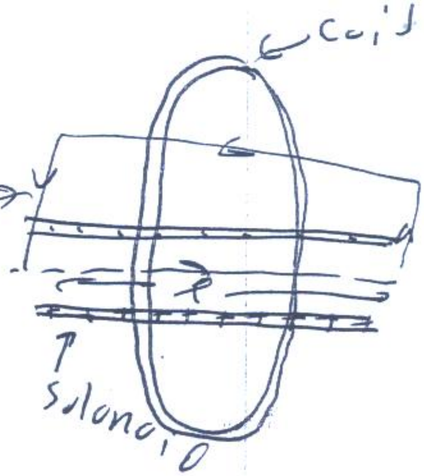
CH #30

H.W. Solution

#5. $\oint \vec{B} \cdot \vec{dl} = N \mu_0 i$

or $B = \frac{N}{l} \cdot \mu_0 \cdot i$



$B = 4\pi \times 10^{-7} \times 220 \times 10^{2}\, i$

$\mathcal{E} = N \times \frac{d\Phi_B}{dt} = N \frac{d}{dt}\left(B \cdot \pi (1.6 \times 10^{-2})^2\right)$

$\mathcal{E} = \cancel{220}\ 120 \times \pi (1.6 \times 10^{-2})^2 \times 4\pi \times 10^{-7} \times 220 \times \frac{di}{dt}$

$= 120 \times 8 \times 10^{-4} \times 4\pi \times 10^{-7} \times 22000 \frac{di}{dt}$

$= 2.65 \times 10^{-3} \times \frac{1.5}{25 \times 10^{-3}}$

$= 1.6 \times 10^{-1}\ V$

$i = \frac{1.6 \times 10^{-1}}{5.3} = 30\, mA.$

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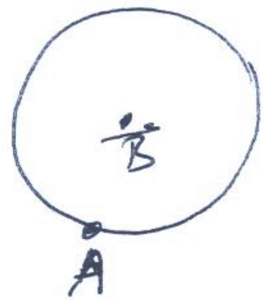
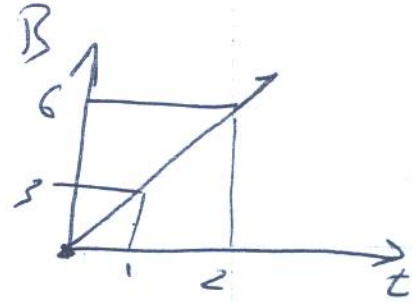
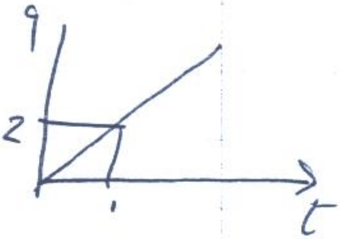




from fig (30-41 b)

$$B = 3t$$



from fig (30-41 c)

$$q = 2t.$$

$$\therefore\ i = \frac{dq}{dt} = 2\ \cancel{A} \cdot 10^{-3}\ A.$$

$$\varepsilon = \frac{d\Phi_B}{dt} = \frac{d}{dt}(AB)$$

$$= 8\times10^{-4} \times \frac{dB}{dt}$$

$$= 8\times10^{-4} \times 3 = 24\times10^{-4}\ V$$

$$R = \frac{\varepsilon}{i} = \frac{24\times10^{-4}}{2\times10^{-3}} = 1.2\ \Omega.$$

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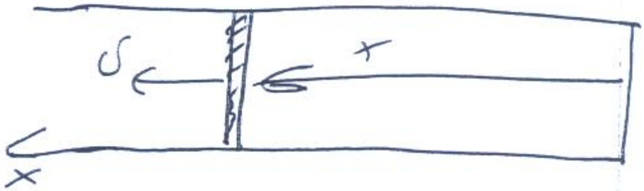


A. $\varepsilon = \frac{d\Phi_B}{dt} = \frac{d}{dt}(BA)$

$= B\frac{d}{dt}(xL)$

$= BLv$

$= 0.35 \times 0.25 \times 55 \times 10^{-2}$

$= \cancel{2.67 \times 10^{-3} A} = 48\,mV$

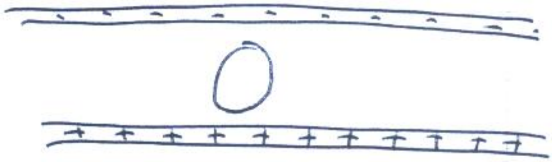
B. $i = \frac{\varepsilon}{R} = \frac{0.048}{18}$

$= 2.67 \times 10^{-3}\,A$

$P = \varepsilon i = 0.048 \times 0.00267$

$= 1.28 \times 10^{-4}\,W$

#35



$$\oint \vec{E}\cdot d\vec{s} = \frac{d}{dt}(BA)$$

$$E(2\pi R) = \pi R^2 \frac{dB}{dt}$$

$$E = \frac{R}{2}\frac{dB}{dt}$$

a. $E = \frac{2.2\times10^{-2}}{2}\times 6.5\times10^{-3}$

$= 7.15\times10^{-5}\ \frac{V}{m}$.

b. $E(2\pi\times 8.2\times10^{-2})$

$= \pi\times(6\times10^{-2})^2\times 6.5\times10^{-3}$

$E = \frac{(6\times10^{-2})^2\times 6.5\times10^{-3}}{2\times 8.2\times10^{-2}}$

$= 1.426\times10^{-4}\ \frac{V}{m}$.

