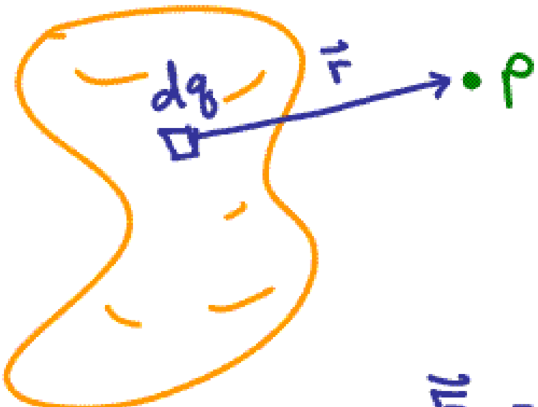
Physics 142 - September 25, 2008

- P142 exam 1 0800-0920 Oct. 7
  in B+L 109

Last Time

$$V_p = \int \frac{k\,dq}{r}$$



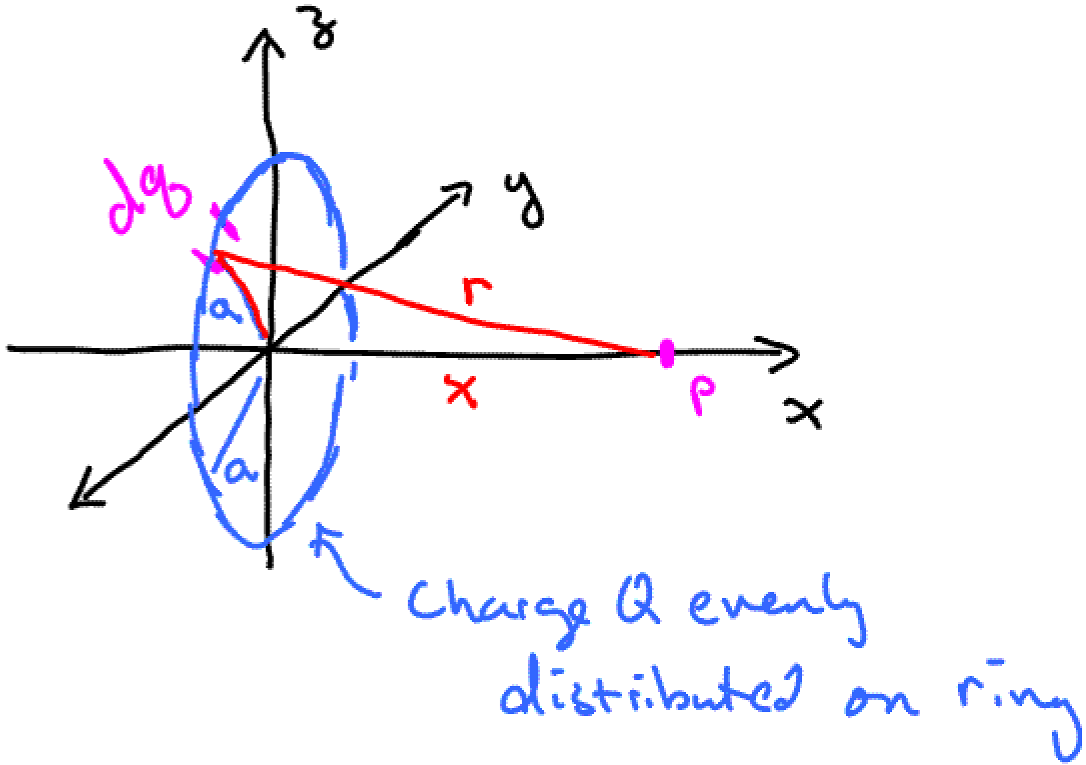
Scalar

~ Simple to calculate

$$\vec{E} = -\vec{\nabla} V$$

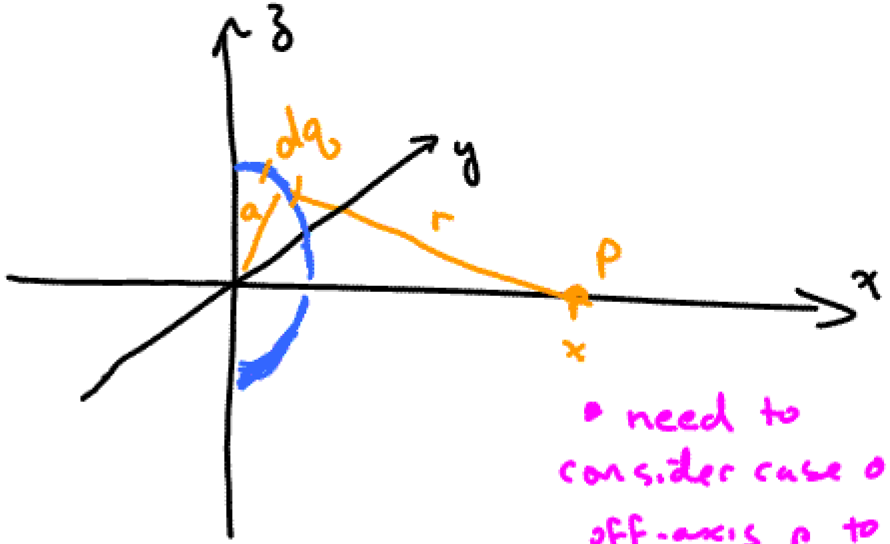
$$\vec{E}(x,y,z) = -\frac{\partial V}{\partial x}\hat{i} - \frac{\partial V}{\partial y}\hat{j} - \frac{\partial V}{\partial z}\hat{k}$$

