

$$\begin{aligned}
 \text{(a. } \mathcal{E} &= -\frac{d\Phi_B}{dt} \\
 &= -\frac{d}{dt} (Blx) \\
 &= -lx \frac{dB}{dt} - Bl \frac{dx}{dt} \\
 &= -lxK - Bl \frac{dx}{dt}
 \end{aligned}$$

$$I = \mathcal{E}/R$$

$$F_x = IlB = m \frac{d^2x}{dt^2}$$

$$\Rightarrow m \frac{d^2x}{dt^2} = -\frac{B^2 l^2}{R} \frac{dx}{dt} - \frac{Bl^2}{R} Kx$$

(b. Force is to left to counteract increasing magnetic flux

(c. If $\frac{dx}{dt} = 0$

$$F = \frac{Bl^2}{R} Kx_0$$

to counteract electromagnetic force

$$2a. \quad \vec{J}_d = \frac{\partial \vec{D}}{\partial t} = \epsilon_0 \frac{\partial \vec{E}}{\partial t} \\ = \epsilon_0 \cdot \frac{1}{\epsilon_0} \frac{I}{\pi R^2} \hat{z} = \frac{I}{\pi R^2} \hat{z}$$

$$I_d = \int \vec{J}_d \cdot d\vec{a} = \vec{J}_d \cdot \pi R^2 \hat{z} = \boxed{I}$$

$$2b. \quad \oint \vec{B} \cdot d\vec{l} = \mu_0 I_{d-enc}$$

$$B \cdot 2\pi s = \mu_0 I \cdot \frac{\pi s^2}{\pi R^2}$$

$$\Rightarrow \boxed{\vec{B} = \mu_0 I \frac{s}{2\pi R^2} \hat{\phi}}$$

$$2c. \quad \vec{J} = \frac{1}{\mu_0} (\vec{E} \times \vec{B})$$

$$= \frac{1}{\mu_0} \left(\frac{Q}{\epsilon_0 \pi R^2} \hat{z} \times \frac{\mu_0 I}{2\pi R} \hat{\phi} \right)$$

$$= \boxed{\frac{-QI}{\epsilon_0 \cdot \pi R^2 \cdot 2\pi R} \hat{s}}$$

$$\frac{\partial W}{\partial t} = - \oint \vec{J} \cdot d\vec{a}$$

$$= \boxed{\frac{Q I d}{\epsilon_0 \cdot \pi R^2}}$$

$$= \frac{d}{dt} \left(\frac{Q^2 d}{2 \epsilon_0 \cdot \pi R^2} \right)$$

$$= \frac{d}{dt} \left(\frac{Q^2}{2C} \right) = \frac{d}{dt} \left(\frac{1}{2} C V^2 \right) //$$

$$= \frac{d}{dt} \left(\frac{1}{2} \epsilon_0 E^2 \cdot \pi R^2 \cdot d \right) //$$

$$3a. \quad \vec{E}(x,t) = E_0 \cos(kx - \omega t + \delta) \hat{y}$$

$$\vec{B}(x,t) = \frac{E_0}{c} \cos(kx - \omega t + \delta) \hat{z}$$

$$3b. \quad T_{xx} = \epsilon_0 \left(-\frac{1}{2} E^2 \right) + \frac{1}{\mu_0} \left(-\frac{1}{2} B^2 \right)$$

$$T_{yy} = \epsilon_0 \left(E^2 - \frac{1}{2} E^2 \right) + \frac{1}{\mu_0} \left(-\frac{1}{2} B^2 \right)$$

$$T_{zz} = \epsilon_0 \left(-\frac{1}{2} E^2 \right) + \frac{1}{\mu_0} \left(B^2 - \frac{1}{2} B^2 \right)$$

$$T_{xx} = \left(-\frac{\epsilon_0}{2} E_0^2 - \frac{1}{2\mu_0} \frac{E_0^2}{c^2} \right) \cos^2(kx - \omega t + \delta)$$

$$= -\epsilon_0 E_0^2 \cos^2(kx - \omega t + \delta)$$

$$T_{yy} = \left(\frac{\epsilon_0}{2} E_0^2 - \frac{1}{2\mu_0} \frac{E_0^2}{c^2} \right) \cos^2(\dots)$$

$$= 0$$

$$T_{zz} = \left(-\frac{\epsilon_0}{2} E_0^2 + \frac{1}{2\mu_0} \frac{E_0^2}{c^2} \right) \cos^2(\dots)$$

$$= 0$$

$$3c. \quad \vec{g} = \epsilon_0 (\vec{E} \times \vec{B})$$

$$= \epsilon_0 \frac{E_0^2}{c} \cos^2(kx - \omega t + \delta) \hat{x}$$

$$\frac{\partial \vec{g}}{\partial t} = -\frac{\epsilon_0 E_0^2}{c} \cdot 2\omega \cdot \cos(kx - \omega t + \delta) \sin(kx - \omega t + \delta)$$

$$\nabla \cdot \vec{T} = \frac{\partial T_{xx}}{\partial x}$$

$$= -\epsilon_0 E_0^2 \cdot 2k \cdot \cos(kx - \omega t + \delta) \sin(kx - \omega t + \delta)$$

$$\frac{\omega}{c} = k //$$