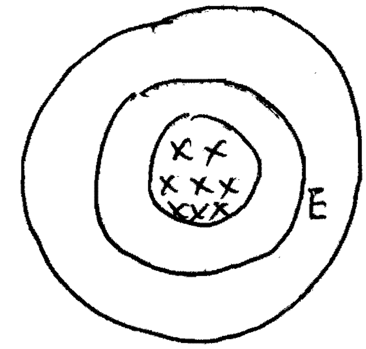
38 

$$\oint E\cdot dl = -\frac{\partial \Phi_B}{\partial t}$$

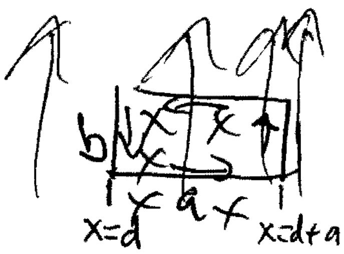
$$2\pi E = -A\frac{\partial B}{\partial t}$$

A is region with field not whole area enclosed

a) $$E = \frac{-A}{2\pi}\frac{\partial B}{\partial t}$$

b) field is increasing in the $-\hat{z}$ direction thus it is decreasing in the $+\hat{z}$ directio so counter clockwise

c) $|W| = |\int F\cdot dl| = q\oint E\cdot dl = qA\frac{\partial B}{\partial t}$

39) 

use box contour

$$\oint E\cdot dl = (E_0+10a)b - E_0 b$$

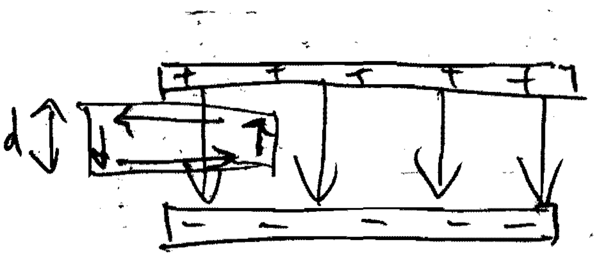
$$= 10ab \neq 0$$ so there must be a B field changing in time

$$\frac{dE}{dx} = 10\,V/m^2 \Rightarrow E = E_0 + 10x$$

$$\Phi_B = abB \Rightarrow \frac{\partial \Phi_B}{\partial t} = -ab\frac{\partial |B|}{\partial t} \Rightarrow$$

$$\frac{\partial |B|}{\partial t} = 10\ V/m^2$$

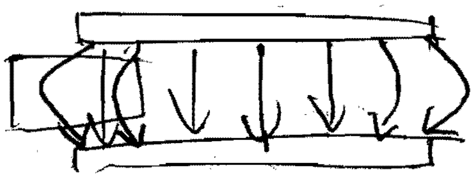
40



this is a static problem so we should expect

$$\frac{\partial \Phi_B}{\partial t} = 0$$

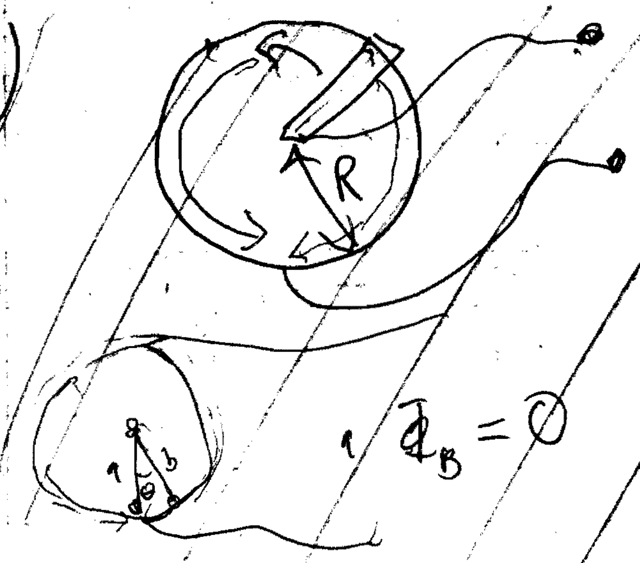
$$\oint E \cdot dl = -dE + 0 \neq 0$$ so clearly our assumption that the field cuts off abruptly is wrong



here we get contributions from the x direction contours that cancel out the part inside

fringing happens because magnetic fields would pop out otherwise and that takes energy

49)



