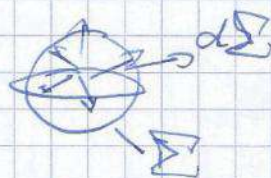


$$P_n = \oint_{\Sigma} \vec{S} \cdot d\vec{\Sigma}$$



$$= \iint_{\Sigma} \vec{S} \cdot d\vec{\Sigma}$$

$$= \int_0^{2\pi} \int_0^{\pi} S \cdot R^2 \cdot \sin \theta \, d\theta \, d\varphi$$

$$= S R^2 \int_0^{\pi} \int_0^{2\pi} d\varphi$$

$$= \boxed{4\pi S R^2}$$

$$= \boxed{4\pi \epsilon_0 c \cdot E^2 R^2}$$

$$E = cB \quad \text{et} \quad c^2 = \frac{1}{\mu_0 \epsilon_0}$$

$$B = \frac{E}{c} \quad c^2 \cdot \epsilon_0 = \frac{1}{\mu_0}$$

$$\vec{S} = \frac{\vec{E} \wedge \vec{B}}{\mu_0} = \frac{E \cdot B}{\mu_0} \vec{e}_n$$

$$= c^2 \epsilon_0 \frac{E^2}{2} \vec{e}_n$$

$$= \epsilon_0 \cdot c \cdot E^2 \cdot \vec{e}_n$$

$$c = 3 \times 10^8 \, \text{m/s}$$

$$\epsilon_0 = 8.85 \times 10^{-12} \, \text{F/m}$$

$$= 4\pi \epsilon_0 c \cdot E_0^2 \cdot \cos^2(kx - \omega t) \cdot R^2$$

$$= 12\pi \epsilon_0 \cos^2(kx - 2\pi t \times 10^{14}) R^2 \times 10^{12}$$

$$= \boxed{12\pi R^2 \epsilon_0 \cdot \cos(kx - 2\pi t \times 10^{14}) \times 10^{12} \, \text{W}}$$

Exercice 7

1) $\vec{E}(z, t) = \begin{pmatrix} E_0 \cos(kz - \omega t) \\ E_y \cos(kz - \omega t) \\ 0 \end{pmatrix}$

$$\vec{E}(z, t) = \begin{pmatrix} E_x \cos(kz - \omega t) \\ E_y \cos(kz - \omega t) \\ 0 \end{pmatrix}$$

$$= \begin{pmatrix} E_0 \cdot \cos \frac{\pi}{3} \cos(kz - \omega t) \\ E_0 \cdot \sin \frac{\pi}{3} \cos(kz - \omega t) \\ 0 \end{pmatrix}$$

$$= \begin{pmatrix} \frac{E_0}{2} \cos(kz - \omega t) \\ \frac{E_0 \sqrt{3}}{2} \cos(kz - \omega t) \\ 0 \end{pmatrix}$$

2) $\vec{E}(y, t) = \begin{pmatrix} E_x \cos(ky - \omega t) \\ 0 \\ 3E_x \cos(ky - \omega t + \varphi) \end{pmatrix}$ avec $\varphi \in]0; \pi[$

3) $\vec{E}(y, t) = \begin{pmatrix} E_0 \cdot \sin \frac{\pi}{4} \cdot \cos(ky - \omega t) \\ 0 \\ E_0 \cdot \cos \frac{\pi}{4} \cdot \cos(ky - \omega t) \end{pmatrix}$

$$= \frac{E_0 \sqrt{2}}{2} \begin{pmatrix} \cos(ky - \omega t) \\ 0 \\ \cos(ky - \omega t) \end{pmatrix}$$

$$\cos \sin \frac{\pi}{4} = \cos \frac{\pi}{4} = \frac{\sqrt{2}}{2}$$

$$\operatorname{div} \vec{E} = \frac{\rho}{\epsilon}$$

$$\operatorname{div} \vec{B} = 0$$

$$\operatorname{rot} \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\operatorname{rot} \vec{B} = \mu \vec{J} + \mu \cdot \epsilon \frac{\partial \vec{E}}{\partial t}$$

