Dark Goodman

ET Homework #6

9.12, 7.15, 7.34

7.12) $\Phi = B \cdot A$

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

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

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

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

$\mathcal{E} = -\frac{d}{dt}(B_0 \frac{\pi a^2}{4} \cos(\omega t)) = \frac{\pi B_0 \omega a^2}{4} \sin(\omega t)$

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

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

7.15) $B = \mu_0 n I$

$\Phi = B \cdot A$

$A = \pi r^2$

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

$-\frac{d\Phi}{dt} = E \oint dl$

$-\frac{d}{dt}(B \cdot A) = E \oint dl$

$-(\pi s^2)(\mu_0 n \frac{dI}{dt}) = E(2\pi s)$

$$\boxed{-\frac{s}{2}\mu_0 n \frac{dI}{dt}\hat{\phi} = E \text{ for } s < a}$$

$\frac{d}{dt}(B \cdot A) = E \oint dl$

$-(\pi a^2)(\mu_0 n \frac{dI}{dt}\hat{\phi}) = E(2\pi s)$

$$\boxed{E = -\frac{a^2 \mu_0 n}{2s}\frac{dI}{dt}\hat{\phi} \text{ for } s > a}$$

7.34)

$$J_d = \varepsilon_0 \frac{\Delta E}{\Delta t} = \frac{I}{A}$$

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

$$\oint B \cdot dl = B(2\pi s)$$

$$= \mu_0 I_{d\,enc}$$

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

$$= \mu_0 \frac{I}{\pi a^2} \pi s^2$$

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