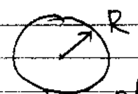
Hw 10

29-17 coil

$R = 17.5$ cm
$N = 20$ ($r = 1.0$ mm Cu)



B perp. to plane of coil

$\frac{dB}{dt} = 3.20 \times 10^{-3} \frac{T}{s}$

a) $I = \frac{\mathcal{E}}{R} = \frac{1}{R}\frac{d\Phi}{dt}$

need $\frac{d\Phi}{dt}$ and R

$\frac{d\Phi}{dt} = \frac{d}{dt}(BAN) = NA\frac{dB}{dt}$

$= (20)\pi\,(0.175\text{ m})^2\,(3.20\times10^{-3}\frac{T}{s})$

$= 6.15 \times 10^{-3}$ V

$R = \rho \frac{l}{A}$ ($l \leftarrow 2\pi RN$, $A \leftarrow \pi r^2$) (Eq 25-3)

Cu: $\rho = 1.68 \times 10^{-8}\ \Omega\cdot m$

$R = (1.68\times10^{-8}\ \Omega\cdot m)\frac{2\cancel{\pi} RN}{\cancel{\pi} r^2}$

$= (1.68\times10^{-8})\left(\frac{35.0\times10^{-2}}{(10^{-3})^2}\right)$

$R = 1.176 \times 10^{-8-2+6}$

$= 0.118\ \Omega$

$I = \frac{1}{0.118\ \Omega}\, 6.15\times10^{-3}\text{ V} = 5.2\times10^{-2}$ A

(Note we can only compute the magnitude because the direction of B is not specified.)

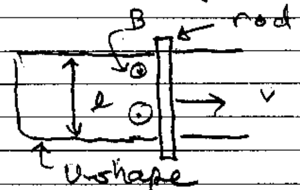
b) $P = IV = (5.2\times10^{-3}\text{ A})(6.15\times10^{-2}\text{ V})$

$= 3.2\times10^{-4}$ V

$= 0.32$ mV

(same answer from $P = I^2R$)

29-23 Fig 29-9 :



$v = 1.8\ m/s$ $B = 0.35\ T$

$\ell = 24.0\ cm$

$R_{rod} = 2.2\,\Omega$

$R_{U\text{-}shape} = 26.0\,\Omega$

a) ~~Induced~~ magnitude EMF

$$\mathcal{E} = \frac{d\Phi_B}{dt} = \frac{d}{dt} B A_{encl.}$$

$$= B \ell v$$

(direction is CW to oppose change of Φ in loop)

$$\mathcal{E} = (0.35T)(0.24m)(1.8m/s)$$
$$= 0.15V$$

b) $I_{U shape} = I_{rod} = \dfrac{0.15V}{\underbrace{(26.0+2.2)\Omega}_{\text{total } R}} = 5.4\times10^{-3} A$

c) $F = B\ell I = (0.35T)(0.24m)(5.4\times10^{-3}A)$

$= 4.5\times10^{-4} N$ (~~to left~~ for I CW)

29-29 for generator

$$V_{rms} = \sqrt{\underbrace{(V^2(t))_{avg}}_{\text{over one cycle}}}$$

$$V(t) = V_0 \sin\omega t$$

$$(V^2(t))_{avg} = V_0^2 \underbrace{(\sin\omega t)^2_{avg}}_{= \frac{1}{2}}$$

$$= V_0^2/2$$

So

$$V_{rms} = \frac{V_0}{\sqrt{2}}$$

for a generator

$V_0 = NAB\omega$ (Eq 24-4)

so

$$V_{rms} = \frac{NAB\omega}{\sqrt{2}}$$

29-41

$V_p = 120\text{ V}$

$I_p = 0.65\text{ A}$

$I_s = 15\text{ A}$

a) use $I_p V_p = I_s V_s$

$\rightarrow V_s = V_p \frac{I_p}{I_s}$

$= 120\text{ V} \frac{0.65\text{A}}{15\text{A}}$

$= 5.2\text{ V}$

b) $V_p > V_s \rightarrow$ step-down

29-43

$N_p = 330$

$N_s = 1510$

$V_p = 120\text{ V}$

$I_s = 15.0\text{ A}$

use $\frac{V_s}{V_p} = \frac{N_s}{N_p} \rightarrow V_s = V_p \frac{N_s}{N_p}$

$= 120\text{V} \frac{1510}{330}$

$= 549\text{ V}$

and

$\frac{I_s}{I_p} = \frac{N_p}{N_s} \rightarrow I_p = I_s \frac{N_s}{N_p}$

$= 15.0\text{ A} \frac{1510}{330}$

$= 68.6\text{ A}$