Phys 2120-4 9/14/12

Note Title 9/14/2012

Chap 22 Electric Potential, V

scalar

Volts

$$\Delta V_{AB} = -\int_A^B \vec{E}\cdot d\vec{r} \qquad \Delta U_{AB} = q\,\Delta V_{AB}$$

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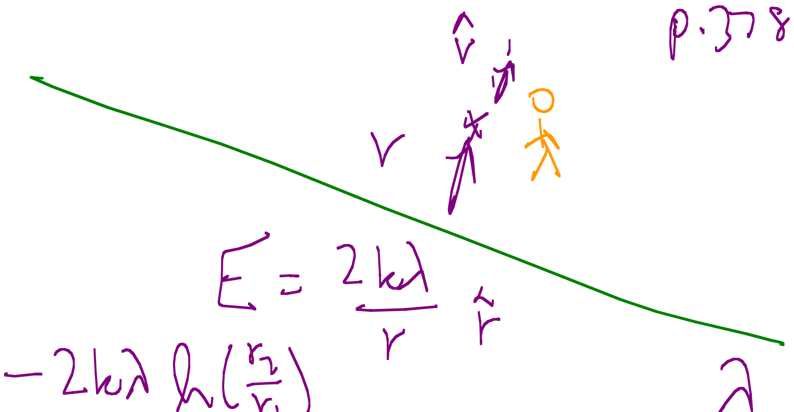


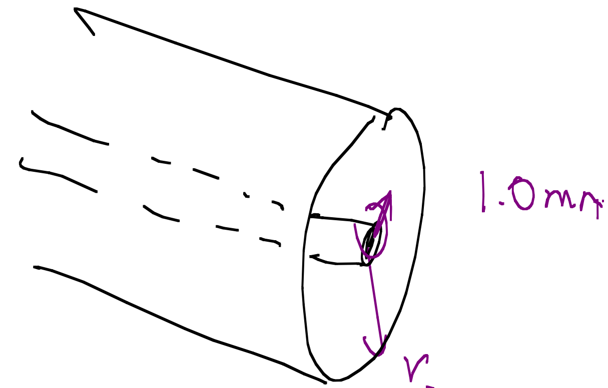
$$\vec{E} = \frac{2k\lambda}{r}\hat{r}$$

$$\Delta V = -\int_{r_1}^{r_2} \vec{E}\cdot d\vec{r} = -\int_{r_1}^{r_2} \frac{2k\lambda}{r}\,dr = -2k\lambda \ln\left(\frac{r_2}{r_1}\right) = 2k\lambda \ln\left(r_1/r_2\right)$$

22.48 Coaxial cable

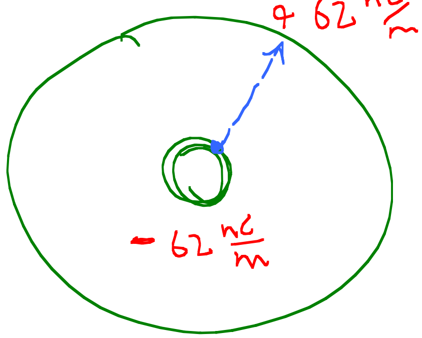
Max. pot'l diff between inner & outer cond's is 2 kV

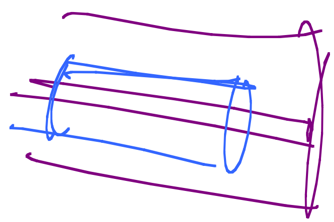
Conductor carry $\pm 62\ \frac{nC}{m}$. Will this cable work?



$$\Delta V = 2k\lambda \ln \frac{r_1}{r_2}$$

$$\lambda = .62\ \frac{nC}{m}$$





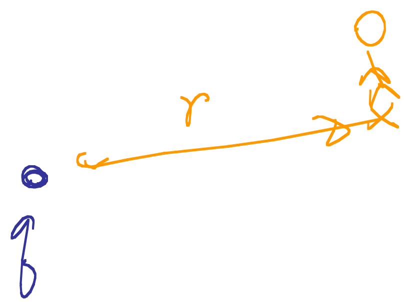
$$\Delta V = \frac{2\left(9.0\times 10^{9}\ \frac{Nm^2}{C^2}\right)\left(-62\times 10^{-9}\ \frac{C}{m}\right)}{} \ln\left(\frac{1.0\ mm}{0.80\ cm}\right)$$

