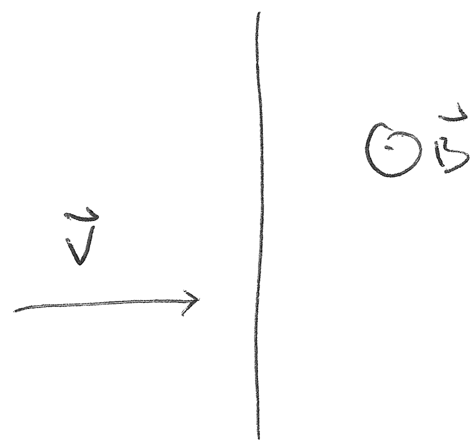
#1

ELECTRON WITH ENERGY U ENTERS AN AREA WITH MAGNTIC FIELD B. ELECTRON HAS

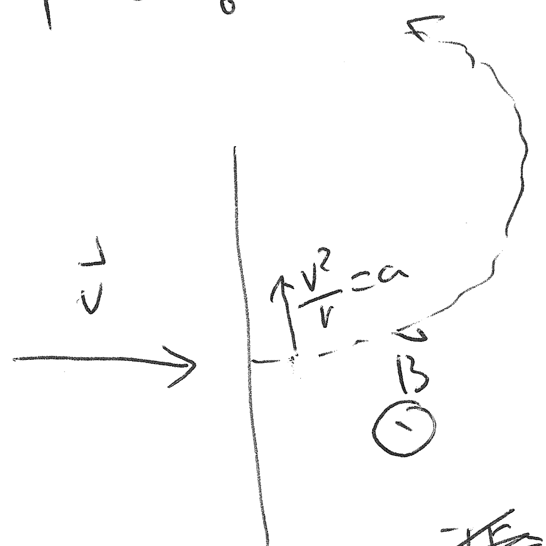
CHARGE e

MASS m.



CALCULATE THE RADIUS OF THE RESULTING MOTION

$$\vec{F} = q\vec{v}\times\vec{B} = m\vec{a}$$



$$qvB = \frac{mv^2}{r}$$

$$r = \frac{mv}{qB}$$

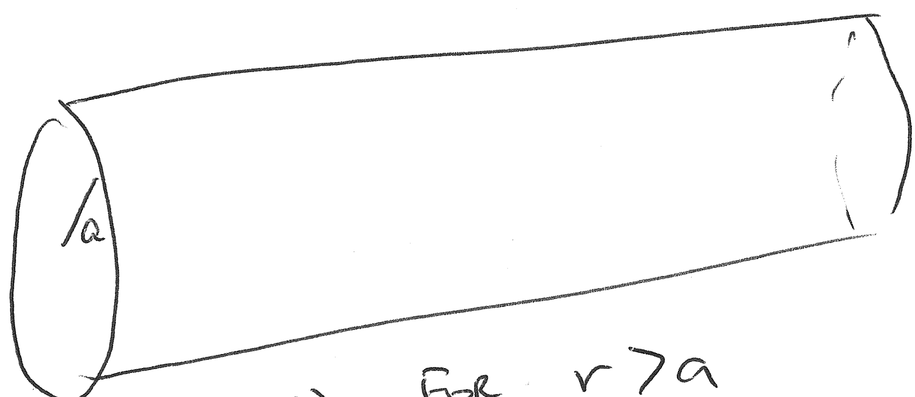
$$U = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2U}{m}}$$

$$r = \frac{m}{qB}\sqrt{\frac{2U}{m}} = \frac{\sqrt{2mU}}{qB}$$

#2 CALCULATE ELECTRIC FIELD FOR AN UNIFORMLY CHARGED INFINITE CYLINDER WITH RADIUS a.

