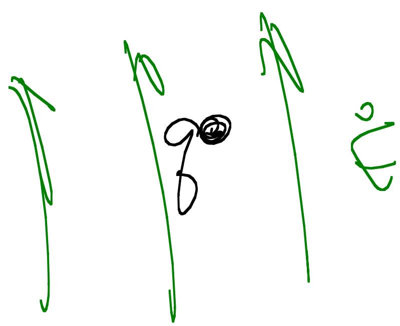
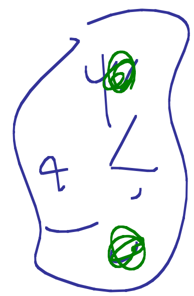
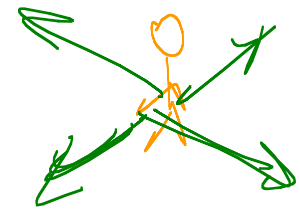
Note Title 9/5/2012

Phys 2120-4 9/5/12

Chap 20







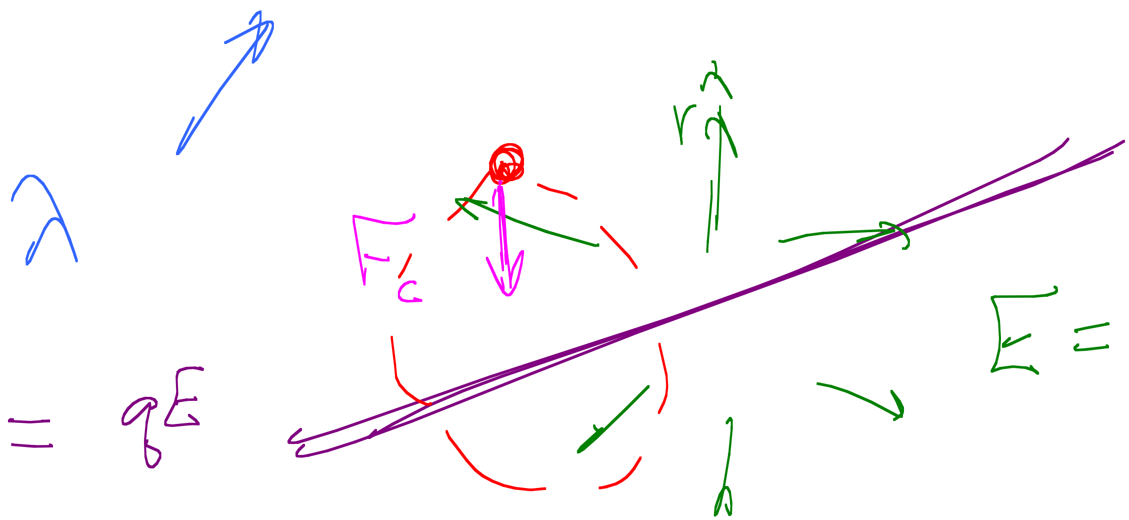
$= \vec{E}$

$$\vec{F} = q\vec{E}$$

pos

$E = k\,q/r^2$

20.56 An electron is moving in a circular path around a long uniformly charged wire carrying $2.5\ \mathrm{nC/m}$. What's the electron's speed.



