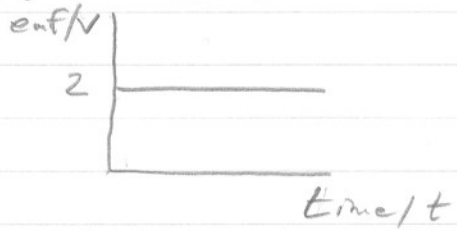
Electromagnetic Induction

1. Flux increases constantly with time
∴ emf is the slope.

$$\frac{\Delta\phi}{\Delta t} = \frac{20-0}{10-0} = 2\ V$$



2. counter clockwise

3. Big coil $\frac{\Delta B}{\Delta t} = \mu_0 \frac{NI}{L} = \frac{(4\pi \times 10^{-7}\ TmA^{-1})(1000)(150\ As^{-1})}{0.20m}$

$= 0.94248\ Ts^{-1}$

$$\mathcal{E} = N\frac{\Delta\phi}{\Delta t} = N\frac{\Delta B\, A \cancel{\cos\theta}}{\Delta t} = (200)(0.94248\ Ts^{-1})(\pi(.01m)^2)$$

$$\underline{\mathcal{E} = 0.059\ V}$$

4. (a) $\frac{N_p}{N_s} = \frac{V_p}{V_s}$

$$V_s = V_p \frac{N_s}{N_p} = (220V)\frac{(200)}{(500)} = \underline{88\ V,\ 50\ Hz}$$

(b) $\frac{N_p}{N_s} = \frac{I_s}{I_p}$

$$I_s = I_p \frac{N_p}{N_s} = (6.0A)\frac{(500)}{(200)} = 15\ A\ (70\%) = \underline{10.5\ A}$$

5. (a) $P = IV$

$$I = \frac{P}{V} = \frac{300 \times 10^6\ W}{80 \times 10^3\ V} = 3750\ A$$

$$P_{Loss} = I^2 R = (3750\ A)^2 (5\ \Omega) = 70.3 \times 10^6\ W$$

$$\%\ loss = \frac{70.3 \times 10^6\ W}{300 \times 10^6\ W} = \underline{23\%}$$

(b) $P = IV$

$$I = \frac{P}{V} = \frac{300 \times 10^6\ W}{100 \times 10^3\ V} = 3000\ A$$

$$P_{Loss} = I^2 R = (3000\ A)^2 (5\ \Omega) = 45 \times 10^6\ W$$

$$\%\ loss = \frac{45 \times 10^6\ W}{300 \times 10^6\ W} = \underline{15\%}$$

6. $\mathcal{E} = -\frac{N \Delta \Phi}{\Delta t} = \frac{-d}{dt}\left(10 \sin(\omega t)\right) = \omega 10 \cos(\omega t)$

$$\omega = 2\pi f = \frac{2\pi}{T} = \frac{2\pi}{0.9 \times 10^{-3}\ s} = 6981\ s^{-1}$$

$$V_0 = 10\omega = 69810\ V$$

$$V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{69810\ V}{\sqrt{2}} = \underline{4.9 \times 10^4\ V}$$