$$Q_{\text{int}} = \iiint_V \rho d\tau$$

Exercise 4

$$\operatorname{div} \vec{B} = 0$$

$$\oint_S \vec{B} \cdot \vec{dS} = \iiint_V \operatorname{div} \vec{B} d\tau \Leftrightarrow \iiint_V \operatorname{div} \vec{B} d\tau = \underbrace{\Phi(\vec{B})}_0$$

$$E_n = \frac{K}{\epsilon_0} \left(\frac{r}{3} - \frac{r^2}{R^2} \right)$$

$$\Rightarrow \boxed{\operatorname{div} \vec{B} = 0}$$

$$3) \operatorname{div} \vec{E}_n = \frac{\rho}{\epsilon_0} \Leftrightarrow \operatorname{div} \left(\frac{K}{\epsilon_0} \left(\frac{r}{3} - \frac{r^2}{R^2} \right) \right) = \frac{\rho}{\epsilon_0}$$

$$\Leftrightarrow \frac{1}{r^2} \times \frac{\partial}{\partial r} (r^2 E_n) + \frac{1}{r \cdot \sin \theta} \times \frac{\partial}{\partial \theta} (\sin \theta \cdot E_\theta) + \frac{1}{r \cdot \sin \theta} \times \frac{\partial E_\varphi}{\partial \varphi} = \frac{\rho}{\epsilon_0}$$

$$\Leftrightarrow \frac{1}{r^2} \times \frac{\partial}{\partial r} (r^2 E_n) = \frac{\rho}{\epsilon_0}$$

$$\Leftrightarrow \frac{2r E_n}{r^2} + \frac{K}{\epsilon_0} \left(\frac{1}{3} - \frac{2r}{R^2} \right) = \frac{\rho}{\epsilon_0}$$

$$\Leftrightarrow \rho = \frac{2 E_n}{r} + K \left(\frac{1}{3} - \frac{2r}{R^2} \right)$$

$$\Leftrightarrow \rho = \frac{2r}{r} \times \frac{K}{\epsilon_0} \left(\frac{r}{3} - \frac{r^2}{R^2} \right) + K \left(\frac{1}{3} - \frac{2r}{R^2} \right)$$

$$\Leftrightarrow \rho = K \left(\frac{2}{r} \times \frac{r}{3} - \frac{2}{r} \times \frac{r^2}{R^2} + \frac{1}{3} - \frac{2r}{R^2} \right)$$

$$\Leftrightarrow \rho = K \left(1 - \frac{4r}{R^2} \right)$$

$$\frac{1}{T} \int_0^T \cos(kz - \omega t) dt = \frac{1}{T} \left[-\frac{\sin(kz - \omega t)}{\omega} \right]_0^T$$

$$= \frac{1}{T} \left(-\frac{\sin(kz - \omega T)}{\omega} + \frac{\sin(kz)}{\omega} \right)$$

On sait $\langle \cos^2 x \rangle = \frac{1}{2}$ donc,

$$\langle S \rangle = \frac{E_0^2 \cdot \pi \cdot R^2}{\mu_0 \cdot c} \times \frac{1}{2}$$

$$= \frac{E_0^2 \cdot \pi \cdot R^2}{2 \mu_0 c}$$

$$= \frac{10^{-4} \cdot \pi \cdot 2 \times 10^{-6}}{3 \times 10^8 \cdot 4\pi \times 10^{-7} \times 10^8}$$

$$= \frac{2 \times 10^{-8}}{3 \times 10^8}$$

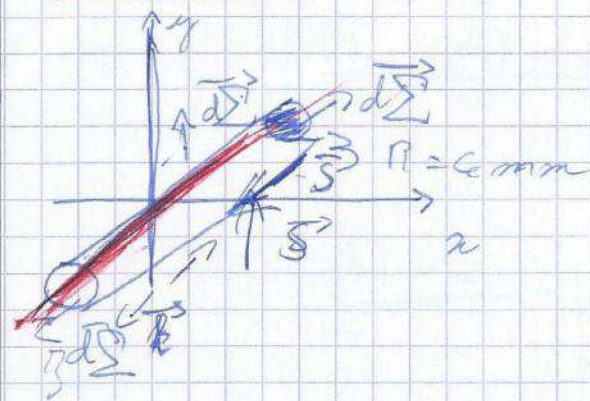
$$= \boxed{\frac{2}{3} \times 10^{-16} \text{ W}}$$

