

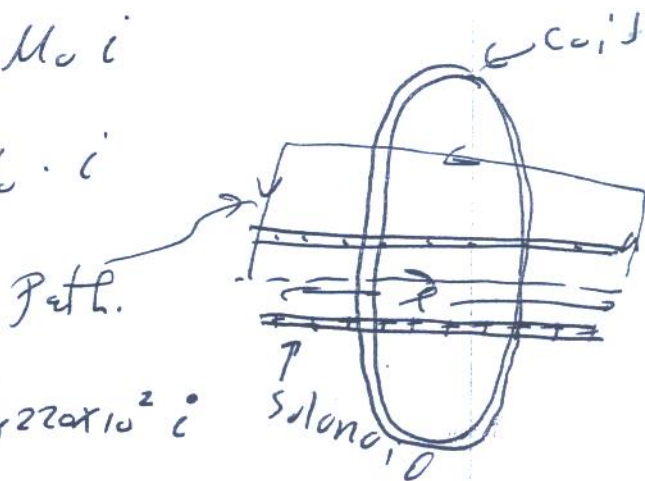
# CH #30

## H.W. Solution

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

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

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



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

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

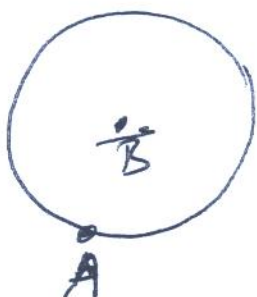
$= 120 \times 8 \times 10^{-4} \times 4\pi \times 10^{-7} \times \pi \times \frac{di}{dt}$

$= 2.65 \times 10^{-3} \times \frac{1.5}{2.5 \times 10^{-3}}$

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

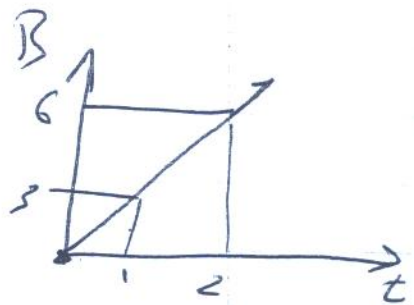
$i = \frac{1.6 \times 10^{-1}}{5.3} = 30 \text{ mA}$

#10



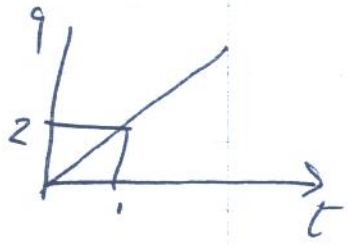
from fig (30-41 b)

$$B = 3t$$



from fig (30-41 c)

$$q = 2t.$$



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

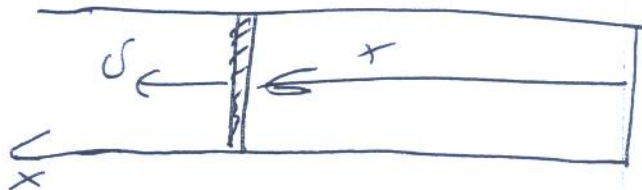
$$\mathcal{E} = \frac{d\Phi_B}{dt} = \frac{d}{dt} (\mu_0 i B)$$

$$= 8 \times 10^{-4} \times \frac{dB}{dt}$$

$$= 8 \times 10^{-4} \times 3 = 24 \times 10^{-4} \text{ V}$$

$$R = \frac{\mathcal{E}}{i} = \frac{24 \times 10^{-4}}{2 \times 10^{-3}} = 1.2 \Omega.$$