$$= 2.3\times 10^{3}\ \frac{N m^2 C}{C^2 m}$$

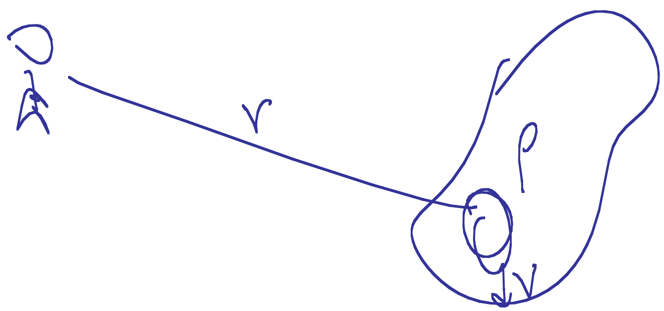
$$\simeq \boxed{2.3\ kV}$$

$$\frac{Nm}{C} = \frac{J}{C} = \text{Volt}$$

> 2 kV Won't work!



$$V = k\frac{q}{r}$$

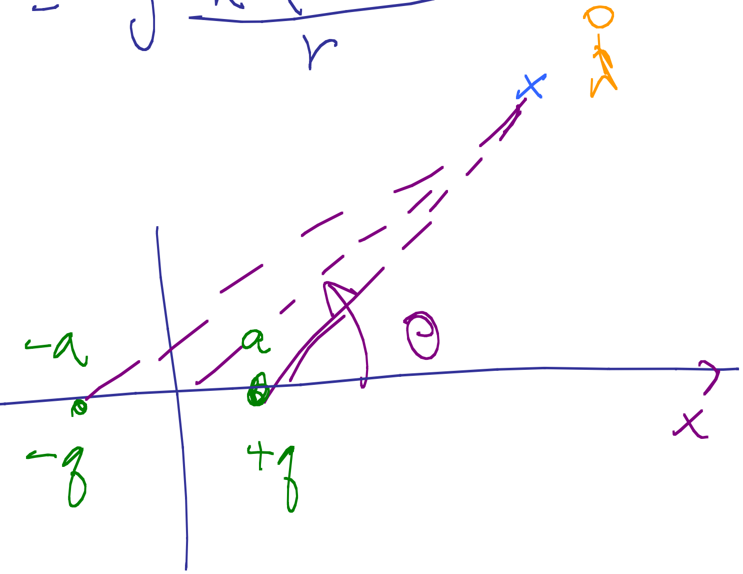


$$V = \int \frac{k\,\rho(\vec{r})\,d^3r}{r}$$

See examples p. 378

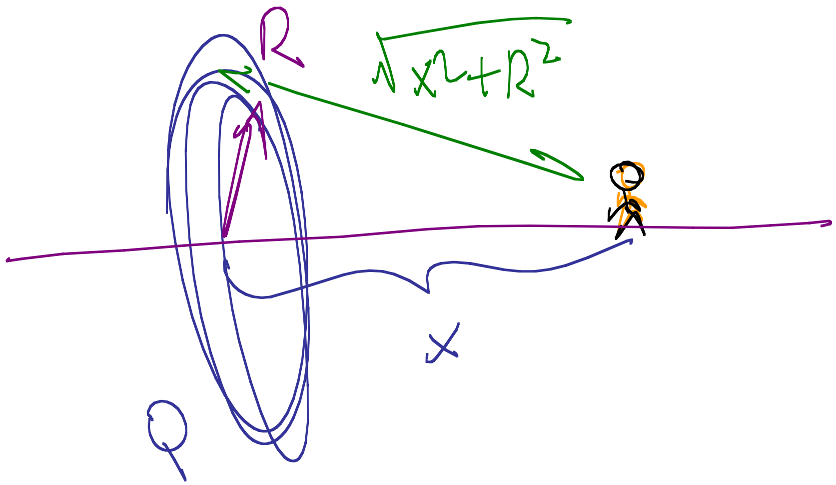
Derives

$$V \simeq \frac{k\,p\cos\theta}{r^2}$$



$$p = 2qa$$

Aug



$$V = \frac{kQ}{\sqrt{x^2+R^2}}$$

Interesting math facts on V, $\vec{E}$

$$V = -\int_A^B \vec{E} \cdot d\vec{r}$$

$$\Rightarrow \quad E_x = -\frac{\partial V}{\partial x} \quad E_y = -\frac{\partial V}{\partial y} \quad E_z = -\frac{\partial V}{\partial z}$$