p. 342

$$E = \frac{2k\lambda}{r}$$

$$F_c = \frac{mv^2}{r} = qE$$

$$F_c = \frac{mv^2}{\cancel{r}} = |qE| = e\frac{2k\lambda}{\cancel{r}}$$

$e = 1.602 \times 10^{-19}\,C$

$$mv^2 = e\,2k\lambda$$

$m = 9.11 \times 10^{-31}\,kg$

$$v^2 = \frac{e\,2k\lambda}{m}$$

$k = 9.0 \times 10^{9}\,\frac{Nm^2}{C^2}$

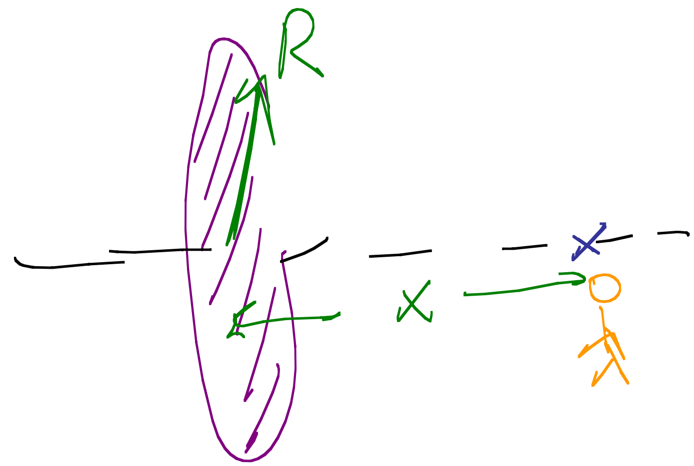
Do it

$$= 2.8 \times 10^{6}\,\frac{m}{s}$$

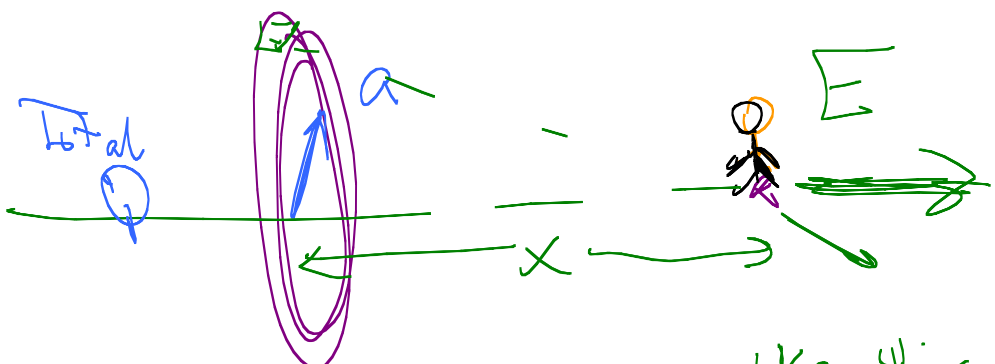
$\lambda = 2.5\,nC/m$

$= 2.5 \times 10^{-9}\,C/m$

20.71 Tell me the electric field from plate.



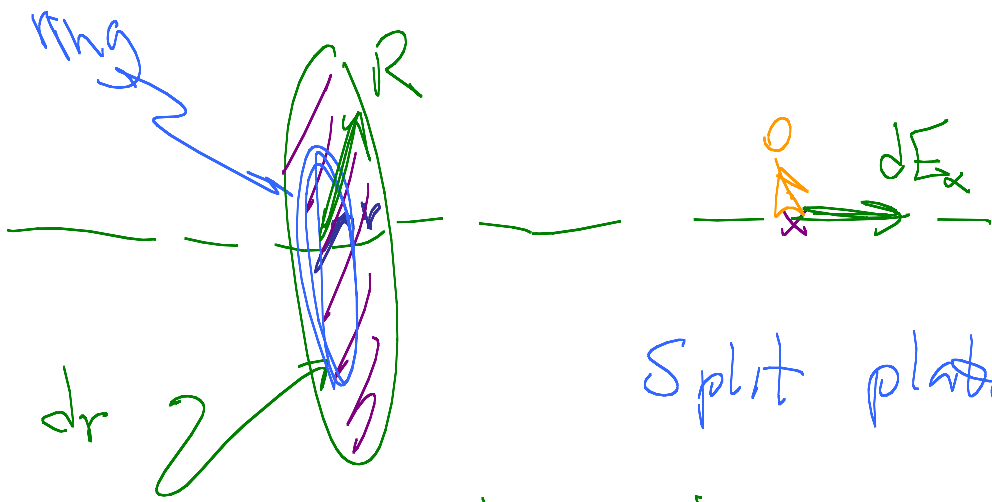
Use p. 341



Use this

charge density $= \sigma$

$$E = \frac{kQx}{(x^2+a^2)^{3/2}}$$



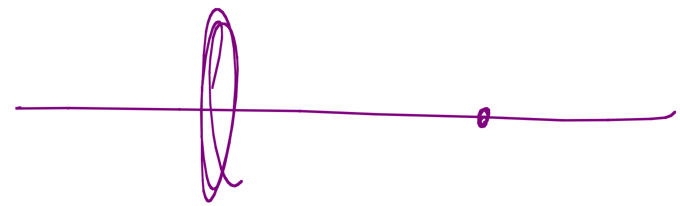
Split plate into rings

Charge in ring $dq = (2\pi r\, dr)\,\sigma$

$$dE = \frac{k(dq)\,x}{(x^2+r^2)^{3/2}} = \frac{k(2\pi r\, dr)\,\sigma x}{(x^2+r^2)^{3/2}}$$