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$$L = \frac{N\Phi_B}{i}$$

$$\Phi_B = \frac{iL}{N} = \frac{5\times10^{-3}\times 8\times10^{-3}}{400}$$

$$\cancel{0.1}$$

$$\Phi_B = 0.1\ \mu Wb$$

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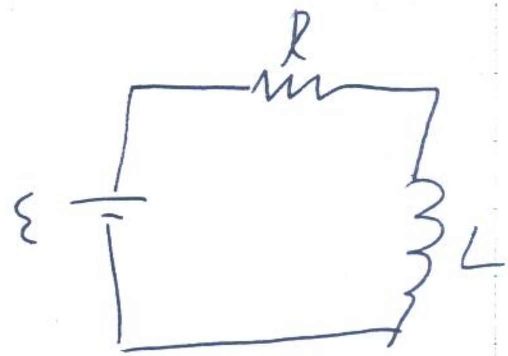

$$\varepsilon_L = L\frac{di}{dt}$$

$$i = \frac{\varepsilon}{R}\left(1 - e^{-\frac{t}{\tau_L}}\right)$$

$$\frac{di}{dt} = +\frac{\varepsilon}{R}\,\frac{1}{\tau}\,e^{-\frac{t}{\tau}}$$

a. at $t = 0$, $\frac{di}{dt} = \frac{\varepsilon}{R\tau}$

$$\varepsilon_L = L\cdot\frac{\varepsilon}{R}\cdot\frac{R}{L} = \varepsilon$$

$$\therefore \frac{\varepsilon_L}{\varepsilon} = 1$$

\# ~~39~~ 50 cont.

b.

$$\frac{di}{dt} = \frac{\varepsilon}{R} \cdot \frac{1}{\tau} \cdot e^{-\frac{t}{\tau}}$$

$$= \frac{\varepsilon}{R} \cdot \frac{R}{L} \cdot e^{-2}$$

$$\varepsilon_L = \varepsilon e^{-2}$$

$$\frac{\varepsilon_L}{\varepsilon} = \frac{1}{e^2} =$$

c. $$\frac{\varepsilon_L}{\varepsilon} = e^{-\frac{t}{\tau}}$$

$$-\frac{t}{\tau} = \ln\left(\frac{\varepsilon_L}{\varepsilon}\right)$$

$$-\frac{t}{\tau} = \ln(0.5)$$

$$t = 0.69\,\tau$$

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$$U_B = \frac{1}{2} L i^2$$

$$i = \frac{\mathcal{E}}{R}\left[1 - e^{-\frac{t}{\tau}}\right]$$

steady-state value

$$i_{max} = \frac{\mathcal{E}}{R}$$

$$U_{max} = \frac{1}{2} L \cdot \left(\frac{\mathcal{E}}{R}\right)^2$$

$$\frac{U}{U_{max}} = 0.5 = \frac{(i)^2}{\left(\frac{\mathcal{E}}{R}\right)^2}$$

$$0.5 = \left[1 - e^{-\frac{t}{\tau}}\right]^2$$

$$1 - e^{-\frac{t}{\tau}} = \sqrt{.5}$$

$$e^{-\frac{t}{\tau}} = 1 - \sqrt{.5} = 0.29$$

$$\frac{t}{\tau} = 1.2$$

$$t = 1.2\tau$$

$$U_B = \frac{1}{2} L i^2$$

$$u_B = \frac{U_B}{\text{Volume}}$$

$$70 = \frac{\frac{1}{2}\times 90\times 10^{-3}\,(i)^2}{0.02}$$

$$i = \sqrt{\frac{0.02\times 70}{0.5\times 90\times 10^{-3}}}$$

$$= 5.5\ A$$

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$$\cancel{M_{21} = \frac{N_2 \Phi_{21}}{i_1}}$$

$$\varepsilon = M \frac{di}{dt}$$

$$M = \frac{\varepsilon}{\frac{di}{dt}} = \frac{30 \times 10^3}{\left(\frac{6}{2.5 \times 10^{-3}}\right)}$$

$$= \cancel{1.25\,H}$$

$$= 12.5\,H.$$