$$\vec{E} = -\nabla V = -\frac{\partial V}{\partial x}\hat{i} - \dots$$

Also follows

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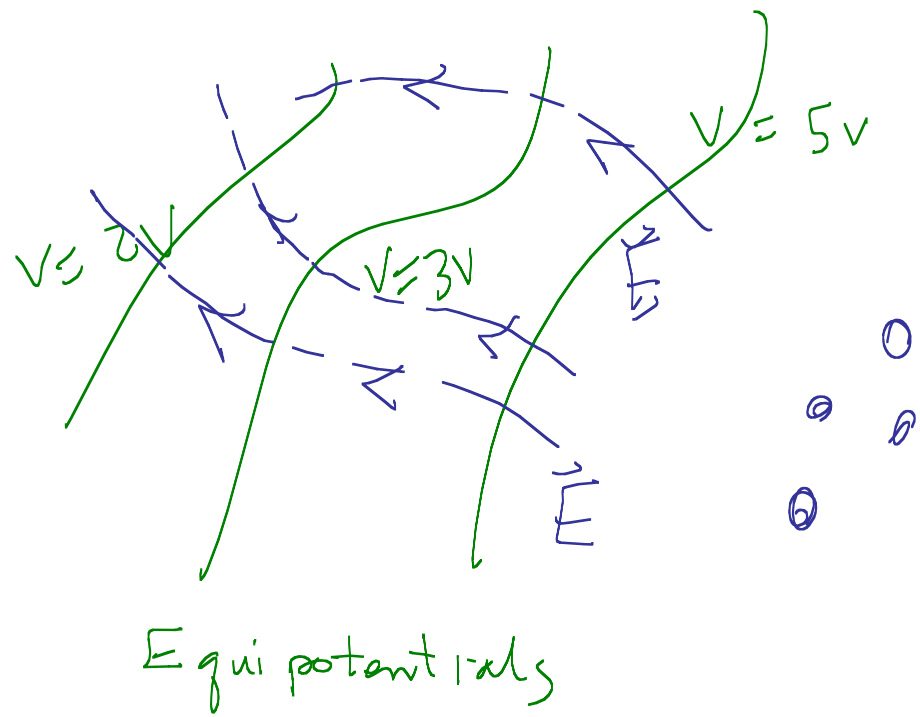
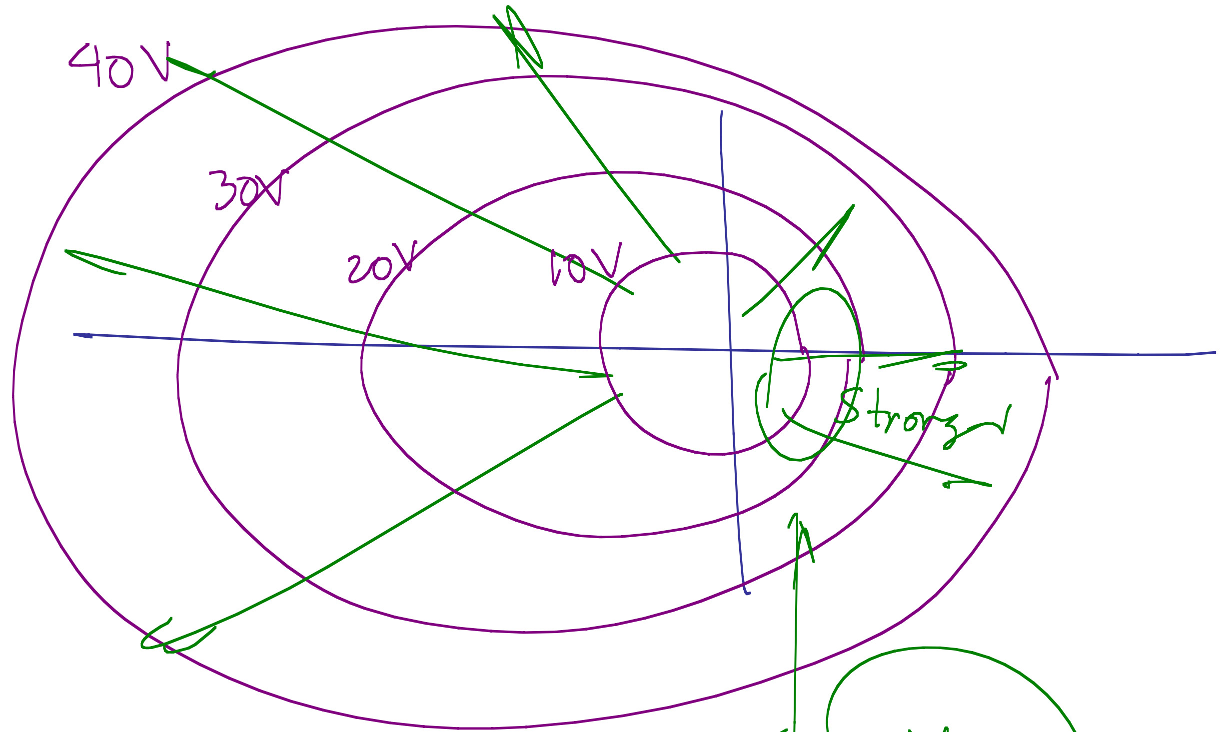
Field lines ($\vec{E}$) perpendicular to equipotentials



