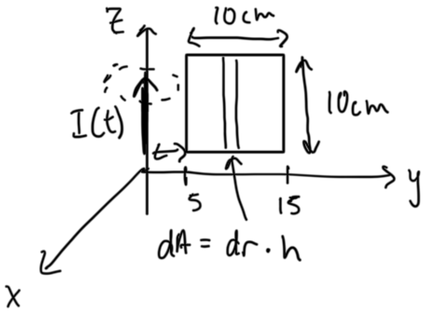
HW 7

6.6 $I(t) = 5\cos(2\pi \cdot 10^4 t)$

a.)

$$\int \nabla \times E \cdot dA = \int \frac{-\partial B}{\partial t} dA \Rightarrow \mathcal{E}_{mf} = \frac{-\partial}{\partial t} \underbrace{\oint B \cdot dA}_{\Phi}$$



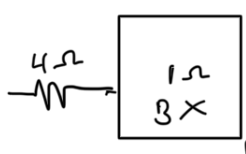
$$\oint B \cdot dl = \mu I_{enc}$$

$$B = \frac{\mu \cdot 5\cos(2\pi \cdot 10^4 t)}{2\pi r}$$

$$\oint B \cdot dA \Rightarrow \int_{r_1}^{r_2} B\, h\, dr = \frac{\mu h I(t)}{2\pi} \int_{r_1}^{r_2} \frac{1}{r} dr$$

$$\Phi = \frac{\mu h I(t)}{2\pi} \ln\left(\frac{r_2}{r_1}\right) \qquad \mathcal{E} = \frac{-\partial \Phi}{\partial t} = \underline{\mu h \ln\left(\frac{r_2}{r_1}\right) \cdot 5 \cdot 10^4 \sin(2\pi \cdot 10^4 t)}$$

b.) current goes clockwise in the coil.



$$I = \frac{\mathcal{E}\ mV}{5\Omega} = \underline{1.381 \sin(2\pi \cdot 10^4 t)\ mA}$$

6.8 $I(t) = I_0 \cos(\omega_0 t)$ $N = 100$

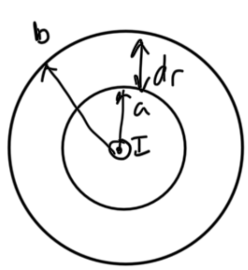
a.)

$$\oint \nabla \times E \cdot dA = \oint -\frac{\partial B}{\partial t} \cdot dA \Rightarrow \mathcal{E}mf = \frac{-\partial}{\partial t} \oint B \cdot dA$$

$$\frac{N \mu I c}{2\pi} \int_a^b \frac{1}{r} dr$$

$$\hookrightarrow \Phi = \frac{\mu I c N}{2\pi} \ln\left(\frac{b}{a}\right)$$

$$\oint B \cdot dl = \mu I_{enc} \Rightarrow B = \frac{\mu I N}{2\pi r}$$



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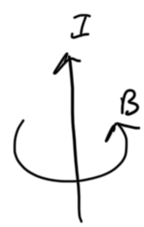
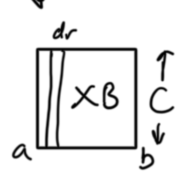


$\Rightarrow$

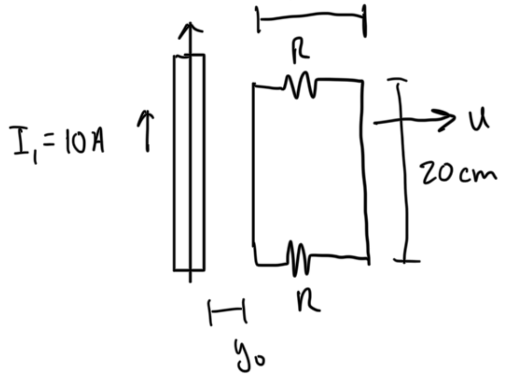


$$\mathcal{E}mf = \frac{-\partial \Phi}{dt} = \frac{N \mu c}{2\pi} \ln\left(\frac{b}{a}\right) \cdot I_0 \omega_0 \sin(\omega_0 t)$$

$$\boxed{V_{emf} = \frac{\mu c I_0 \omega_0 N}{2\pi} \ln\left(\frac{b}{a}\right) \sin(\omega_0 t), \quad \mu = \mu_0 \mu_r}$$

