Physics 1C Chapter 29 Problems

29.7) $\oint \vec{B} \cdot \partial \vec{s} = \mu_0 I_{enc}$

a) $B(2\pi r) = \mu_0 i$

$\boxed{B = \frac{\mu_0 i}{2\pi r}}$

b) $\boxed{\text{into the page}}$

c) $d\Phi_B = B\,dA$

$\boxed{d\Phi_B = \frac{\mu_0 i}{2\pi r} L\,dr}$

d) $d\Phi_B = \frac{\mu_0 i}{2\pi r} L\,dr$

$\Phi_B = \frac{\mu_0 L}{2\pi} \int_a^b \frac{1}{r}\,dr$

$\boxed{\Phi_B = \frac{\mu_0 L}{2\pi} \ln\left(\frac{b}{a}\right)}$

e) $\mathcal{E}_i = -\frac{d\Phi_B}{dt}$

$\mathcal{E}_i = \frac{d}{dt}\left(\frac{\mu_0 i L}{2\pi} \ln\left(\frac{b}{a}\right)\right)$

$\boxed{\mathcal{E}_i = \frac{\mu_0 L}{2\pi} \ln\left(\frac{b}{a}\right) \frac{di}{dt}}$

f) $\mu_0 = 4\pi \times 10^{-7}$

$L = 0.24\,m$

$b = 36\,cm$

$a = 12\,cm$

$\frac{di}{dt} = 9.6\,A/s$

$\boxed{\mathcal{E}_i = 5.06 \times 10^{-7}\,V}$

29.20) a) $\boxed{\text{right} \rightarrow \text{left}}$

b) $\boxed{\text{right} \rightarrow \text{left}}$

c) $\boxed{\text{left} \rightarrow \text{right}}$

29.25) $L = 40\,cm = 0.4\,m$

$\vec{B} = 0.470\,T$

$v = 5.70\,\frac{m}{s}$

a) $\mathcal{E}_i = BLv$

$\boxed{\mathcal{E}_i = 1.07\,V}$

b) $\boxed{b}$

c) $E = \frac{\mathcal{E}_i}{L}$

$\boxed{\vec{E} = 2.68\,\frac{V}{m}}$

d) $\boxed{b\ b\ a}$

e) $\boxed{b}$

f) $\boxed{0V}$

g) $\boxed{0V}$

29.27) $B = 0.8\,T$, $L = 50\,cm = 0.5\,m$

a) $\mathcal{E} = BLv$

$v = 7.5\,\frac{m}{s}$

$\boxed{\mathcal{E}_i = 3\,V}$

b) $\boxed{\text{counterclockwise}}$

c) $R = 1.5\,\Omega$

$F_B = I\vec{L} \times \vec{B}$

$V = IR \rightarrow \mathcal{E} = IR$

$3V = I(1.5\,\Omega)$

$I = 2A$

$F_B = 2A(0.5m)(0.8T)$

$\boxed{F_B = 0.8N}$

d) $\boxed{\text{to the right}}$

e) $W = F_d = 6J$

$P = I^2 R$

$P = 4A^2(1.5\,\Omega) = 6W$

$\boxed{\text{Equal}}$

29.28) $L = 0.750\,m$, $B = 0.55\,T$

$v = 6\,\frac{m}{s}$, $R = 25\,\Omega$

a) $\mathcal{E}_i = BLv$

$\boxed{\mathcal{E}_i = 2.48\,V}$

b) $\boxed{\text{counterclockwise}}$

c) $V = IR \rightarrow \mathcal{E} = IR$

$\boxed{I = 0.099A}$

29.29) $L = 0.370\,m$, $R = 41\,\Omega$

$B = 0.670\,T$

a) $v = 5.9\,\frac{m}{s}$

$\boxed{\text{counterclockwise}}$

b) $P = I^2 R$

$I = \frac{V}{R}$

$V = \mathcal{E}_i = BLv$

$P = \frac{(BLv)^2}{R}$

$\boxed{P = 0.052W}$

29.47) $A = 2.2\,cm^2 = 2.2\times10^{-4}\,m^2$

$n_1 = 86\,turns/cm = 8600\,turns/m$