22.30

a) In what region is field strongest

$$E_x = \frac{\partial V}{\partial x}$$

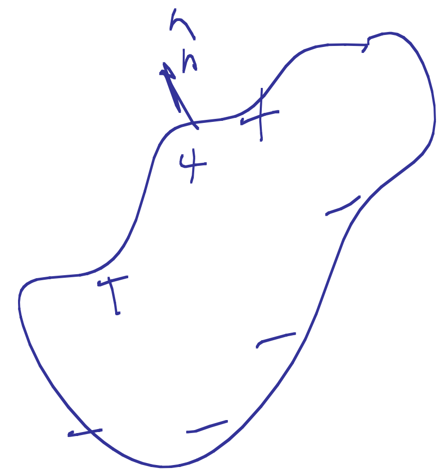


b) Magnitude of field in this region

$$-\frac{\Delta V}{\Delta x}$$

Conductor

$$\vec{E} = \frac{\sigma}{\epsilon_0}\hat{n}$$



Inside, $\vec{E} = 0$

$$\Delta V = \int \vec{E}\cdot d\vec{l} = 0$$ inside.

$$V = \text{constant}$$

Dipole:

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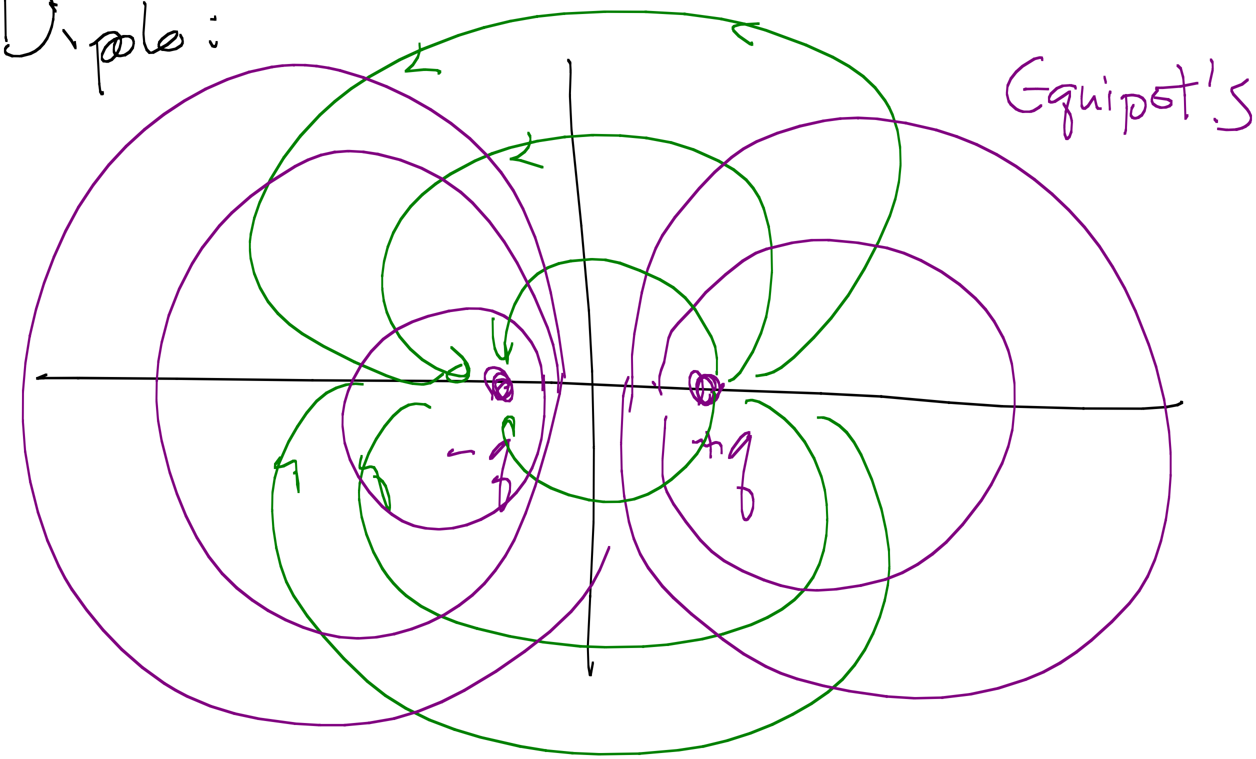

