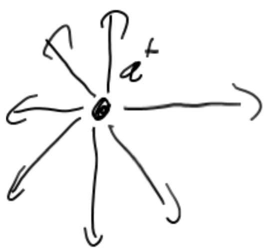
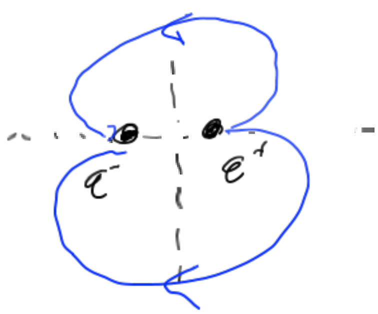


$$\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{q_1}{|\vec{r}|^2}\hat{r}$$

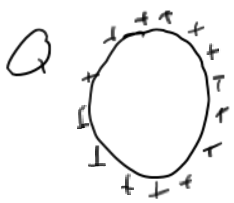
$$\vec{F}_2 = q_2 \vec{E}_1$$



$$|\vec{E}_{axis}| \approx \frac{1}{4\pi\epsilon_0}\frac{2qs}{r^3}$$

$$|\vec{E}_{\perp}| \approx \frac{1}{4\pi\epsilon_0}\frac{qs}{r^3} \qquad r \gg s$$

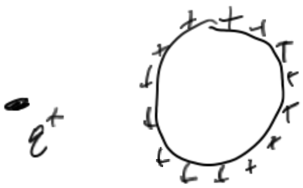
$$p = qs$$



uniform shell of charge

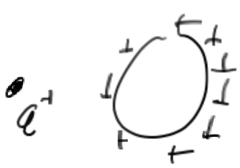
$\vec{E}$ inside due to charges on the shell is 0

E outside $\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{Q}{|r|^2}\hat{r}$

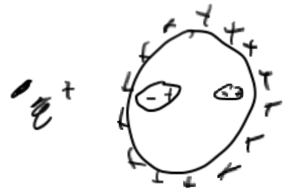


Conductor → $\vec{E}_{inside} = 0$

insulator → $E_{inside} = \frac{1}{4\pi\epsilon_0}\frac{q}{|\vec{r}|^2}\hat{r}$

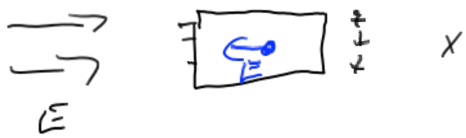


Conductor

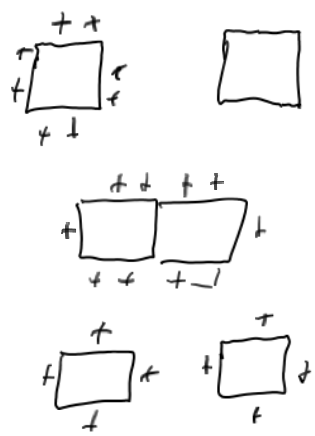


$E_{inside} = \frac{E_{app}}{K}$

c



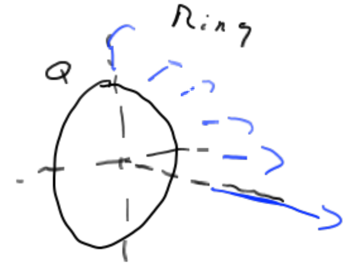
$E_{net} = E + E_- + E_+$



conservation of charge

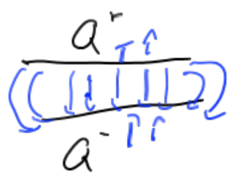
Rod $E \approx \frac{1}{4\pi\epsilon_0} \frac{2Q/L}{r}$

Ring



Disk

$E \approx \frac{Q/A}{2\epsilon_0}$

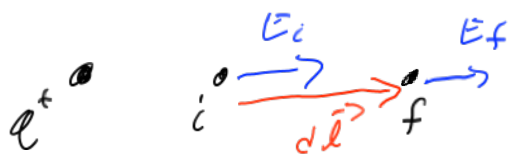


Capacitor

$E_{cap} \approx \frac{Q/A}{\epsilon_0}$

$\Delta V = V_f - V_i = -\int_i^f \vec{E}\cdot d\vec{l}$ if $\vec{E}$ is constant

$\to \sum -E \cdot \Delta l$



$\vec{E}\cdot d\vec{l}$ is $(+)$

if $\vec{E}$ and $d\vec{l}$ are $\perp$ $\to \Delta V = 0$

$\Delta U = q\Delta V$

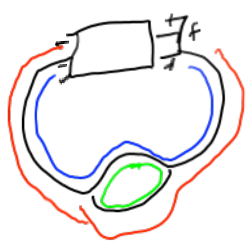
round trip $\Delta V = 0$

$$\vec{B} = \frac{\mu_0}{4\pi} q \frac{\vec{v} \times \hat{r}}{r^2}$$

$$\vec{v} \times \hat{r} = |\vec{v}||\hat{r}| \sin\theta$$
$$= |\vec{v}| \sin\theta$$