$$L_{\text{mm}} = 4 \times 10^{-3} \text{ m}$$

$$\vec{E} = E_0 \cos(kz - \omega t)$$

Exercise 5

$$|\vec{E} \wedge \vec{B}| = |\vec{E}| |\vec{B}| \sin(\angle \vec{E}, \vec{B})$$



$$\vec{S} = \frac{\vec{E} \wedge \vec{B}}{\mu}$$

$$= \frac{E \cdot B \cdot \sin(\angle \vec{E}, \vec{B})}{\mu} \vec{e}_r$$

$$= \left[\frac{E \cdot B}{\mu} \vec{e}_r \right]$$

$$\vec{E} \perp \vec{B} \Rightarrow E = cB \Leftrightarrow B = \frac{E}{c}$$

$$S = \frac{E^2}{\mu_0 \cdot c}$$

$$\langle \cos \rangle = \frac{1}{\sqrt{2}}$$

$$P = \oint_S \vec{S} \cdot d\vec{\Sigma} = \iint S d\Sigma$$

$$= \frac{E_0^2}{\mu_0 \cdot c} \iint d\Sigma$$

$$= \left[\frac{E_0^2 \pi R^2}{\mu_0 \cdot c} \right]$$

$$= \left[\frac{E_0^2 \pi R^2 \cos^2(ky - \omega t)}{\mu_0 \cdot c} \right]$$

$$\langle P \rangle = \frac{1}{T} \int_0^T \frac{E_0^2 \pi R^2 \cos^2(ky - \omega t)}{\mu_0 \cdot c} dt$$

$$= \frac{E_0^2 \pi R^2}{\mu_0 \cdot c} \cdot \frac{1}{T} \int_0^T \cos^2(ky - \omega t) dt$$

Exercice 11

$$1) \vec{E}(z,t) = E_0 \cdot \cos(kz - \omega t) \cdot \vec{e}_y \quad \text{donc,}$$

$$\boxed{\vec{E}(R,t) = E_0 \cdot \cos(k \cdot R - \omega t) \cdot \vec{e}_y}$$

$$\nabla \times \vec{E} = - \frac{\partial \vec{B}}{\partial t} \Leftrightarrow \vec{k} \wedge \vec{E} = \omega \vec{B}$$

$$\Leftrightarrow \frac{k}{\omega} \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \wedge \left(E_0 \cdot \cos(k \cdot R - \omega t) \right) = \vec{B}$$

$$\Leftrightarrow \boxed{\vec{B} = c \begin{pmatrix} 0 \\ 0 \\ E_0 \cos(k \cdot R - \omega t) \end{pmatrix}}$$

$$2) \vec{S} = \frac{\vec{E} \wedge \vec{B}}{\mu_0}$$

$$\epsilon_0 = \frac{1}{\mu_0 \cdot c^2}$$

$$= \frac{\vec{E} \cdot \vec{B}}{\mu_0} \vec{e}_z$$

$$E = cB \quad \mu_0 \cdot \epsilon_0 = \frac{1}{c^2}$$

$$= \epsilon_0 \cdot c \cdot E^2 \cdot \vec{e}_z$$

$$= \boxed{\epsilon_0 \cdot c \cdot E_0^2 \cos^2(k \cdot R - \omega t) \vec{e}_z}$$

S_0

$$S_0 = \epsilon_0 \cdot c \cdot E_0^2$$

$$= \frac{1}{\mu_0 \cdot c} E_0^2$$

$$= \boxed{\frac{E_0^2}{\mu_0 \cdot c}}$$

$$= \frac{10^6}{4\pi \times 10^{-7} \times 3 \times 10^8}$$

$$= \boxed{\frac{1}{12\pi} \times 10^5 \text{ W}}$$

Exercice 17

$$(\sin)' = \cos$$

$$(\cos)' = -\sin$$

$$(\sin)'' = -\sin$$

L'onde se propage selon l'axe Oz donc,

$$\frac{\partial \vec{E}}{\partial z} - \frac{1}{c^2} \times \frac{\partial^2 \vec{E}}{\partial t^2} = 0 \quad \left(\sin \frac{\pi z}{a} \right)'' = -\left(\frac{\pi}{a} \right)^2 \sin \frac{\pi z}{a}$$