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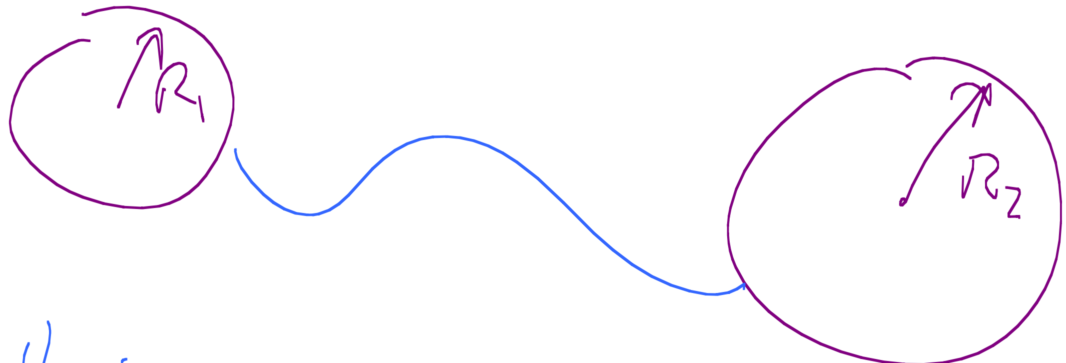
Example



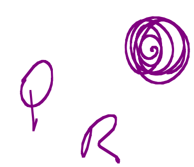
charged

Connects w/ wire

$\Rightarrow$ Everything at same pot'l

$$k\frac{Q_1}{R_1} = k\frac{Q_2}{R_2} \qquad \sigma = \frac{Q}{4\pi R^2}$$

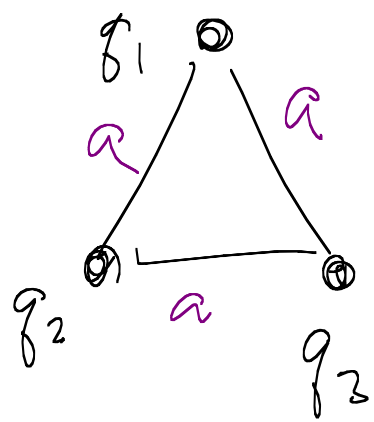
$$\Rightarrow \sigma_1/\sigma_2 = R_2/R_1$$



