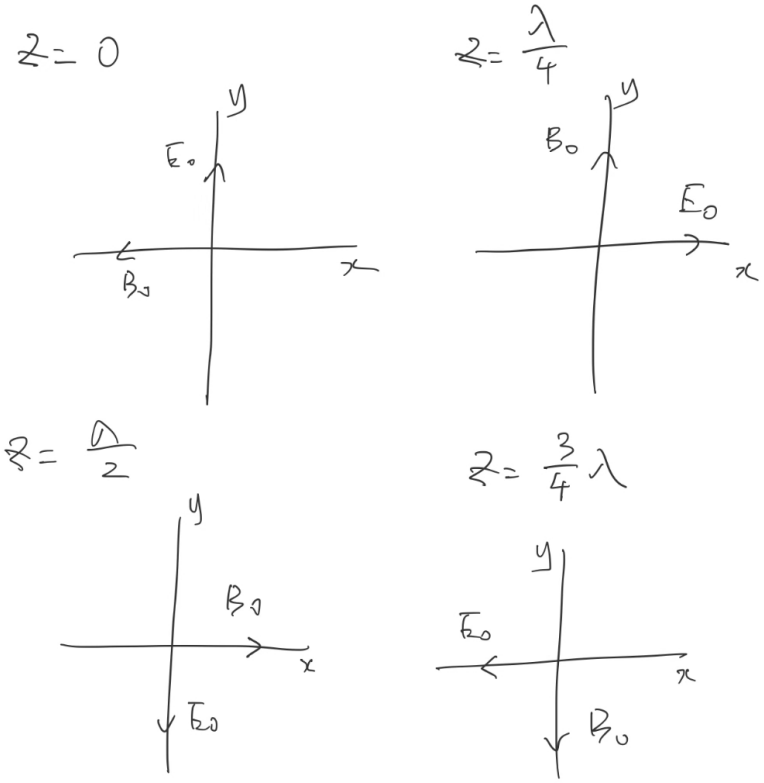
c)

$$u = \frac{\epsilon_0}{2} E^2 + \frac{1}{2\mu_0} B^2 = \epsilon_0 E^2$$

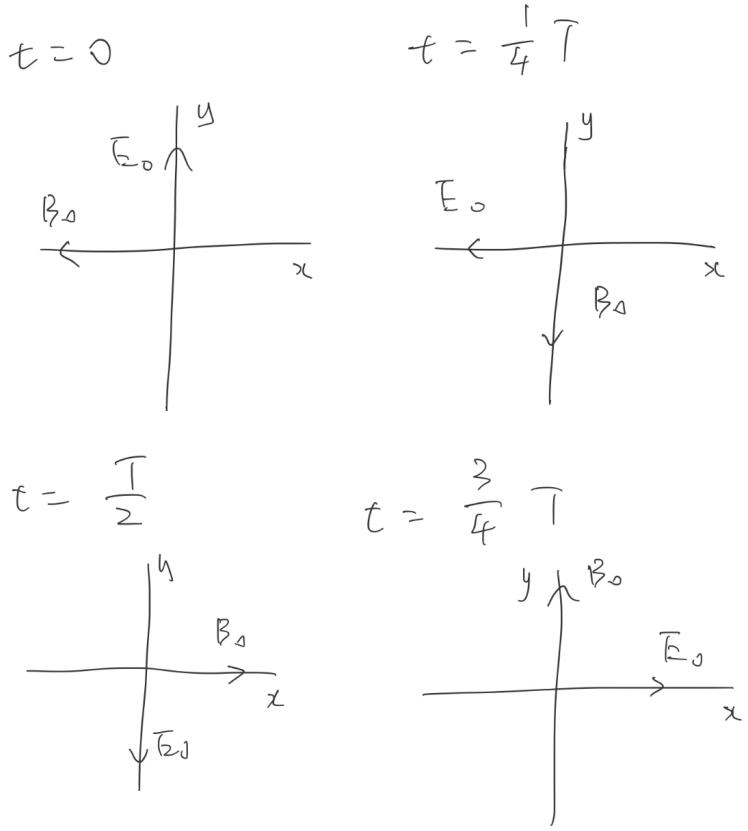
d)

$$\begin{aligned} \vec{E} \cdot \vec{B} &= \begin{bmatrix} E_0 \sin(kz - \omega t) \\ E_0 \cos(kz - \omega t) \\ 0 \end{bmatrix} \cdot \begin{bmatrix} -B_0 \cos(kz - \omega t) \\ B_0 \sin(kz - \omega t) \\ 0 \end{bmatrix} \\ &= 0 \end{aligned}$$

e)



f)



h)

$$\begin{aligned}\vec{E} \times \vec{B} &= \begin{bmatrix} E_0 \sin(kz - \omega t) \\ E_0 \cos(kz - \omega t) \\ 0 \end{bmatrix} \times \begin{bmatrix} -B_0 \cos(kz - \omega t) \\ B_0 \sin(kz - \omega t) \\ 0 \end{bmatrix} \\ &= E_0 B_0 \left(\sin^2(kz - \omega t) + \cos^2(kz - \omega t) \right) \hat{k} \\ &= E_0 B_0 \hat{k}\end{aligned}$$

i)

$$\begin{aligned} f_1 &= \begin{bmatrix} E_0 \sin(kz - \omega t) \\ 0 \\ 0 \end{bmatrix} \times \begin{bmatrix} 0 \\ B_0 \sin(kz - \omega t) \\ 0 \end{bmatrix} \\ &= E_0 B_0 \sin^2(kz - \omega t) \hat{k} \\ f_2 &= \begin{bmatrix} 0 \\ E_0 \cos(kz - \omega t) \\ 0 \end{bmatrix} \times \begin{bmatrix} -B_0 \cos(kz - \omega t) \\ 0 \\ 0 \end{bmatrix} \\ &= E_0 B_0 \cos^2(kz - \omega t) \hat{k} \\ f_1 + f_2 &= E_0 B_0 \left(\sin^2(kz - \omega t) + \cos^2(kz - \omega t) \right) \hat{k} \\ &= E_0 B_0 \hat{k} \end{aligned}$$

j)

Wave 1 oscillates in the x direction. Wave 2 oscillates in the y direction.