Homework 6: 7.12, 7.15, 7.34

7.12) $B(t) = B_0 \cos(\omega t)\,\hat{z}$ $\quad r = \frac{a}{2}$ $\quad$ resistance R

solenoid: $\quad \Phi = B \cdot A$

$$A = \pi (r)^2 \hat{z} = \pi \left(\frac{a}{2}\right)^2 \hat{z}$$

$$\Phi = \left(B_0 \cos(\omega t)\,\hat{z}\right) \cdot \left(\pi \left(\frac{a}{2}\right)^2 \hat{z}\right)$$

$$\Phi = \frac{B_0 \pi a^2}{4} \cos(\omega t)$$

$$\mathcal{E} = -\frac{d\Phi}{dt}$$

$$= +\frac{B_0 \pi a^2 \omega}{4} \sin(\omega t)$$

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

$$= \frac{\left(\frac{B_0 \pi a^2 \omega}{4} \sin(\omega t)\right)}{R} = \boxed{\frac{B_0 \pi a^2 \omega}{4R} \sin(\omega t)}$$

7.15) long solenoid $\quad r = a \quad$ $\hat{\phi}$ direction $\quad$ electric field?

distance s

$$B = \mu_0 n I \qquad A = \pi r^2$$

$$\Phi = B \cdot A$$

$$\Phi = \begin{cases} \mu_0 n I (\pi s^2) & \text{inside} \\ \mu_0 n I (\pi a^2) & \text{outside} \end{cases}$$

inside:

$$-\frac{\partial \Phi}{\partial t} = E \oint dl$$

$$-\pi s^2 \mu_0 n \frac{\partial I}{\partial t} \hat{\phi} = E (2\pi s)$$

$$\boxed{E = -\frac{\mu_0 n s}{2} \frac{dI}{dt} \hat{\phi} \quad \text{inside}}$$

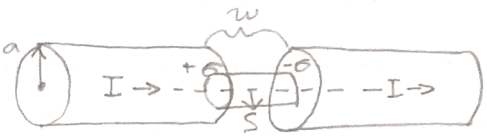
outside:

$$-\frac{\partial \Phi}{\partial t} = E \oint dl$$

$$-\pi a^2 \mu_0 n \frac{\partial I}{\partial t} \hat{\phi} = E (2\pi s)$$

$$\boxed{E = \frac{-a^2 \mu_0 n \frac{\partial I}{\partial t}}{2s} \hat{\phi} \quad \text{outside}}$$

7.34)



$s < a$

$$J = \frac{I}{A} = \frac{I}{\pi a^2}\hat{z}$$

$$\oint B \cdot dI = \mu_0 I_{enc}$$

$$\oint B \cdot dI = \mu_0 J(\pi s^2)$$

$$B(2\pi s) = \mu_0 J \pi s^2$$

$$B = \frac{\mu_0}{2}\left(\frac{I}{\pi a^2}\right)s$$

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