$$\text{On } \vec{E}(x, y, z, t) = E_0 \sin \frac{\pi z}{a}$$

$$\Delta \vec{E} - \frac{1}{c^2} \cdot \frac{\partial^2 \vec{E}}{\partial t^2} = 0$$

$$\text{d'où } \vec{\nabla} \cdot (\text{div } \vec{E}) - \text{rot} \cdot (\text{rot } \vec{E}) - \frac{1}{c^2} \cdot \frac{\partial^2 \vec{E}}{\partial t^2} = 0$$

$$\left(\sin \frac{\pi z}{a} \right)' = -\left(\frac{\pi}{a} \right)^2 \sin \frac{\pi z}{a} \quad \left(\sin \frac{\pi z}{b} \right)'' = -\left(\frac{\pi}{b} \right)^2 \sin \frac{\pi z}{b}$$

$$\Delta E = \frac{1}{c^2} \times \frac{\partial^2 E}{\partial t^2} = 0 \Leftrightarrow \frac{\partial^2 E}{\partial x^2} + \frac{\partial^2 E}{\partial y^2} + \frac{\partial^2 E}{\partial z^2} - \frac{1}{c^2} \times \frac{\partial^2 E}{\partial t^2} = 0$$

$$\Leftrightarrow E_0 \sin \frac{\pi z}{a} \sin \frac{\pi z}{b} \left(\left(\frac{\pi}{a} \right)^2 - \left(\frac{\pi}{b} \right)^2 + k^2 - \frac{\omega^2}{c^2} \right)$$

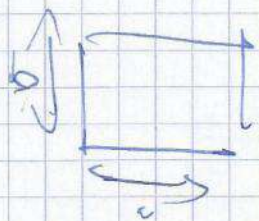
$$e^{i(kx - \omega t)} = 0$$

$$\underline{E} = E_0 \cdot \sin \frac{\pi z}{a} \cdot \sin \frac{\pi z}{b} \cdot e^{i(kx - \omega t)}$$

$$\Leftrightarrow -\left(\frac{\pi}{a} \right)^2 - \left(\frac{\pi}{b} \right)^2 + k^2 - \frac{\omega^2}{c^2} = 0$$

2)

$$\left(\frac{u}{a}\right)^2 + \left(\frac{u}{b}\right)^2 + k^2 - \frac{\omega^2}{c^2} = 0 \Rightarrow \frac{\omega^2}{c^2} = \left(\frac{u}{a}\right)^2 + \left(\frac{u}{b}\right)^2 + k^2$$



$$a = b$$

AN: $\omega_c = 2\pi f \Leftrightarrow f = \frac{c}{2\pi} \sqrt{\left(\frac{u}{a}\right)^2 + \left(\frac{u}{b}\right)^2 + k^2}$

$$\Leftrightarrow f_c = \frac{3 \times 10^8}{2\pi} \sqrt{\left(\frac{u}{10^{-2}}\right)^2 + \left(\frac{u}{10^{-2}}\right)^2 + k^2}$$

$$\text{Si } a = b$$

$$= \frac{3 \times 10^8}{2\pi} \sqrt{2 \left(\frac{u}{10^{-2}}\right)^2 + k^2}$$

$$\vec{B} = c \vec{E} \quad \text{et} \quad \vec{B} \perp \vec{E}$$

$$\vec{B} = -c E_0 \sin \frac{\pi x}{a} \sin \frac{\pi y}{b} \cos(ky - \omega t) \vec{e}_y$$

Exercice 12

$$\begin{aligned}(\sin)' &= \cos \\ (\cos)' &= -\sin \\ (\sin)'' &= -\sin\end{aligned}$$

$$\Delta \vec{E} - \frac{1}{c^2} \frac{\partial^2 \vec{E}}{\partial t^2} = \vec{0}$$

