Physics 142 - September 28, 2010

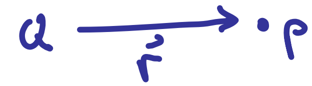
- Exam 1
- Thursday Oct. 7 0800 - 0930
- Location - TBA
- Old exams on web (need to post 2008)
- Index card of formulas (Front + Back)
- Formula sheet included
- Will be thru material in
  Prob Set 4
  Workshop 3

No Topological enhancements

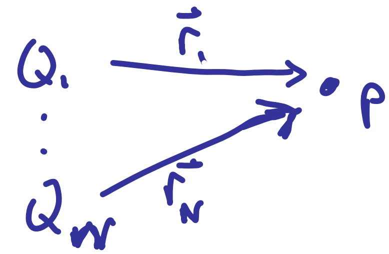
- Prob sets - To be handed back soon

Last Time

$$V_P = \frac{kQ}{r}$$



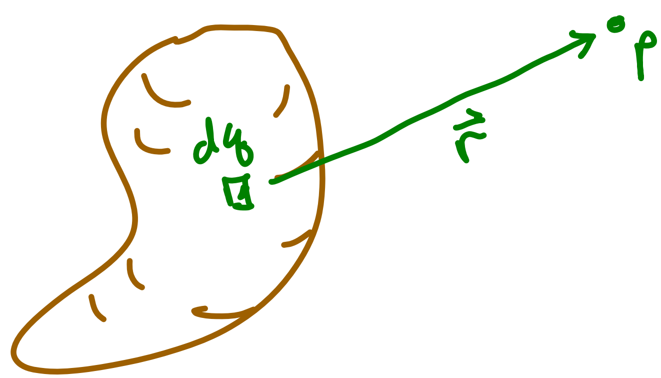
$$V_P = \sum_{i=1}^{N} \frac{kQ_i}{r_i}$$



$$V_P = \int_{volume} \frac{k\,dQ}{r} = \int_{volume} \frac{k\rho\,dV}{r}$$

V for potential

V for volume



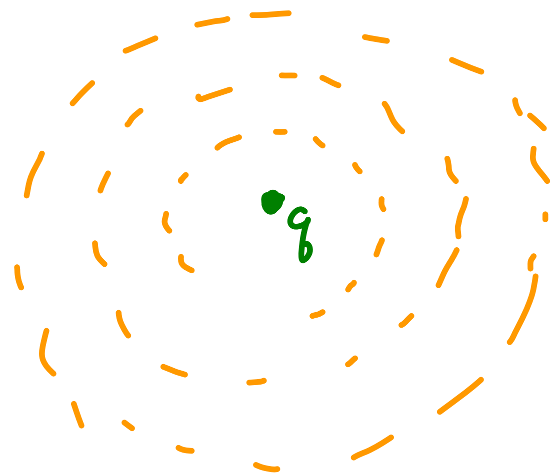
$$E_s = -\frac{dV}{ds}$$

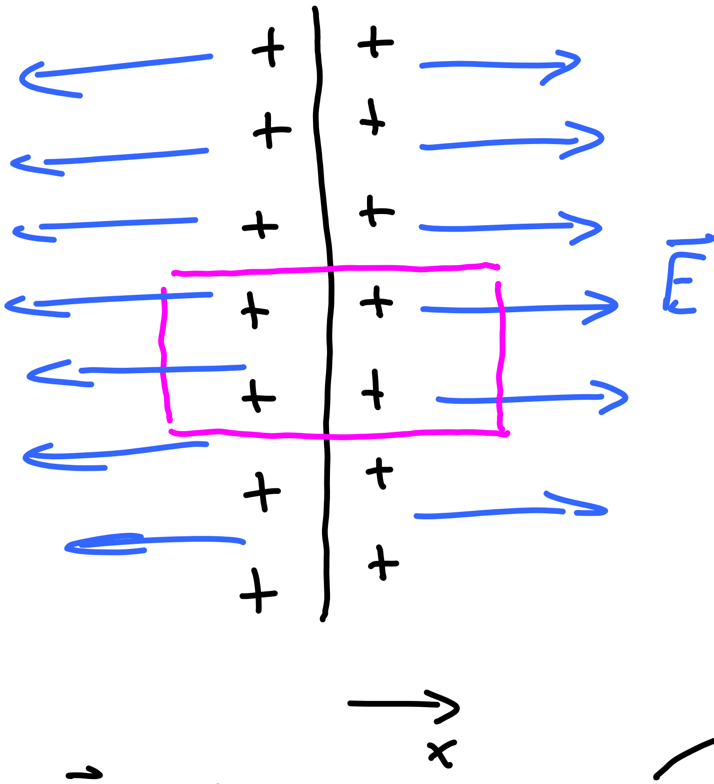
$$\vec{E} = -\vec{\nabla} V = -\frac{\partial V}{\partial x}\hat{i} - \frac{\partial V}{\partial y}\hat{j} - \frac{\partial V}{\partial z}\hat{k}$$

$$\vec{\nabla} \equiv \left(\frac{\partial}{\partial x}\right)\hat{i} + \left(\frac{\partial}{\partial y}\right)\hat{j} + \left(\frac{\partial}{\partial z}\right)\hat{k}$$