#29

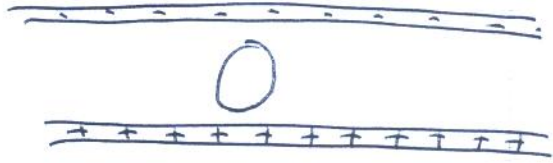


$$\begin{aligned}
 A. \quad \mathcal{E} &= \frac{d\Phi_B}{dt} = \frac{d}{dt}(BA) \\
 &= B \frac{d}{dt}(xL) \\
 &= BLv \\
 &= 0.35 \times 0.25 \times 55 \times 10^{-2} \\
 &= \cancel{2.67 \times 10^{-3}} = 48 \text{ mV}
 \end{aligned}$$

$$\begin{aligned}
 B. \quad i &= \frac{\mathcal{E}}{R} = \frac{0.048}{18} \\
 &= 2.67 \times 10^{-3} \text{ A}
 \end{aligned}$$

$$\begin{aligned}
 P &= \mathcal{E}i = 0.048 \times 0.00267 \\
 &= 1.28 \times 10^{-4} \text{ W}
 \end{aligned}$$

#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. 
$$E = \frac{2 \cdot 2 \times 10^{-2}}{2} \times 6.5 \times 10^3$$
$$= 7.15 \times 10^5 \frac{V}{m}$$

b. 
$$E (2 \times 8.2 \times 10^{-2})$$

$$= \pi \times (6 \times 10^{-2})^2 \times 6.5 \times 10^3$$

$$E = \frac{(6 \times 10^{-2})^2 \times 6.5 \times 10^3}{2 \times 8.2 \times 10^{-2}}$$

$$= 1.426 \times 10^4 \frac{V}{m}$$

# 39

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

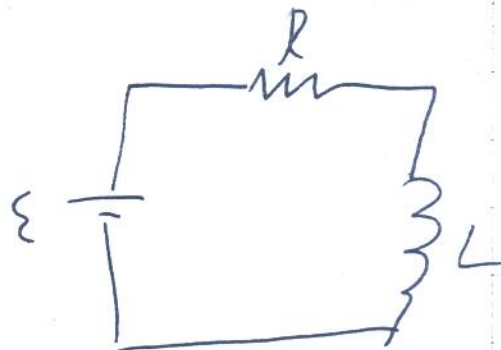
$$\Phi_B = \frac{iL}{N} = \frac{5 \times 10^{-3} \times 8 \times 10^{-3}}{400}$$

~~$\Phi_B$~~   
 $\Phi_B = 0.1 \text{ mWb}$

# 50

$$\mathcal{E}_L = L \frac{di'}{dt}$$

$$i = \frac{\mathcal{E}}{R} (1 - e^{-\frac{t}{\tau}})$$



$$\frac{di'}{dt} = + \frac{\mathcal{E}}{R} \cdot \frac{1}{\tau} e^{-\frac{t}{\tau}}$$

a. at  $t=0$ ,  $\frac{di'}{dt} = \frac{\mathcal{E}}{R\tau}$

$$\mathcal{E}_L = L \cdot \frac{\mathcal{E}}{R} \cdot \frac{1}{\tau} = \mathcal{E}$$

$$\frac{\mathcal{E}_L}{\mathcal{E}} = 1$$

# 39<sup>50</sup> Cont.

b.

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

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

$$\xi_L = \xi e^{-2}$$

$$\frac{\xi_L}{\xi} = \frac{1}{e^2} =$$

c.

$$\frac{\xi_L}{\xi} = e^{-\frac{t}{\tau}}$$

$$-\frac{t}{\tau} = \ln\left(\frac{\xi_L}{\xi}\right)$$

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

$$t = 0.69 \tau$$

#58

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

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

Steady-state value

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

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

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

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

$$1 - e^{-\frac{t}{\tau}} = \sqrt{0.5}$$

$$e^{-\frac{t}{\tau}} = 1 - \sqrt{0.5} = 0.29$$

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

$$t = 1.2 \tau$$

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

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

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

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

$$= 5.5 \text{ A.}$$



# 68

$$M_{21} = \frac{N_2 \phi_{21}}{c_1}$$

$$\Sigma = M \frac{d_i}{dt}$$

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

$$= \cancel{12.5} \text{ H} -$$

$$= 12.5 \text{ H}.$$