$i(t) = (0.162\,A/s^2)\,t^2$

$N_2 = 5\,turns$

a) $I = 3.2A$, $t = 4.44s$

$\mathcal{E}_1 = \mathcal{E}_2$

$\mathcal{E}_1 = -\frac{\partial\Phi_B}{\partial t}$

$\Phi_B = \int B\cdot dA = BA$

$B = \mu_0 n I(t)$

$\mathcal{E}_1 = \frac{\partial}{\partial t}(\mu_0 n_1 A I(t))$

$\mathcal{E}_1 = \mu_0 n_1 A\left(\frac{\partial}{\partial t} I(t)\right)$

$\mathcal{E}_1 = \mu_0 n_1 A(0.324\,A/s)\,t(N_2)$

$\boxed{\mathcal{E} = 1.7\times10^{-5}\,V}$

27.51) $d = 6.1cm \rightarrow r = 0.0305m$

$B = 1.03T$, $t = 0.21s$

a) $\mathcal{E} = -\frac{\partial\Phi_B}{\partial t}$

$\partial\Phi_B = B\,\partial A$

$\langle\mathcal{E}\rangle = -\frac{\partial}{\partial t}(B\langle A\rangle)$

$\langle A\rangle = \frac{1}{T}\int_0^{0.005} \partial A = 0.0292\,m^2$

$\langle\mathcal{E}\rangle = 1.03T(0.0292\,m^2)$

$\boxed{\langle\mathcal{E}\rangle = 0.0143\,V}$

b) a to b

29.52) $L = 0.153m$, $m = 0.150kg$

$R = 82.4\Omega$, $B = 1.50T$

$F = 1.9N$

$\sum F = ma$

$F + F_D = m\frac{\partial v}{\partial t}$

~~$t = \frac{mv}{F+F_D}$~~

~~$t = \frac{mv}{F_T I L B}$~~

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

$\mathcal{E} = BLv$

$I = \frac{BLv}{R}$

$F = \frac{BLv}{R}(LB) = m\frac{\partial v}{\partial t}$

$\frac{FR + B^2L^2v}{Rm} = \frac{\partial v}{\partial t}$

$(FR - B^2L^2v)\,\partial t = Rm\,\partial v$

$\frac{1}{Rm}\partial t = \frac{\partial v}{(FR+B^2L^2v)}$

$\frac{t}{Rm} = \int \frac{\partial v}{FR+B^2L^2v}$

$u = FR - B^2L^2v$, $du = B^2L^2\partial v$

$\frac{t}{Rm} = \frac{1}{B^2L^2}\int_0^v \frac{du}{u}$

$\frac{t}{Rm} = \frac{1}{B^2L^2}\left[\ln(FR) - \ln(FR - B^2L^2v)\right]$

$t = \frac{Rm}{B^2L^2}\ln\left(\frac{FR}{FR-B^2L^2v}\right)$

$\boxed{t = 2.24s}$

29.56) $r_0 = 0.0420m$

$\vec{B} = B_0\left[1 - 3\left(\frac{t}{t_0}\right)^2 + 2\left(\frac{t}{t_0}\right)^3\right]\hat{z}$

$t_0 = 0.01s$, $B_0 = 0.08T$

$R = 12\Omega$

a) $\Phi_B = \int B\,dA$

$\boxed{\Phi_B = B_0\pi r_0^2\left[1 - 3\left(\frac{t}{t_0}\right)^2 + 2\left(\frac{t}{t_0}\right)^3\right]}$

b) $\mathcal{E} = -\frac{\partial\Phi_B}{\partial t}$

$|\mathcal{E}| = B_0\pi r_0^2\left(\frac{\partial}{\partial t}\left[1 - 3\left(\frac{t}{t_0}\right)^2 + 2\left(\frac{t}{t_0}\right)^3\right]\right)$

$|\mathcal{E}| = B_0\pi r_0^2\left(-\frac{6}{t_0^2}t + \frac{6}{t_0^3}t^2\right)$

