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

$= -d/dt\,(B \times l)$

$= -Blv$

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

$F = m\,dv/dt = IlB$

$= -B^2 l^2 v/R$

$\frac{dv}{dt} = -\frac{B^2 l^2}{mR} v$

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

$P = \mathcal{E} I = Blv \cdot Blv/R$

$= \frac{B^2 l^2}{R} v_0^2 e^{-\frac{2B^2 l^2 t}{mR}}$

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

Or, conclude this based on conservation of energy!

2a. $\oint \vec{E} \cdot d\vec{l} = -d\Phi_B/dt$

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

$= -K\mu_0 N/l \cdot \pi R^2$

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

$\mathcal{E} = N \oint \vec{E} \cdot d\vec{l} = -\frac{K\mu_0 N^2 \cdot \pi R^2}{l}$

2b. $L = \Phi_B / I = NBA / I$

$= N \cdot \mu_0 \frac{N}{l} I \cdot \pi R^2 / I$

$= \mu_0 \frac{N^2}{l} \cdot \pi R^2$

$\mathcal{E} = -L \, dI/dt = -K \frac{\mu_0 N^2 \pi R^2}{l}$

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

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

$= -\frac{K \mu_0 N^2 R I}{2 l^2} \hat{r}$

$\partial U / \partial t = -\oint \vec{S} \cdot d\vec{a} = |\vec{S}| \cdot 2\pi R \cdot l$

$\frac{K \mu_0 N^2 I \cdot \pi R^2}{l}$

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

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

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

3. $\vec{E} = \sigma/2\varepsilon_0 \, \hat{n}$ w/ $\hat{n} = \pm\hat{z}$ above/below

$$T_{xx} = \varepsilon_0\left(-\tfrac{1}{2}E^2\right)$$
$$T_{yy} = \varepsilon_0\left(-\tfrac{1}{2}E^2\right)$$
$$T_{zz} = \varepsilon_0\left(E^2 - \tfrac{1}{2}E^2\right)$$

$$\boxed{T_{xx} = -\frac{\sigma^2}{8\varepsilon_0} \quad T_{yy} = -\frac{\sigma^2}{8\varepsilon_0} \quad T_{zz} = \frac{+\sigma^2}{8\varepsilon_0}}$$

Uniform, so no force anywhere ($\tilde{f} = \nabla\cdot\overleftrightarrow{T}$)

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

b. $$u = \tfrac{1}{2}\varepsilon_0E^2 + \frac{1}{2\mu_0}B^2$$
$$= \left(\tfrac{1}{2}\varepsilon_0E_0^2 + \frac{1}{2\mu_0}\frac{E_0^2}{c^2}\right)\cos^2(kz-\omega t+\delta)$$
$$= \varepsilon_0E_0^2\left(\frac{1}{2} + \frac{1}{2\mu_0\varepsilon_0}\cdot\frac{1}{c^2}\right)\cos^2(kz-\omega t+\delta)$$

$$= \boxed{\varepsilon_0E_0^2\cos^2(kz-\omega t+\delta)}$$

$$\vec{S} = (\vec{E}\times\vec{B})/\mu_0$$
$$= \boxed{\frac{E_0^2}{\mu_0c}\cos^2(kz-\omega t+\delta)\,\hat{z}}$$

$$\partial u/\partial t = -\omega\varepsilon_0E_0^2\cdot 2\sin(kz-\omega t+\delta)\cdot\cos(kz-\omega t+\delta)$$

$$-\nabla\cdot\vec{S} = -\frac{kE_0^2}{\mu_0c}\cdot 2\sin(kz-\omega t+\delta)\cos(kz-\omega t+\delta)$$

$$\omega/k\cdot\mu_0\varepsilon_0 = c/c^2 = 1/c \quad //$$