L'onde se propage selon l'axe (Oz) donc,

$$\frac{\partial^2 E}{\partial z^2} - \frac{1}{c^2} \times \frac{\partial^2 E}{\partial t^2} = 0 \quad \left(\sin \frac{\pi z}{a} \right)'' = - \left(\frac{\pi}{a} \right)^2 \sin \frac{\pi z}{a}$$

on $E(x, y, z, t) = E_0 \sin \frac{\pi z}{a}$

$$\Delta \vec{E} - \frac{1}{c^2} \frac{\partial^2 \vec{E}}{\partial t^2} = \vec{0}$$

général $\vec{\nabla} \cdot (\text{div } \vec{E}) - \text{rot} \cdot (\text{rot } \vec{E}) - \frac{1}{c^2} \frac{\partial^2 \vec{E}}{\partial t^2} = \vec{0}$

test: $\left(\sin \frac{\pi z}{a} \right)' = - \left(\frac{\pi}{a} \right) \times \left(\sin \frac{\pi z}{b} \right)'' = - \left(\frac{\pi}{b} \right)^2 \sin \frac{\pi z}{b}$

$$\Delta E = \frac{1}{c^2} \times \frac{\partial^2 E}{\partial t^2} = 0 \Leftrightarrow \frac{\partial^2 E}{\partial x^2} + \frac{\partial^2 E}{\partial y^2} + \frac{\partial^2 E}{\partial z^2} - \frac{1}{c^2} \times \frac{\partial^2 E}{\partial t^2} = 0$$

$$\Leftrightarrow E_0 \sin \frac{\pi z}{a} \sin \frac{\pi y}{b} \left(\left(\frac{\pi}{a} \right)^2 - \left(\frac{\pi}{b} \right)^2 + k^2 - \frac{\omega^2}{c^2} \right)$$

$$e^{i(ky - \omega t)} = 0$$

$$\underline{E} = E_0 \cdot \sin \frac{\pi z}{a} \cdot \sin \frac{\pi y}{b} \cdot e^{i(ky - \omega t)}$$

$$\Leftrightarrow \left(\left(\frac{\pi}{a} \right)^2 - \left(\frac{\pi}{b} \right)^2 \right) + k^2 - \frac{\omega^2}{c^2} = 0$$

$$(c) \Leftrightarrow p = \frac{\epsilon_0}{n^2} \left(2nE_n + \frac{Kn^2}{\epsilon_0} \left(\frac{1}{3} - \frac{3n^2}{5R^2} \right) \right)$$

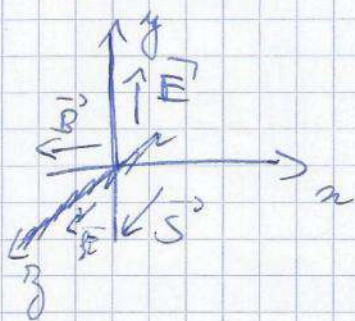
$$\Leftrightarrow p = \frac{2\epsilon_0}{n} E_n + K \left(\frac{1}{3} - \frac{3n^2}{5R^2} \right)$$

$$\Leftrightarrow p = \frac{2\epsilon_0}{n} \times \frac{K}{\epsilon_0} \left(\frac{n}{3} - \frac{n^3}{5R^2} \right) + K \left(\frac{1}{3} - \frac{3n^2}{5R^2} \right)$$

$$\Leftrightarrow p = K \left(\frac{2}{3} - \frac{2n^2}{5R^2} + \frac{1}{3} - \frac{3n^2}{5R^2} \right)$$

$$\Leftrightarrow p = K \left(1 - \frac{5n^2}{5R^2} \right) = \boxed{K \left(1 - \frac{n^2}{R^2} \right)}$$