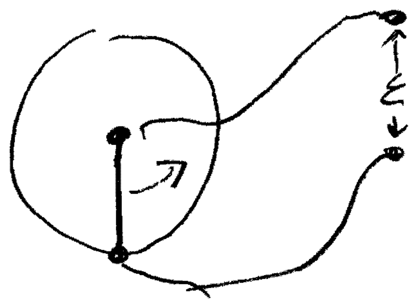
$$\frac{\partial \Phi_B}{\partial t} = AB$$

$$\pi R^2 B \omega$$

a $\Phi_B = 0$

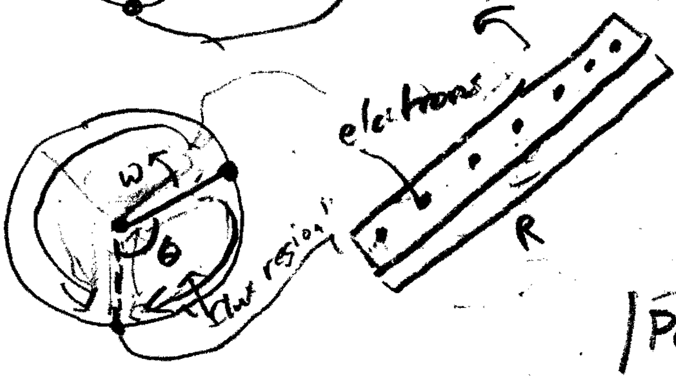
b $\Phi_B = R^2 \theta B \quad \frac{d\Phi_B}{dt} = BR^2\omega$

49)



note in this position
$\Phi_B = 0$ as there is no loop

Step 1 ignore fluxes



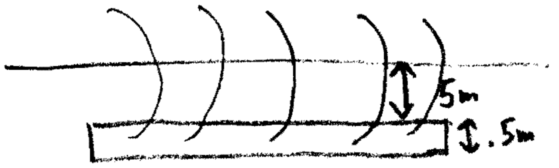
$$V(r) = \omega r$$

$$F = qV \times B = q\omega r B \hat{r}$$

$$|Pe| = \int_0^R F \cdot dr = q\frac{R^2}{2}B\omega$$

$$Pe = q\mathcal{E} \text{ so } \mathcal{E} = \frac{R^2}{2}B\omega$$

57) $I = I_0 \sin\omega t$ $\quad I_0 = 10\,KA$ $\quad B = \dfrac{\mu_0 I(t)}{2\pi r}$



$$\Phi_B = \frac{l\mu_0 I(t)}{2\pi}\int_5^{5.5}\frac{1}{r}$$

a) $\Phi_B = \dfrac{l\mu_0 I(t)}{2\pi}\ln\left(\dfrac{5.5}{5}\right)$ $\quad \mathcal{E} = \dfrac{\partial \Phi_B}{\partial t} = \dfrac{l\mu_0 \omega \cos(\omega t)}{2\pi}\ln(1.1)$

$$l = \frac{170\,2\pi}{\mu_0 \omega \ln(1.1)}$$

b) $\langle P \rangle = \dfrac{P_{max}}{2}$ (this comes from $\frac{1}{2\pi}\int_0^{2\pi}\sin^2\theta\, d\theta = \frac{1}{2}$)

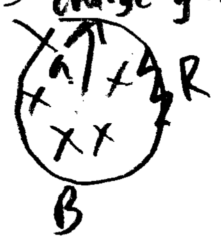
$$P_{max} = \frac{V_{max}^2}{R} = \frac{(170)^2}{5} \Rightarrow \langle P \rangle = \frac{(170)^2}{10}$$

c) $\langle P \rangle \cdot 3.6 = \text{Kw/hour}$ $\quad \cancel{\#}\langle P \rangle \cdot 3.6 \cdot .1$

3600 sec/hour
1000 W/KW

d) there would be excessive power loss over the wires

58) q = charge going through this line $I = dQ/dt$



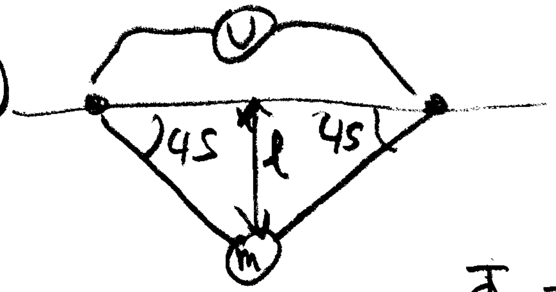
B goes from $B_1 \Rightarrow B_2$

$$\mathcal{E} = -\frac{\partial \Phi}{\partial t} = \pi a^2 \frac{\partial B}{\partial t} \text{ (in magnitude)}$$

$$\frac{dQ}{\cancel{dt}} = \frac{\pi a^2}{R}\frac{dB}{\cancel{dt}}$$

$$\int dQ = \int_{B_1}^{B_2} \frac{\pi a^2}{R}\, dB \Rightarrow q = \frac{\pi a^2}{R}(B_2 - B_1)$$

62)



assume currents are negligible

$$\Phi_B = B \cdot A = BA\cos\theta \approx BA\left(1 - \frac{\theta^2}{2}\right)$$

$$\frac{-\partial \Phi}{\partial t} = BA\theta\dot{\theta} = Bl^2\theta\dot{\theta}$$

back to 2A!

$$\theta(t) = \theta_0 \cos(\omega t) \qquad \omega = \sqrt{g/l}$$

$$\theta'(t) = -\theta_0\sqrt{g/l}\,\sin\left(\sqrt{\tfrac{g}{l}}\,t\right)$$

$$\mathcal{E} = \frac{-Bl^2\theta_0^2\sqrt{g/l}}{2}\sin\left(2\sqrt{g/l}\,t\right)$$