$t = 5\times10^{-3}s$

$\boxed{|\mathcal{E}| = 0.067\,V}$

c) counterclockwise

d) $I = 3mA = 0.003A$

$\mathcal{E} - Ir - IR = 0V$

$\mathcal{E} = Ir + IR$

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

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

$\boxed{r = 10.17\Omega}$

e) $t = 1.21\times10^{-2}s$

$\boxed{|\mathcal{E}| = 0.068\,V}$

f) clockwise

g) $5\times10^{-3}s < t < 1.21\times10^{-2}s$

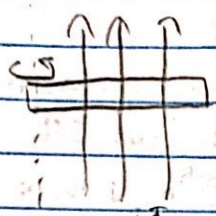
$-\frac{6}{t_0^2}t + \frac{6}{t_0^3}t^2 = 0$

$\boxed{t = t_0 = 0.01s}$

29.57) $L = 0.200m$

$\omega = 9\frac{rad}{s}$

$B = 0.7T$



a) $\mathcal{E}_i = -\frac{d\Phi_B}{dt}$

$\Phi_B = \int B \cdot dA = \int B\theta r\,dr$

$\mathcal{E}_i = -B\omega \int_0^L r\,dr$

$\mathcal{E}_i = -B\omega\left(\frac{L^2}{2}\right)$

$\boxed{\mathcal{E}_i = 0.126V}$

b) $\mathcal{E}_i = \boxed{\Delta V = 0.126V}$

c) $\mathcal{E}_i = -B\omega \int_0^{L/2} r\,dr$

$\mathcal{E}_i = -B\omega\left(\frac{(L/2)^2}{2}\right)$

$\mathcal{E}_i = -B\omega\left(\frac{L^2}{8}\right) + B\omega\left(\frac{L^2}{8}\right)$

$\boxed{0V}$

d) $\mathcal{E}_i = -B\omega\left(\frac{L^2}{8}\right)$

$\boxed{\mathcal{E}_i = 0.0315\ V}$

29.58) $L = 0.23m$

$\theta = 36.1°$

$V = 6.8\frac{m}{s}$

$\vec{B} = (0.180T)\hat{i} - (0.250T)\hat{j} - (0.0700T)\hat{k}$

$\mathcal{E}_i = -\frac{d\Phi_B}{dt}$

$\Phi_B = \int B \cdot dA$

$\mathcal{E}_i = \vec{v} \times \vec{B} \circ \vec{L}$

$v = 6.8\hat{i}$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 6.8 & 0 & 0 \\ 0.18 & -0.25 & -0.07 \end{vmatrix} \quad \begin{matrix} \hat{i} & \hat{j} \end{matrix}$$

$(0.476\hat{j} - 1.7\hat{k}) \cdot L$

$0.476 \sin(36.1°) L$

$\boxed{\mathcal{E}_i = 0.066}$

29.59) a) $\mathcal{E}_i = -\frac{d\Phi_B}{dt}$

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

$F_B = IL \times B$

$\mathcal{E}_i = BLv$

$I = \frac{BLv}{R}$

$\boxed{F_B = \frac{B^2L^2v}{R}}$

b) $\frac{B^2L^2v}{R} = +m\frac{dv}{dt}$

$\frac{B^2L^2v}{R} = +mv\frac{dv}{dx}$

$\frac{B^2L^2}{+mR} = \frac{dv}{dx}$

$\frac{B^2L^2}{+mR} x = v_0$

$\boxed{x = v_0 \frac{mR}{B^2L^2}}$

29.60) $N_1 = 5000$, $R_2 = 0.01\Omega/m$

$a = 40cm = 0.4m$

$C = 10\mu F$

$b = 4cm = 0.04m$

$N_2 = 100$

$Q = 100\mu C$

a) $\mathcal{E}_i = q/C$

$\mathcal{E}_i = IR$

$R = 5000(2\pi a)(0.01\Omega/m)$

$R = 125.66\Omega$

$10V = I(125.66\Omega)$

$\boxed{I = 0.0796A}$

b) $\Phi_2 = \int B\,dA = BA$

$B = \mu_0 nI$

$\Phi = \mu_0 nI\pi b^2$

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