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

$\mu = A I$



current node

$i_{in} = i_{out} \rightarrow I_{in} = I_{out}$

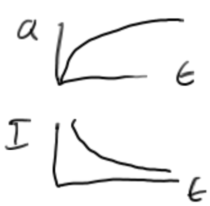
Emf or Energy Conservation

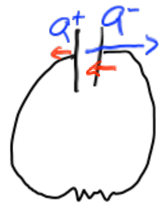
$\Delta V = 0$

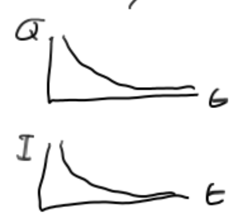
$\mathcal{E}_{mf} - I_1 R_1 + \dots = 0$

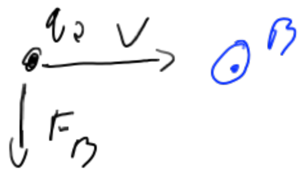
$I = |q| n A u E$

$R = \frac{L}{\sigma A}$ $\quad \sigma = |q| n u$ $\quad \Delta V = IR$ ohmic only!

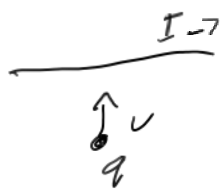




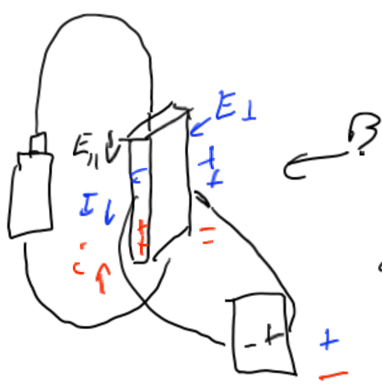




$$\vec{F}_0 = q_0 \vec{E}_1 + q_0 \vec{v}_0 \times \vec{B}_1$$

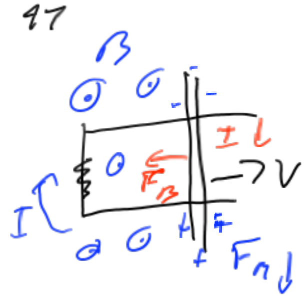


$$F_q = \cancel{q_0 \vec{v}_0 \times \frac{(\vec{v}_0 \times \vec{r})}{r^3} \frac{\mu_0}{4\pi}}$$



$$F_B = F_{E\perp}$$

$$qvB = qE_\perp$$



$$\Phi = \oint \vec{E}\cdot\hat{n}\,da = \frac{\Sigma q_{in}}{\epsilon_0} \qquad \oint \vec{B}\cdot\hat{n}\,da = 0$$

all of these charges contribute to the field of the surface!

but only q_{in} contribute to flux

Gauss' Law

Ampere's Law $\oint \vec{B}\cdot d\vec{l} = \mu_0 \Sigma I_{inc}$

direction of $d\vec{l}$ is arbitrary

$$\boxed{\mathcal{E}_{mf} = -\frac{d\Phi}{dt}}$$

$$B_s = \frac{\mu_0 N I}{d}$$

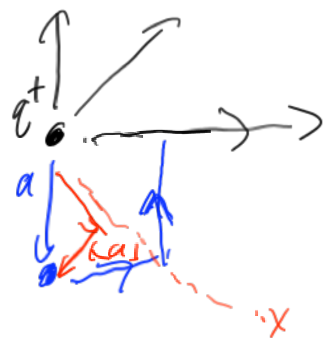
$$\boxed{\Phi = \int \vec{B}\cdot\hat{n}\, da}$$

$$\Phi_{r_w} = \Phi_{r_s} \rightarrow \frac{d\Phi_{r_w}}{dt} = \frac{d\Phi_{r_s}}{dt}$$

$$\frac{d\Phi}{dt} = \frac{\mu_0 N}{d}\pi r_s^2 \frac{dI}{dt} = 0.016\ V = \varepsilon_{mf}$$

$$\boxed{\varepsilon_{mf} = \oint \vec{E}_{nc}\cdot d\vec{l}} \rightarrow \varepsilon_{mf} = E_{NC}\, 2\pi r_w$$

$$E_{NC} = \frac{\varepsilon_{mf}}{2\pi r_w} = .0035\ \frac{V}{m}$$



$a_\perp = a$

x

$$E_{rad} = \frac{1}{4\pi\epsilon_0} \cdot \frac{q\, a_\perp}{c^2 r}$$

$a_\perp, r$
from observer

$\overset{x}{a_\perp} = 0$

$\hat{c} = \hat{E} \times \hat{B}$

$|\vec{E}| = |\vec{B}|c$

$\rightarrow |\vec{B}| = \frac{|\vec{E}|}{c}$