Integrate from $r=0$ to $r=R$

Total E field



$$E_x = \int_0^R \frac{2\pi k \sigma x \; r}{(r^2 + x^2)^{3/2}} \, dr$$

$R \to \infty$

$E = 2\pi k \sigma$

sheet of charge

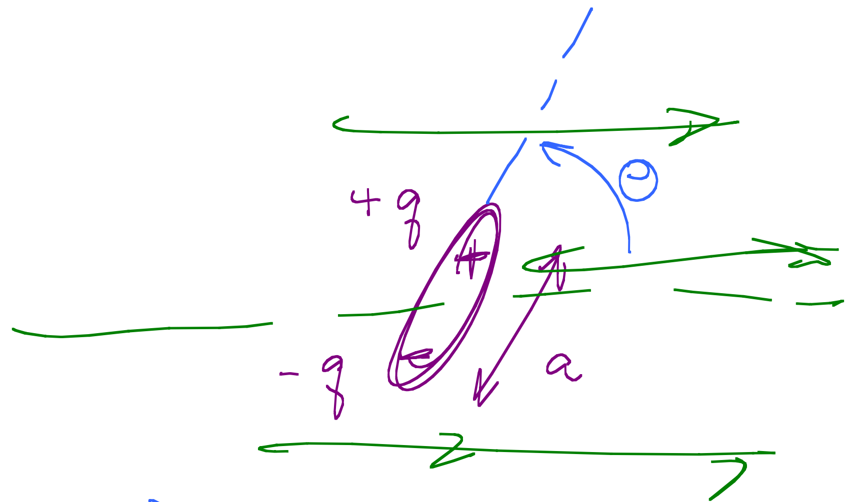
$$= 2\pi k \sigma \int_0^R \frac{r}{(r^2 + x^2)^{3/2}} \, dr$$

$$= 2\pi k \sigma x (-1) \left. \frac{1}{(r^2 + x^2)^{1/2}} \right|_0^R = 2\pi k \sigma \left[1 - \frac{x}{\sqrt{x^2 + R^2}} \right]$$

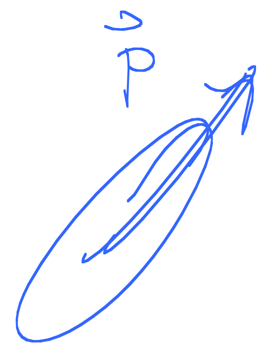
$$\vec{F} = q\vec{E}$$

Total charge = 0

No net force, but there is a torque



$$\vec{\tau} = \vec{p} \times \vec{E}$$



$$p = qa$$

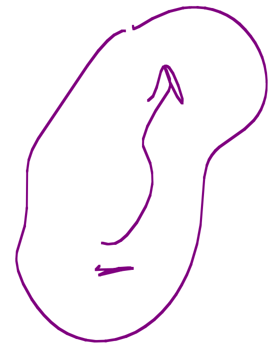
Energy stored $\quad U = -\vec{p} \cdot \vec{E}$

$$W = \int_{\theta_1}^{\theta_2} \tau \, d\theta$$

Materials

Divide up between

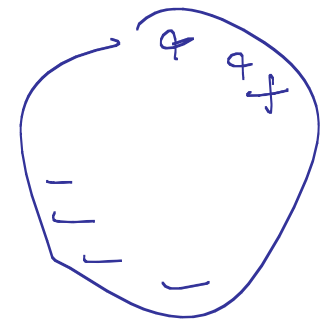
In conductor, excess charges all lie on surface



charges moves freely

Conductors

Metals



charge does not move

Insulators

Dielectric.

