

$$\begin{aligned}
 1a. \quad \mathcal{E} &= -d\Phi_B/dt \\
 &= -d/dt (Blv) \\
 &= -Blv \\
 I &= \mathcal{E}/R = -Blv/R
 \end{aligned}$$

$$F = m dv/dt = I l B$$

$$\begin{aligned}
 dv/dt &= -B^2 l^2 v / R \\
 &= -\frac{B^2 l^2}{mR} v
 \end{aligned}$$

$$1b. \quad v = v_0 e^{-\frac{B^2 l^2}{mR} t}$$

$$\begin{aligned}
 P = \mathcal{E} I &= Blv \cdot Blv/R \\
 &= \frac{B^2 l^2}{R} v_0^2 e^{-\frac{2B^2 l^2}{mR} t}
 \end{aligned}$$

$$\int P dt = \frac{B^2 l^2}{R} v_0^2 \cdot \frac{mR}{2B^2 l^2} = \frac{1}{2} m v_0^2$$

Or, conclude this based on conservation of energy!

$$2a. \quad \int \vec{E} \cdot d\vec{\ell} = -d\Phi_B/dt$$

$$\begin{aligned}
 E \cdot 2\pi R &= -d/dt \mu_0 \frac{N}{l} I \cdot \pi R^2 \\
 &= -\kappa \mu_0 \frac{N}{l} \cdot \pi R^2
 \end{aligned}$$

$$\Rightarrow \vec{E} = -\frac{\kappa \mu_0 N R}{2l} \hat{\phi}$$

$$Q = N \int \vec{E} \cdot d\vec{\ell} = -\frac{\kappa \mu_0 N^2 \cdot \pi R^2}{l}$$

$$26. L = \Phi_B / I = N \Phi_A / I$$

$$= N \cdot \mu \cdot \frac{N}{l} I \cdot \pi R^2 / I$$

$$= \mu \cdot \frac{N^2}{l} \cdot \pi R^2$$

$$\mathcal{E} = -L \frac{dI}{dt} = -\mu \frac{N^2 \pi R^2}{l} \frac{dI}{dt}$$

$$27. \vec{S} = (\vec{E} \times \vec{B}) / \mu_0$$

$$= \left(-\frac{\mu N R}{2l} \hat{\phi} \times \mu \frac{NI}{l} \hat{z} \right) \cdot \frac{1}{\mu_0}$$

$$= \frac{\mu N^2 R I}{2l^2} \hat{r}$$

$$\frac{dU}{dt} = -\oint \vec{S} \cdot d\vec{a} = |\vec{S}| \cdot 2\pi R \cdot l$$

$$\frac{\mu N^2 I \cdot \pi R^2}{l}$$

$$= \frac{d}{dt} \left(\frac{\mu N^2 I^2 \cdot \pi R^2}{2l} \right)$$

$$= \frac{d}{dt} \left(\frac{B^2}{2\mu_0} \cdot \pi R^2 l \right)$$

$$= \frac{d}{dt} \left(\frac{1}{2} L I^2 \right)$$

$$3. \vec{E} = \frac{\sigma}{2\epsilon_0} \hat{n} \quad w/ \hat{n} = \pm \hat{z}$$

above/below

$$T_{xx} = \epsilon_0 \left(-\frac{1}{2} E^2 \right)$$

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

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

$$\boxed{T_{xx} = -\frac{\sigma^2}{8\epsilon_0} \quad T_{yy} = -\frac{\sigma^2}{8\epsilon_0} \quad T_{zz} = \frac{+\sigma^2}{8\epsilon_0}}$$

Uniform, so no force anywhere
 $(\vec{F} = \nabla \cdot \vec{T})$

$$4a. \begin{cases} \vec{E}(z,t) = E_0 \cos(kz - \omega t + \delta) \hat{x} \\ \vec{B}(z,t) = \frac{E_0}{c} \cos(kz - \omega t + \delta) \hat{y} \end{cases}$$

$$6. \quad u = \frac{1}{2} \epsilon_0 E^2 + \frac{1}{2\mu_0} B^2$$

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

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

$$= \boxed{\epsilon_0 E_0^2 \cos^2(kz - \omega t + \delta)}$$

$$\vec{S} = \frac{(\vec{E} \times \vec{B})}{\mu_0}$$

$$= \boxed{\frac{E_0^2}{\mu_0 c} \cos^2(kz - \omega t + \delta) \hat{z}}$$

$$\frac{\partial u}{\partial t} = \omega \epsilon_0 E_0^2 \cdot 2 \sin(kz - \omega t + \delta) \cdot \cos(kz - \omega t + \delta)$$

$$-\nabla \cdot \vec{S} = \frac{\kappa E_0^2}{\mu_0 c} \cdot 2 \sin(kz - \omega t + \delta) \cos(kz - \omega t + \delta)$$

$$w/\kappa \cdot \mu_0 \epsilon_0 = c/c^2 = 1/c //$$