6.11

$$\int \nabla \times E \, dA = \int -\frac{\partial B}{\partial t} dA = \mathcal{E}mf = -\frac{\partial}{\partial t}\oint B \cdot dA$$

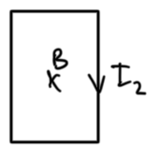


$$\oint B \cdot dl = \mu_0 I_{enc}$$

$$B = \frac{\mu I_1}{2\pi r} \qquad \frac{\mu I_1 h}{2\pi}\int_y^{y+w} \frac{1}{r} dr$$

$$\phi = \frac{\mu I_1 h}{2\pi} \ln(y+w) - \ln(y)$$

$$\frac{d\phi}{dy} = \frac{\mu I_1 h}{2\pi}\left[\frac{1}{y+w} - \frac{1}{y}\right]$$

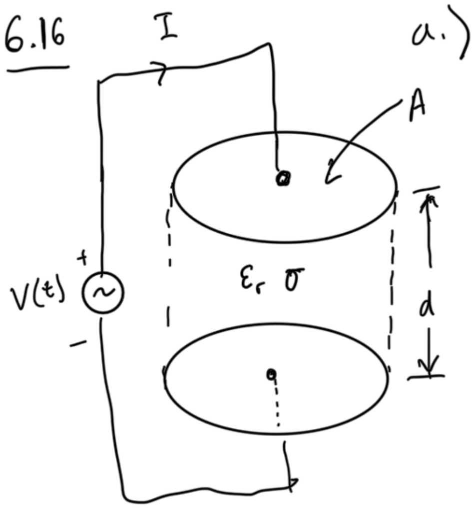


$$u = \frac{dy}{dt} = 7.5$$

$$V_{emf} = -\frac{d\phi}{dt} = \frac{\mu I_1 h u}{2\pi}\left[\frac{1}{y} - \frac{1}{y+w}\right]$$

$$I_2 = \frac{V_{emf}}{R} \qquad I_2 = \frac{\mu I_1 h u}{2\pi R}\left[\frac{1}{y_0} - \frac{1}{y_0+w}\right]$$

6.16



a.)

$$I = \frac{dQ}{dt} \qquad Q = CV$$

$$I = C\frac{dV}{dt} \qquad E = \frac{Q}{\varepsilon A} \Rightarrow Q = E\varepsilon A$$

$$I = C \cdot E \qquad E = \frac{V(t)}{d} \text{ uniform}$$

$$J = \sigma E$$

$$\frac{J}{A} = I \Rightarrow \underline{I = \frac{\sigma A}{d} V(t)}$$

b.)

$$I = C\frac{dV}{dt} \qquad Q = CV \Rightarrow E\varepsilon A = CV$$

$$\hookrightarrow \frac{V\varepsilon A}{d} = CV$$

$$\underbrace{\frac{\varepsilon A}{d}}_{C}$$

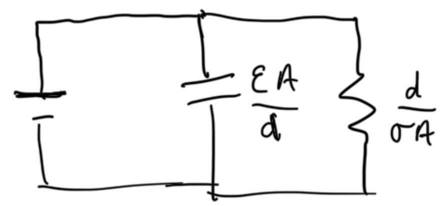
$$\underline{I = \frac{\varepsilon A}{d}\frac{dV}{dt}}$$

c.) $I = \frac{\sigma A}{d} V(t) \Rightarrow V = IR \Rightarrow V = \frac{d}{\sigma A} I$

$I = \frac{\varepsilon A}{d} \frac{dV}{dt} \Rightarrow I = C \frac{dV}{dt}$

equivalent circuit

different currents
same voltages }



d.) $A = 4\ cm^2 \quad d = 0.5\,cm \quad \varepsilon_r = 4 \quad \sigma = 2.5\ (S/m)$

$V(t) = 10\cos(3\pi \cdot 10^3 t)\ V$

$C = \frac{\varepsilon A}{d} = 2.83\ pF \qquad R = \frac{d}{\sigma A} = 5.0\ \Omega$