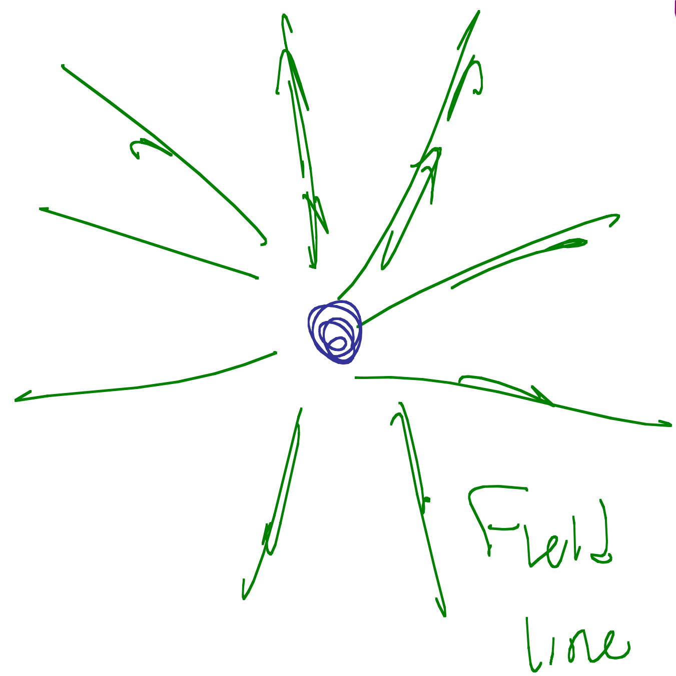
Chap 21

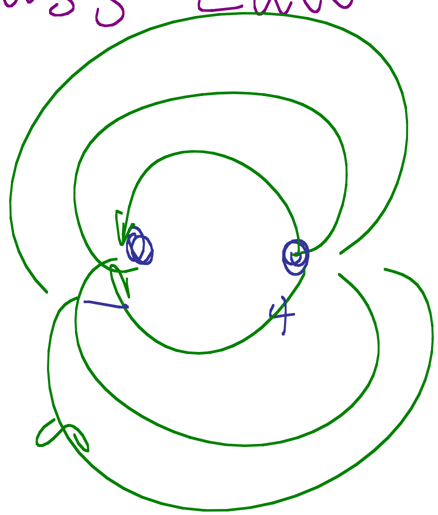
Gauss's Law

Gauss' Law

they're

there





Electric Flux

$$\sum_{\text{all patch}} \vec{E}\cdot d\vec{A}$$

surface integral

$$= \int_{\text{surface } S} \vec{E}\cdot d\vec{A}$$

Electric flux

$$\int f(x)\,dx = \sum f(x)\,dx$$

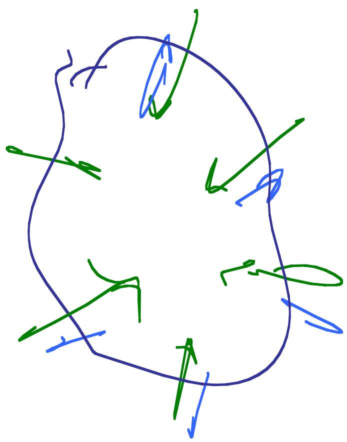
$$= \Phi$$

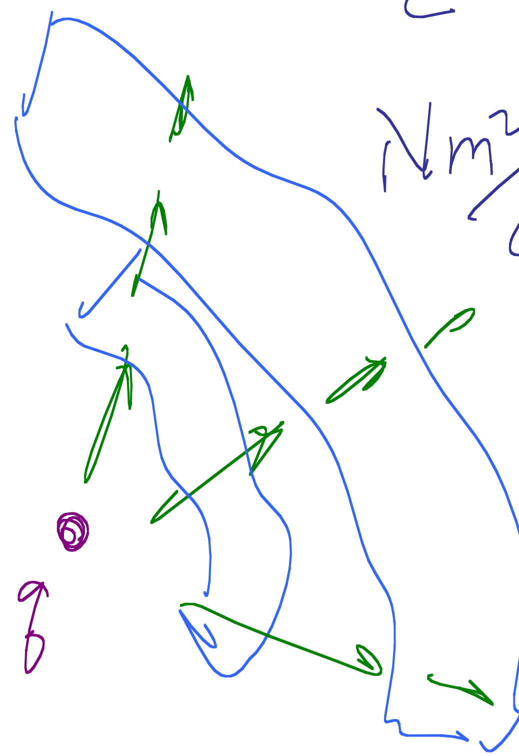
$$\int_S \vec{E}\cdot d\vec{A} = \Phi$$

Number

Units $\frac{N}{C}\cdot m^2$

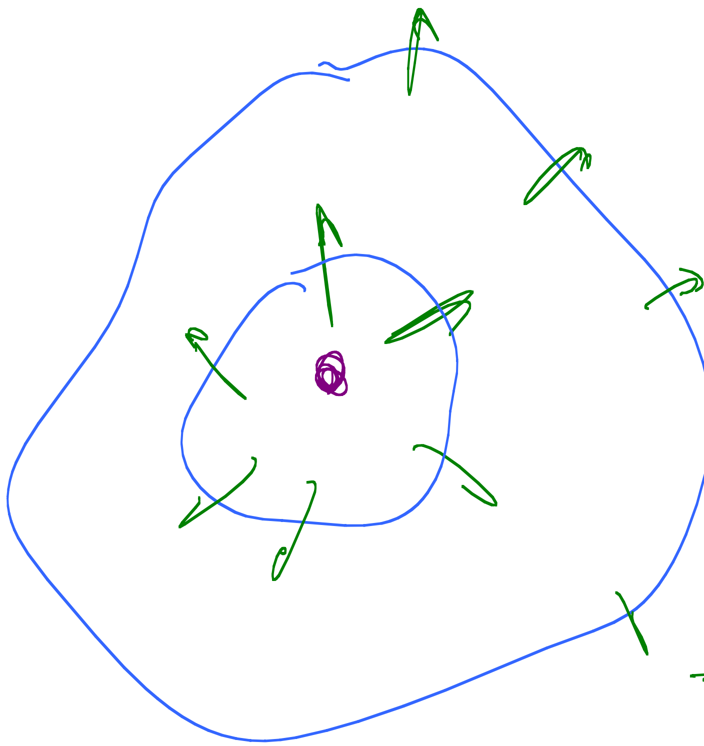
Nm^2/C