$$E_s = -\frac{dV}{ds}$$



$$V_P = \frac{kQ}{(a^2+x^2)^{1/2}}$$

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



Was asked at end of class last time about what happens if we have a semicircle of charge

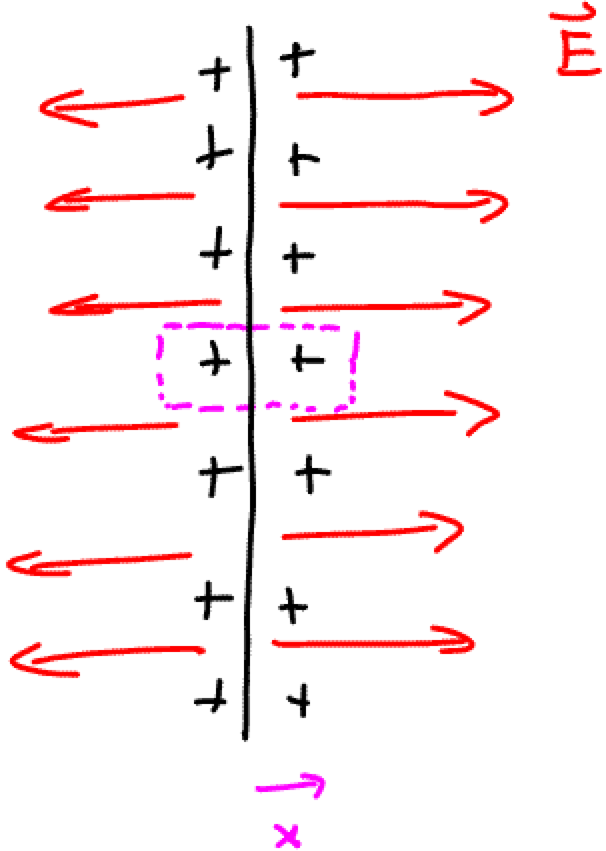
• need to consider case of off-axis p to bring in the z and y dependence

on Axis

$$V_p = \int \frac{k\,dq}{r} \sim \frac{kQ}{(a^2+x^2)^{1/2}}$$

$$E_p = -\nabla V_p = \frac{kQx}{(a^2+x^2)^{3/2}}\,\hat{x}$$

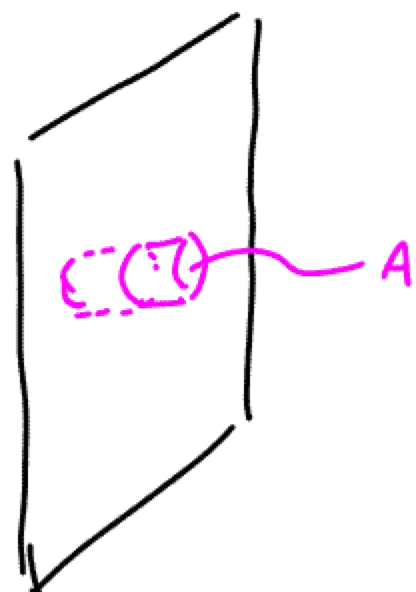
$$\frac{\partial V_p}{\partial x} \qquad \frac{\partial V_p}{\partial y} \qquad \frac{\partial V_p}{\partial z}$$



∞ sheet

uniform chg. density

$\sigma \sim \text{Coul}/m^2$



what is $\vec{E}$ as fn of σ?