CHARGE DENSITY : ρ (C/m^3)

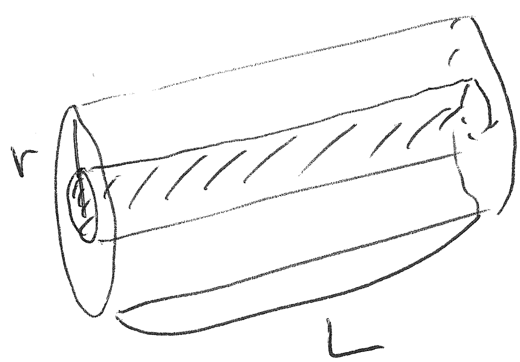


a) FOR $r > a$

b) FOR $r < a$

a) For $r > a$

$$\oint E \cdot ds = \frac{Q_{enc}}{\varepsilon_0}$$



$$2\pi r L E = \frac{\pi a^2 L \rho}{\varepsilon_0}$$

$$\boxed{E = \frac{\rho a^2}{2 r \varepsilon_0}}$$

b) For $r < a$

$$\oint E \cdot ds = 2\pi r L E = \frac{\pi r^2 L \rho}{\varepsilon_0}$$

$$\boxed{E = \frac{\rho r}{2 \varepsilon_0}}$$

#3 CALCULATE THE CAPACITANCE OF A CONDUCTING SPHERE WITH RADIUS a.

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\hat{r} \qquad r > a$$

$$\frac{\partial V}{\partial r} = -E = -\frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$$

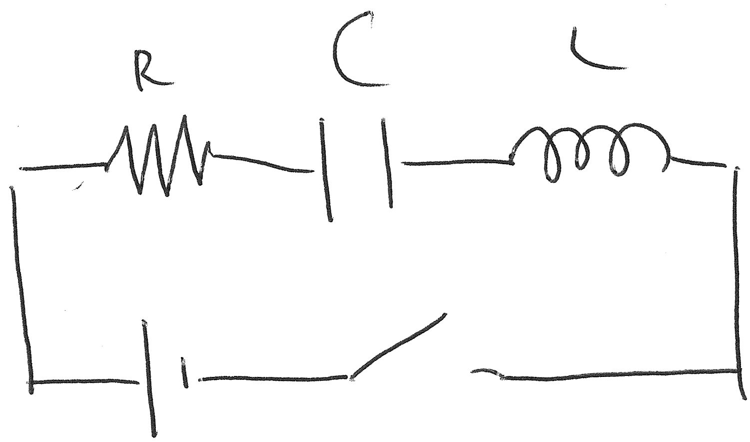
$$V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r} + C$$

AT the $r = \infty$ $V = 0$ SO $C = 0$

$$V(a) = \frac{1}{4\pi\varepsilon_0}\frac{Q}{a} \Leftrightarrow C|\Delta V| = Q$$

