1a. $\mathcal{E} = -d\Phi_B/dt$

$= -d/dt\,(B\ell x)$

$= -\ell x\, dB/dt - B\ell\, dx/dt$

$= -\ell x K - B\ell\, dx/dt$

$I = \mathcal{E}/R$

$F_x = I\ell B = m\, d^2x/dt^2$

$$\Rightarrow m\, d^2x/dt^2 = -\frac{B^2\ell^2}{R}\, dx/dt - \frac{B\ell^2}{R} K x$$

1b. Force is to left to counteract increasing magnetic flux

1c. If $dx/dt = 0$

$\boxed{F = \frac{B\ell^2}{R} K x_0}$ to counteract electromagnetic force

2a. $\vec{J_d} = \partial \vec{D}/\partial t = \varepsilon_0 \, \partial \vec{E}/\partial t$

$$= \varepsilon_0 \cdot \frac{1}{\varepsilon_0} \frac{I}{\pi R^2} \hat{z} = \frac{I}{\pi R^2} \hat{z}$$

$$I_d = \int \vec{J_d} \cdot d\vec{a} = J_d \cdot \pi R^2 = I$$

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

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

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

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

$$= \frac{1}{\mu_0}\left(\frac{Q}{\varepsilon_0 \pi R^2} \hat{z} \times \frac{\mu_0 I}{2\pi R} \hat{\varphi} \right)$$

$$= \boxed{\frac{-QI}{\varepsilon_0 \cdot \pi R^2 \cdot 2\pi R} \hat{s}}$$

$$\partial u/\partial t = -\oint \vec{S} \cdot d\vec{a}$$

$$= \boxed{\frac{QId}{\varepsilon_0 \cdot \pi R^2}}$$

$$= d/dt \left(\frac{Q^2 d}{2\varepsilon_0 \cdot \pi R^2} \right)$$

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

$$= d/dt \left(\tfrac{1}{2} \varepsilon_0 E^2 \cdot \pi R^2 \cdot d \right) //$$

3a. $\boxed{\begin{aligned}\vec{E}(x,t) &= E_0 \cos(kx-\omega t+\delta)\,\hat{y}\\ \vec{B}(x,t) &= \frac{E_0}{c}\cos(kx-\omega t+\delta)\,\hat{z}\end{aligned}}$

3b. $T_{xx} = \varepsilon_0\left(-\frac{1}{2}E^2\right) + \frac{1}{\mu_0}\left(-\frac{1}{2}B^2\right)$

$T_{yy} = \varepsilon_0\left(E^2 - \frac{1}{2}E^2\right) + \frac{1}{\mu_0}\left(-\frac{1}{2}B^2\right)$

$T_{zz} = \varepsilon_0\left(-\frac{1}{2}E^2\right) + \frac{1}{\mu_0}\left(B^2 - \frac{1}{2}B^2\right)$

$$T_{xx} = \left(-\frac{\varepsilon_0}{2}E_0^2 - \frac{1}{2\mu_0}\frac{E_0^2}{c^2}\right)\cos^2(kx-\omega t+\delta)$$
$$= -\varepsilon_0 E_0^2 \cos^2(kx-\omega t+\delta)$$

$$T_{yy} = \left(\frac{\varepsilon_0}{2}E_0^2 - \frac{1}{2\mu_0}\frac{E_0^2}{c^2}\right)\cos^2(---)$$
$$= 0$$
$$T_{zz} = \left(-\frac{\varepsilon_0}{2}E_0^2 + \frac{1}{2\mu_0}\frac{E_0^2}{c^2}\right)\cos^2(---)$$
$$= 0$$

3c. $\vec{g} = \varepsilon_0(\vec{E}\times\vec{B})$
$$= \varepsilon_0 \frac{E_0^2}{c}\cos^2(kx-\omega t+\delta)\,\hat{x}$$

$$\partial \vec{g}/\partial t = \frac{\varepsilon_0 E_0^2}{c}\cdot 2\omega\cdot\cos(kx-\omega t+\delta)\sin(kx-\omega t+\delta)$$

$$\nabla\cdot\overleftrightarrow{T} = \partial T_{xx}/\partial x$$
$$= \varepsilon_0 E_0^2\cdot 2k\cdot\cos(kx-\omega t+\delta)\sin(kx-\omega t+\delta)$$

$\omega/c = k$ //