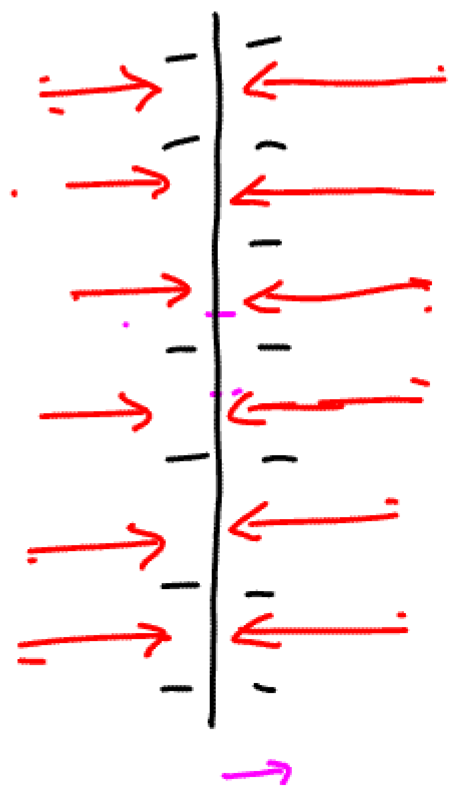
$$\oint \vec{E} \cdot dA = \frac{Q_{encl}}{\epsilon_0}$$

$$\oint \vec{E} \cdot \vec{dA} = \overset{0,\ \vec{E}\cdot dA = 0}{\cancel{\int_{pipe}}} + \underbrace{\int_{endcap\,1} + \int_{endcap\,2}}_{2|\vec{E}|A}$$