$$\boxed{C = 4\pi\varepsilon_0 a}$$

#4



CALCULATE CURRENT SOURCED BY THE BATTERY AT a) $t=0$

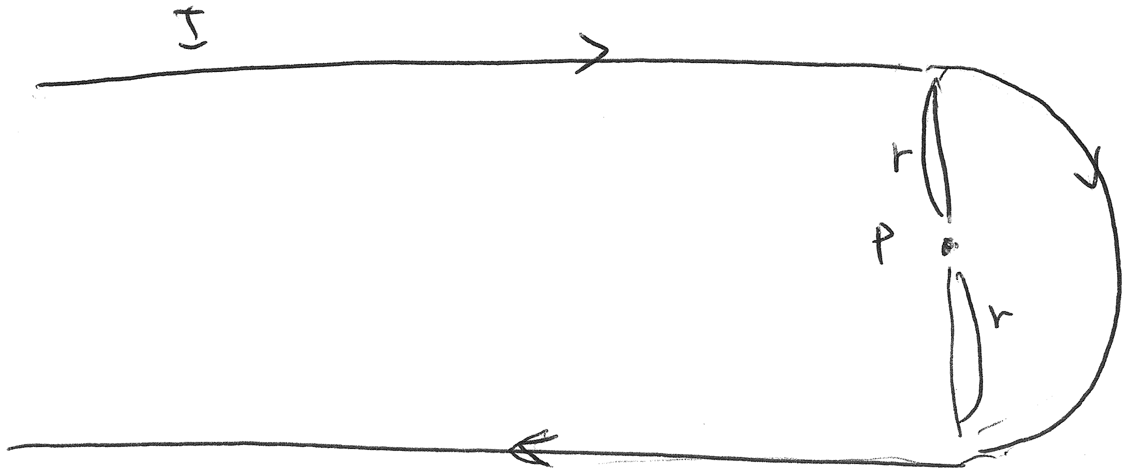
b) $t=\infty$

$V_c(t=0) = 0$,

a) $I = 0$

b) $I = 0$

#5



FIND DIRECTION AND MAGNITUDE OF MAGNETIC FIELD AT POINT P

$$d\vec{B} = \frac{\mu_0 I}{4\pi} \frac{d\vec{s} \times \hat{r}}{r^2}$$

STRAIGHT SEGMENTS $\quad B = \dfrac{\mu_0 I}{2\pi r}$

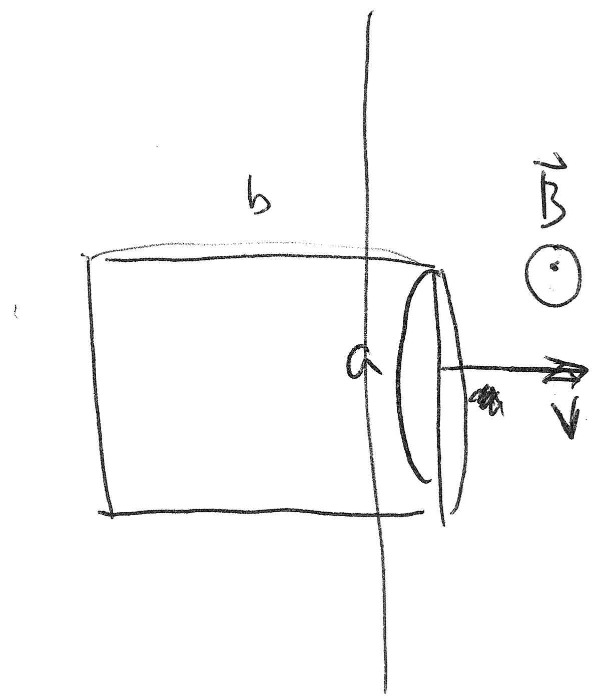
CURVED SEGMENT $\quad d\vec{B} = \dfrac{\mu_0 I}{4\pi} \dfrac{ds}{r^2}$

$$\vec{B} = \frac{\mu_0 I}{4\pi} \frac{\pi r}{r^2} = \frac{\mu_0 I}{4r}$$

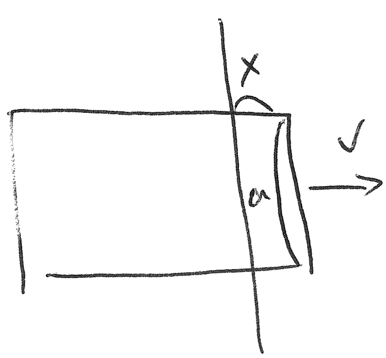
$$B_{TOTAL} = \frac{\mu_0 I}{2\pi r} + \frac{\mu_0 I}{4r}$$

POINTING INTO THE SHEET

#6



CALCULATE
EMF INDUCED
ON THE LOOP.
(~~ALS~~ ALSO DIRECTION
OF INDUCED CURRENT)