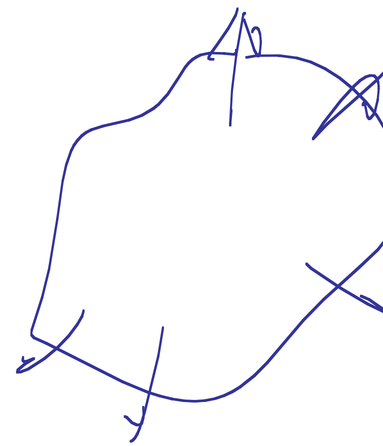




Closed surface

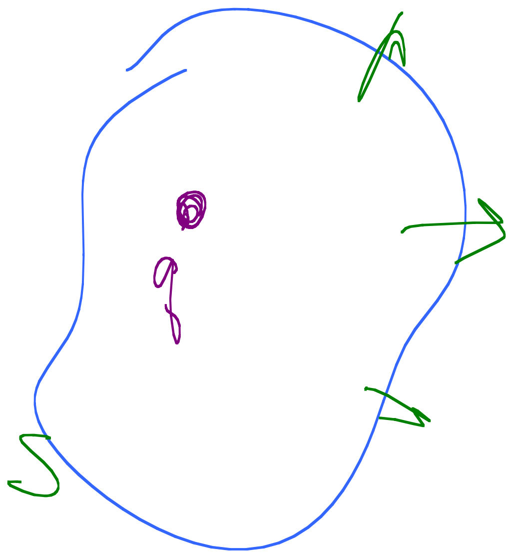
$$\oint_S \vec{E}\cdot d\hat{A}$$





Field weaker, more area

$\rightarrow$ Flux is same



Given a config of charges $\longleftrightarrow$ measure flux,

$\longrightarrow$ tells how much charge is inside.

$$\oint_S \vec{E}\cdot d\vec{A} \propto q_{\text{inside}}$$

Almost ~~f~~ right

$$k = \frac{1}{4\pi\epsilon_0}$$

?

$$\epsilon_0 = 8.85 \times 10^{-12} \frac{C^2}{N \cdot m^2}$$

F/r

$$\oint_S \vec{E} \cdot d\hat{A} = \frac{q_{encl}}{\epsilon_0}$$

q_{encl} is charge inside S