$$2|\vec{E}|A = \frac{\sigma A}{\epsilon_0}$$

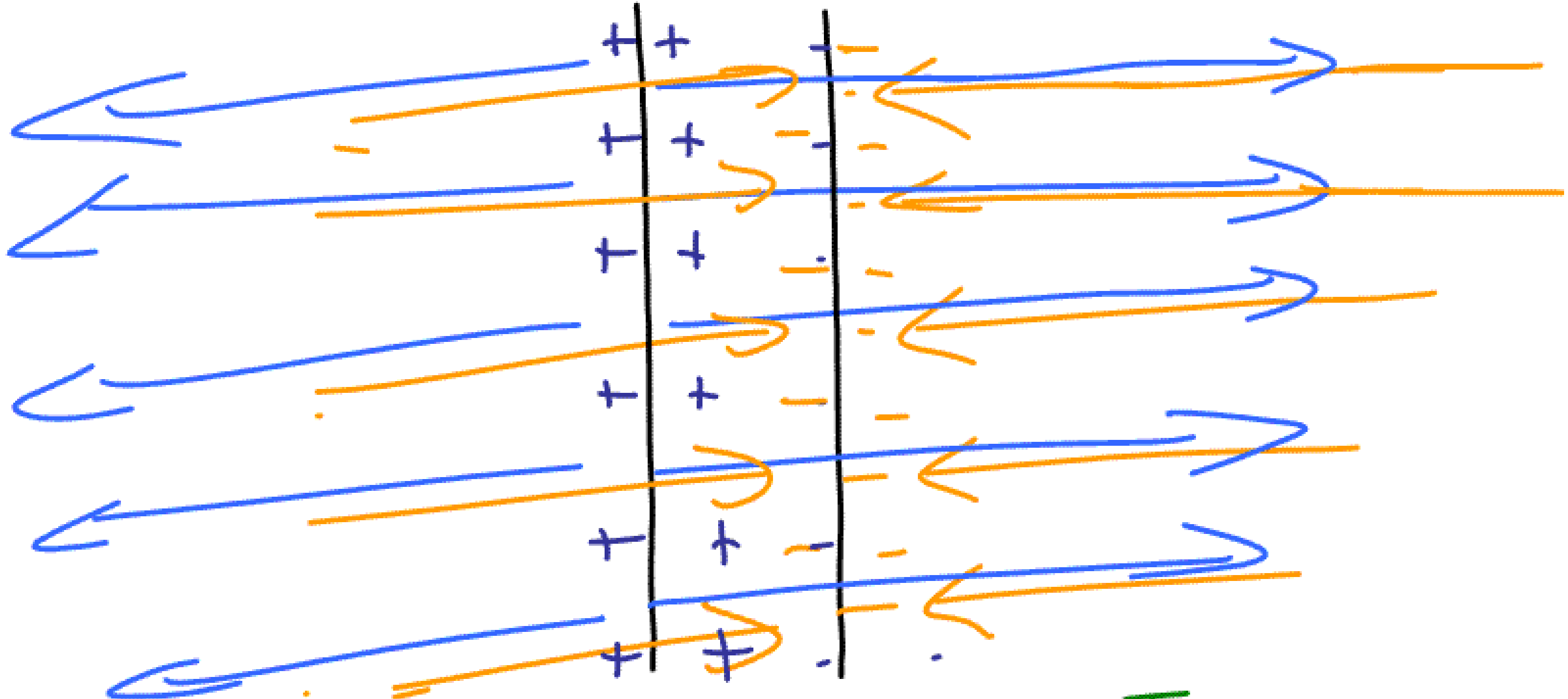
Q_{encl}

$$|\vec{E}| = \frac{\sigma}{2\epsilon_0}$$



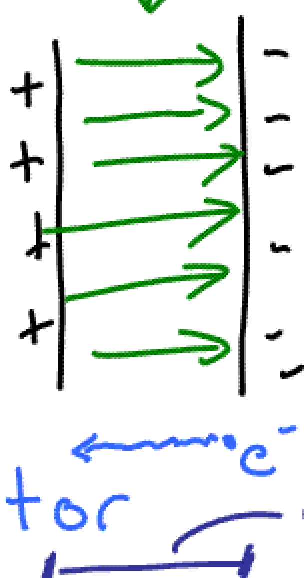
Again

$$|\vec{E}| = \frac{\sigma}{2\epsilon_0}$$



$$|\vec{E}| = \sigma / \epsilon_0$$

$\vec{E} = 0$



$|\vec{E}| = 0$

e^-

Parallel plate capacitor

distance d

$$V_{\substack{\text{between}\\ \text{plates}}} = -\int \vec{E}\cdot d\vec{s} = -|E|\, d$$

$$\frac{W}{q} \quad \frac{F\cdot ds}{q}$$

$$|\Delta V| = \frac{\sigma}{\epsilon_0} d$$

if $\Delta V = 1$ volt

e^- goes from "$-$" plate to "$+$" plate

$$KE_{e^-} = q_e V = eV$$

unit of energy $\equiv$ eV 1 electron-Volt of energy/work to move e^- from 1 plate to other

$$1\ eV = (|e|)(1\ \text{volt}) = 1.6\times10^{-19}\ \text{Coul}\cdot1\text{volt}$$

$$= 1.6\times10^{-19}\ \text{Joules}$$

$$E = mc^2$$

eV

$\frac{eV}{c^2}$ is a unit of Mass

$\frac{MeV}{c^2}$

Not the same "c"

each sphere has radius R

Far Apart

$$V_+ = \frac{kQ}{R}$$ $V_+ \propto Q$

$$V_{\pm} = V_+ - V_- = \frac{2kQ}{R}$$

$V_{\pm} \propto Q$

$V_- \propto Q$

$$V_- = -\frac{kQ}{R}$$

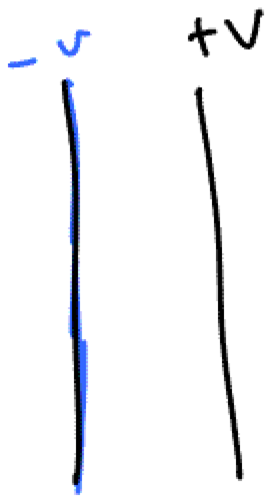
define capacitance as the constant of proportionality

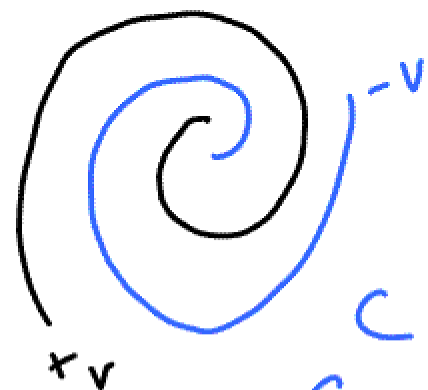
$$Q_+ = C_+ V_+ \qquad Q_- = C_- V_-$$

$$Q = C_{+-} V_{+-}$$

capacitance depends only on geometry

Capacitance quantifies how much charge a system can hold at a given potential difference





C calorie

C heat capacity

C coulomb

C speed of light

$$\boxed{Q = CV}$$

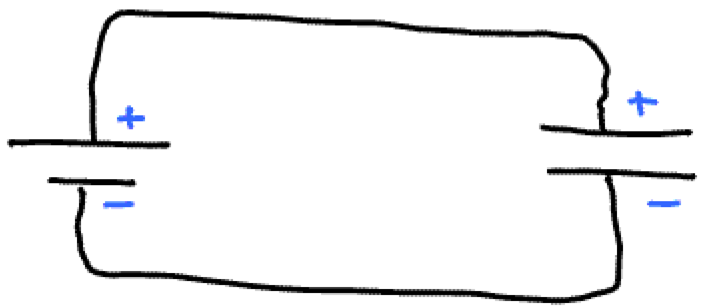
Capacitance, C · Units Farads

Capacitance is a measure of potentential diff for given charge in system

our first circuit

$\mathcal{E}$

battery



) capacitor

$$Q = CV$$
$$= C\mathcal{E}$$

Capacitors act as resevoirs of charge

$\mathcal{E}$ maintains a potential diff across terminals

EMF ≡ Electromotive force