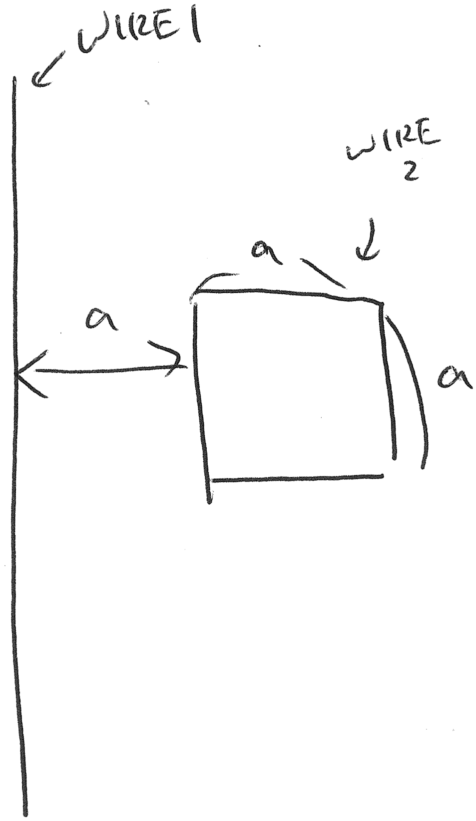
$$\Phi = B a x$$

$$\frac{d\Phi_B}{dt} = B a \frac{dx}{dt} = B a v$$

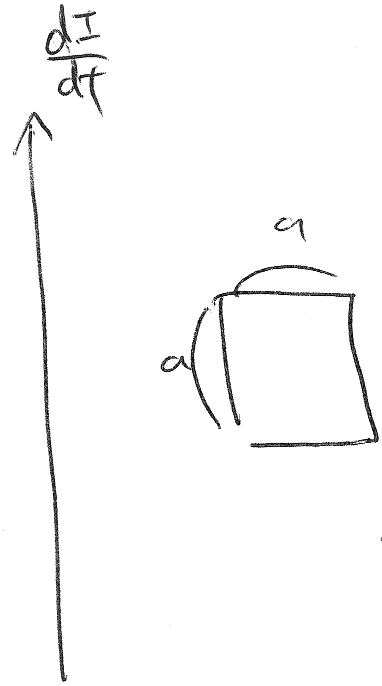
$$\boxed{|\mathcal{E}| = B a v}$$

CLOCKWISE CURRENT

#7



CALCULATE EMF INDUCED ON WIRE 1 IF CURRENT CHANGE IN WIRE 2 IS EQUAL TO $\frac{dI}{dt}$.



$$\mathcal{E} = -M\frac{dI}{dt}$$

M.

$=$

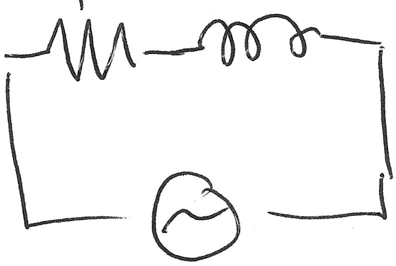
$$\Phi_B = \int_a^{2a} \frac{\mu_0 I}{2\pi r}\, dr\, a$$

$$\Phi_B = \frac{\mu_0 I a}{2\pi} \ln 2 = MI$$

$$M = \frac{\mu_0 a}{2\pi} \ln 2$$

$$\boxed{\mathcal{E} = -\frac{\mu_0 a}{2\pi} \ln 2 \frac{dI}{dt}}$$

#8 $Z_R = R$ | $Z_C = \frac{1}{i\omega C}$ | $Z_L = i\omega L$



a) CALCULATE MAGNITUDE OF IMPEDANCE

b) I_{MAX} GIVEN V_{MAX}

c) CALCULATE ϕ

$V(t) = V_{MAX} \cos(\omega t)$

$I(t) = I_{MAX} \cos(\omega t - \phi)$

$$Z = a + bi$$

$$|Z| = \sqrt{a^2 + b^2}$$

a) $R + i\omega L = Z_{TOTAL}$

$$\boxed{|Z_{TOTAL}| = \sqrt{R^2 + (\omega L)^2}}$$

b) $$\boxed{I_{MAX} = \frac{V_{MAX}}{|Z_{TOTAL}|} = \frac{V_{MAX}}{\sqrt{R^2 + (\omega L)^2}}}$$

c) $$\boxed{\tan^{-1}\left(\frac{\omega L}{R}\right) = \phi}$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\,\hat{r} \qquad a > r$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\frac{r^3}{a^3} = \frac{1}{4\pi\varepsilon_0} Q\frac{r}{a^3}\,\hat{r} \qquad a < r$$

$a > r$

$$\frac{\partial V}{\partial r} = -E \Rightarrow V = -\int \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\,dr$$

$$V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r} + C$$

$V(\infty) = 0$: BY DEFINITION, $C = 0$

$$V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$$

$$V(a) = \frac{1}{4\pi\varepsilon_0}\frac{Q}{a}$$

$a < r$

$$\frac{\partial V}{\partial r} = -\frac{1}{4\pi\varepsilon_0}\frac{Qr}{a^3}$$

$$V = -\frac{1}{4\pi\varepsilon_0}\frac{Qr^2}{2a^3} + C$$

$$V = -\frac{1}{8\pi\varepsilon_0}\frac{Qr^2}{a^3} + C$$

$$V(a) = -\frac{1}{8\pi\varepsilon_0}\frac{Q}{a} + C$$