Energia S



$$\vec{S} = \frac{\vec{E} \wedge \vec{B}}{\mu_0}$$

$$= \frac{E \cdot B \cdot \sin(\vec{E}, \vec{B})}{\mu_0} \vec{e}_3$$

$$= \frac{E \cdot B}{\mu_0} \vec{e}_3 \quad \text{or} \quad \begin{cases} E = cB \Leftrightarrow B = \frac{E}{c} \\ \dots \end{cases}$$

$$= \frac{E^2}{c\mu_0} \vec{e}_3$$

$$P_n = \iint_{\Sigma} \vec{S} \cdot d\vec{\Sigma}$$

$$= \iint_{\Sigma} S \cdot d\Sigma$$

$$= \int_0^{2\pi} \int_0^{\hat{\theta}} SR^2 \sin \theta d\theta d\varphi$$

$$= SR^2 \int_0^{2\pi} d\varphi \int_0^{\hat{\theta}} \sin \theta d\theta = 4\pi R^2 S = \frac{4\pi R^2}{c\mu_0} E^2$$

$$= \frac{4\pi R^2 \epsilon_0 E^2 \cos^2(\theta_B - \alpha)}{c\mu_0}$$

$$\underbrace{\oint_S \vec{B} \cdot d\vec{S}}_{\Phi(\vec{B}) = 0} = \iiint_{\tau} \operatorname{div} \vec{B} d\tau \Leftrightarrow \iiint_{\tau} \operatorname{div} \vec{B} d\tau = 0$$

$$\Rightarrow \boxed{\operatorname{div} \vec{B} = 0} \quad \text{CQFD}$$

$$\operatorname{div} \vec{E} = \frac{\rho}{\epsilon}$$

$$Q_{\text{int}} = \iiint_{\tau} \rho d\tau$$

$$\oint_S \vec{E} \cdot d\vec{S} = \iiint_{\tau} \operatorname{div} \vec{E} d\tau \Leftrightarrow \iiint_{\tau} \operatorname{div} \vec{E} d\tau = \frac{Q_{\text{int}}}{\epsilon}$$

$$\Leftrightarrow \iiint_{\tau} \operatorname{div} \vec{E} d\tau = \iiint_{\tau} \frac{\rho}{\epsilon} d\tau$$

$$\Leftrightarrow \iiint_{\tau} \left(\operatorname{div} \vec{E} - \frac{\rho}{\epsilon} \right) d\tau = 0$$

$$\Rightarrow \operatorname{div} \vec{E} - \frac{\rho}{\epsilon} = 0$$

$$\Rightarrow \boxed{\operatorname{div} \vec{E} = \frac{\rho}{\epsilon}} \quad \text{CQFD}$$

$$\operatorname{div} \vec{E} = \frac{1}{r^2} \times \frac{\partial}{\partial r} (r^2 E_r) + \underbrace{\frac{1}{r \sin \theta} (\sin \theta \cdot E_\theta)}_0 + \underbrace{\frac{1}{r \cdot \sin \theta} \times \frac{\partial E_\phi}{\partial \phi}}_0 = \frac{\rho}{\epsilon_0}$$

$$(c) \Leftrightarrow \frac{1}{r^2} \times \frac{\partial}{\partial r} (r^2 E_r) = \frac{\rho}{\epsilon_0}$$

$$\Leftrightarrow \rho = \frac{\epsilon_0}{r^2} \frac{\partial}{\partial r} (r^2 E_r)$$

$$\Leftrightarrow \rho = \frac{\epsilon_0}{r^2} \left(2r E_r + \cancel{\frac{K}{\epsilon_0}} \left(\frac{1}{3} - \frac{3r^2}{5R^2} \right) \right)$$

$$\Leftrightarrow \rho = \frac{2\epsilon_0 E_r}{r} + K \left(\frac{1}{3} - \frac{3r^2}{5R^2} \right) \Leftrightarrow \rho = \frac{2K}{r} \left(\frac{r}{3} - \right)$$

$$\langle P_r \rangle = \frac{4\pi R^2 E_0^2}{c \cdot \mu_0} \underbrace{\langle \cos^2(kz - \omega t) \rangle}_{\frac{1}{2} \quad \frac{1}{\sqrt{2}}}$$