surf $= V = \frac{kQ}{R}$

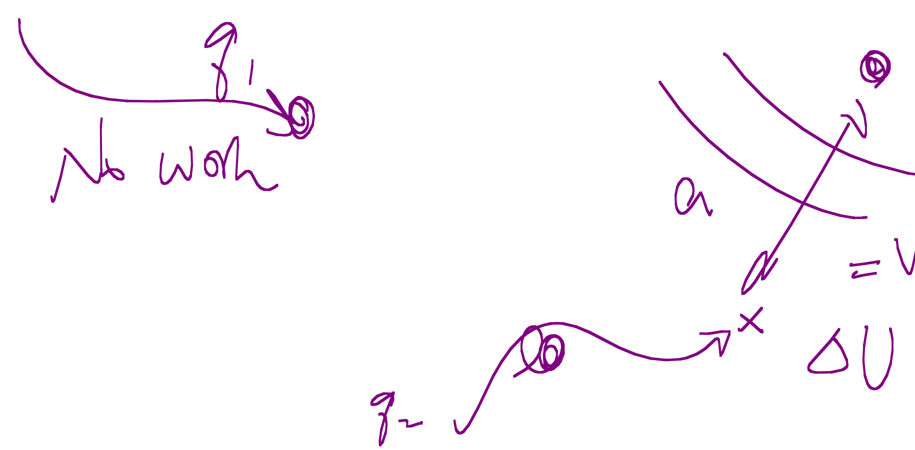
$\Delta U = q\,\Delta V$ Calc'd V.

Chap 23 Capacitor Storage of Electrostatic Energy



Work req'd to construct this

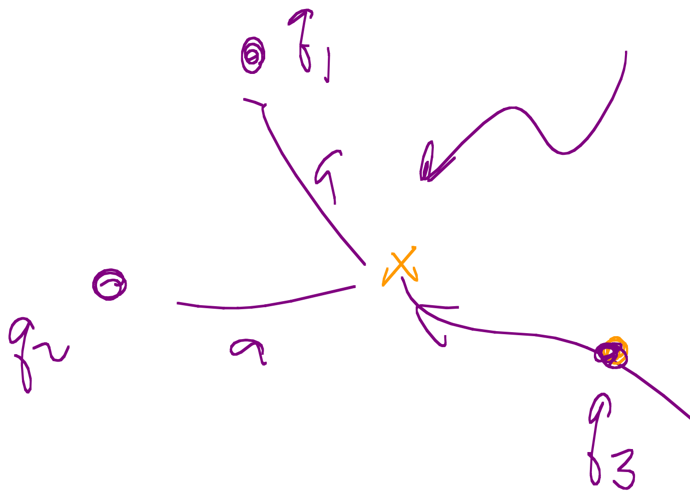
No work



$V = \frac{kq_1}{r}$

$= W_2$

$\Delta U = \frac{kq_1}{a} q_2$



$$V = k\frac{q_1}{a} + k\frac{q_2}{a}$$

$$\Delta U = W_3 = k\frac{q_1 q_3}{a} + k\frac{q_2 q_3}{a}$$

$$W_{Total} = W_2 + W_3$$

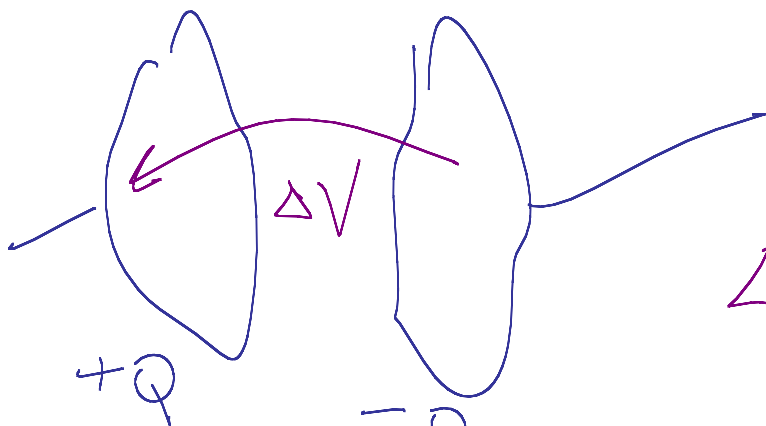
$$= k\frac{q_1 q_2}{a} + k\frac{q_2 q_3}{a} + k\frac{q_1 q_3}{a}$$

(Sum over pairs of chgs divide by distance

$$\sum_{\substack{i \neq j \\ \text{once}}} k\frac{q_i q_j}{r_{ij}}$$

Capacitor

Two pieces of metal sep'd from each other.



charge on capacitor "Q"

$\Delta V \longrightarrow V$

Parallel Plates:

$\sigma = Q/A$ $\qquad$ $\sigma = \frac{-Q}{A}$

$$E_{\text{inside}} = \frac{Q}{\epsilon_0 A} = \frac{\sigma}{\epsilon_0}$$

$$V = -\int_0^d E_x \, dx = \frac{Q}{\epsilon_0 A} \cdot d$$