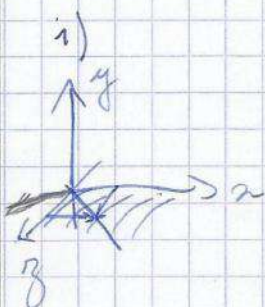
$$= \boxed{\frac{2\pi R^2 E_0^2}{c \cdot \mu_0}}$$

$$= \frac{\cancel{2\pi} \times 18 \times 10^{-6} \times 10^{14}}{3 \times 10^8 \times \cancel{4\pi} \times 10^{-7}}$$

$$= \frac{8 \times 10^8}{3 \times 10}$$

$$= \frac{8}{3} \times 10^7 \text{ W} = \frac{8}{3} \times 10 \text{ MW}$$

Exercice 6



$$\vec{k} = k \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} \quad k = \frac{2\pi}{\lambda} \Rightarrow \lambda = \frac{2\pi}{k} = \frac{5 \times 2\pi}{2\pi} \times 10^{-7} = \boxed{5 \times 10^{-7} \text{ m}}$$

$$kc = \omega \Leftrightarrow \omega = \frac{2\pi}{5} \times 10^7 \times 3 \times 10^8 = \frac{6\pi}{5} \times 10^{15} \text{ rad/s}$$

$$\omega = 2\pi f \Leftrightarrow f = \frac{\omega}{2\pi} = \frac{3 \times 2\pi}{5 \times 2\pi} \times 10^{15} = \boxed{\frac{3}{5} \times 10^{15} \text{ Hz}}$$

2)

$$\vec{E}(y,t) = \begin{pmatrix} E_0 \cdot \cos \frac{\pi}{4} \cdot \cos(ky - \omega t) \\ 0 \\ E_0 \cdot \sin \frac{\pi}{4} \cdot \cos(ky - \omega t) \end{pmatrix}$$

$$= \begin{pmatrix} \frac{E_0 \sqrt{2}}{2} \cos(ky - \omega t) \\ 0 \\ \frac{E_0 \sqrt{2}}{2} \cos(ky - \omega t) \end{pmatrix}$$

$$e^{i(\omega t - \vec{k} \cdot \vec{r})}$$

$$\frac{\partial \vec{\Phi}}{\partial t} = i\omega \vec{\Phi}$$

$$\vec{B} = c\vec{E}$$

$$B = cE$$

3)

$$\text{rot } \vec{E} = -\frac{\partial \vec{B}}{\partial t} \Leftrightarrow \vec{k} \wedge \vec{E} = \omega \vec{B}$$

$$\left(\frac{\sqrt{2}}{2}\right)^2 = \frac{1}{2}$$

$$\frac{E_0^2}{2}$$

$$\Leftrightarrow k \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} \wedge \vec{E} = \omega \vec{B}$$

$$\Leftrightarrow \vec{B} = \frac{k}{\omega} \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} \wedge \vec{E}$$

$$\Leftrightarrow \vec{B} = c \begin{pmatrix} \frac{E_0 \sqrt{2}}{2} \cos(ky - \omega t) \\ 0 \\ 0 \end{pmatrix}$$

$$\vec{S} = \frac{\vec{E} \wedge \vec{B}}{\mu_0} = \frac{1}{\mu_0} \begin{pmatrix} \frac{E_0 \sqrt{2}}{2} \cos(ky - \omega t) \\ \frac{E_0 \sqrt{2}}{2} \cos(ky - \omega t) \\ 0 \end{pmatrix} \wedge \begin{pmatrix} 0 \\ 0 \\ \frac{E_0 \sqrt{2}}{2} \cos(ky - \omega t) \end{pmatrix}$$

$$= \frac{1}{\mu_0} \begin{pmatrix} -\left(\frac{E_0 \sqrt{2}}{2} \cos(ky - \omega t)\right)^2 \\ \left(\frac{E_0 \sqrt{2}}{2} \cos(ky - \omega t)\right)^2 \\ 0 \end{pmatrix}$$

$$\vec{E}(y,t) = \begin{pmatrix} E_0 \cdot \cos \frac{\pi}{6} \cdot \cos(ky - \omega t) \\ E_0 \cdot \sin \frac{\pi}{6} \cdot \cos(ky - \omega t) \\ 0 \end{pmatrix}$$

$$= \begin{pmatrix} \frac{E_0 \sqrt{3}}{2} \cos(ky - \omega t) \\ 0 \\ \frac{E_0}{2} \cos(ky - \omega t) \end{pmatrix}$$