Equipotential lines

$\perp$ to $\vec{E}$



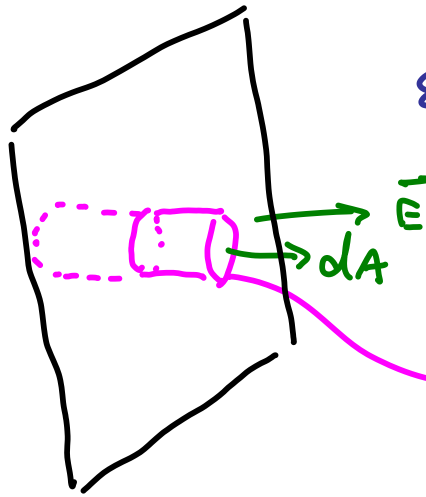


∞ Sheet

Uniform charge density $\equiv \sigma$

$$\sigma \sim \frac{\text{coul}}{m^2} = \frac{C}{m^2}$$

What is $\vec{E}(x)$ as a function of σ



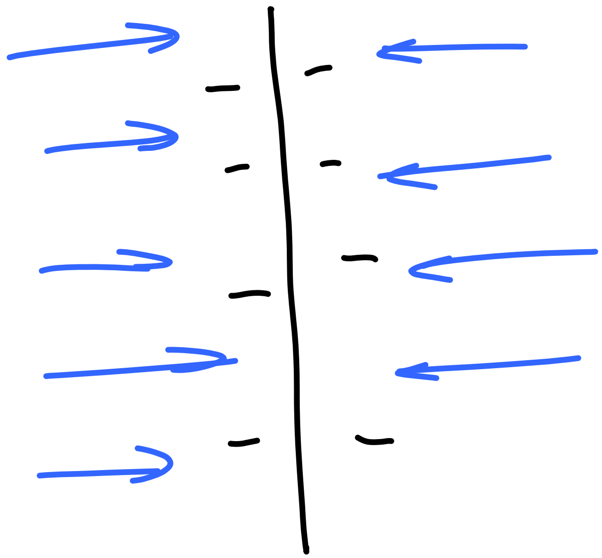
Endcaps // to plane

Endcaps have Area A

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

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

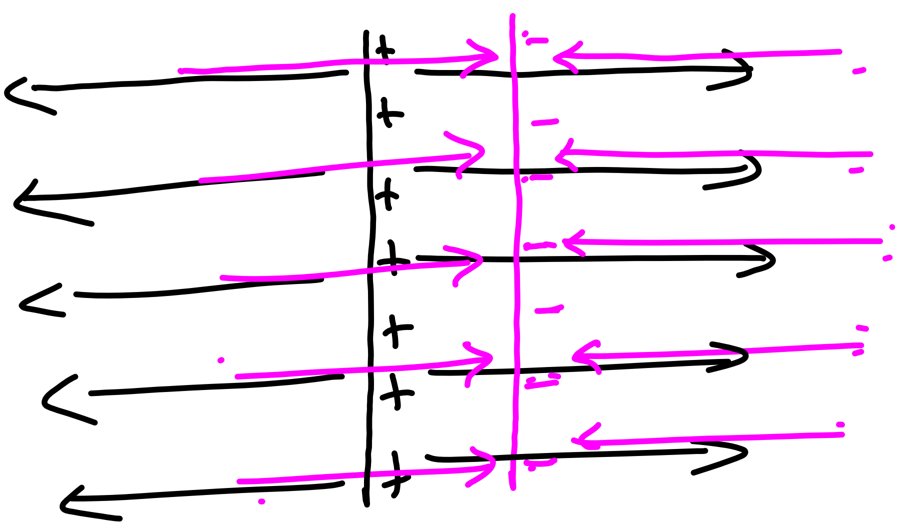
$$\boxed{|E| = \sigma / 2\epsilon_0}$$

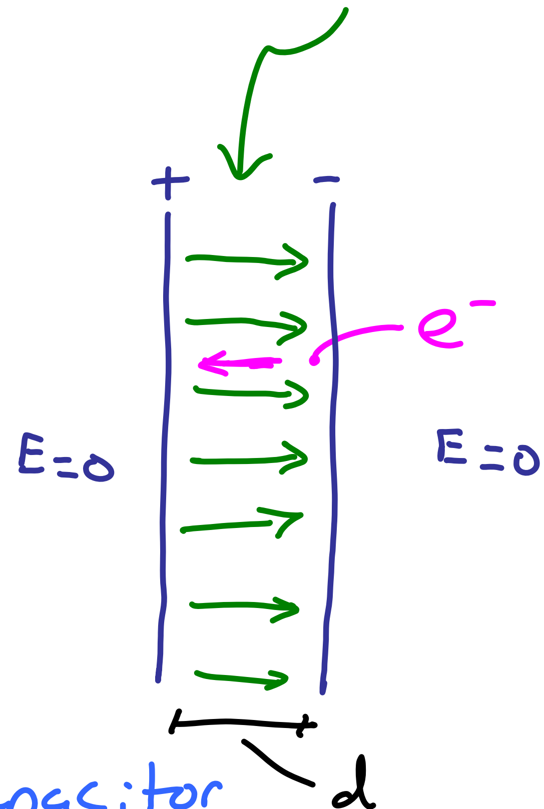


σ is negative

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

$|E| = \sigma / \epsilon_0$





// plate capacitor

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

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

Energy $= qV$

let $|V| = 1$ volt

KE of e^- is 1 electron-Volt $= 1\,eV$

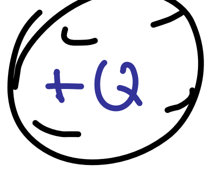
$$1\,eV = (1\,|e|)(1\text{ volt}) = 1.6\times10^{-19}\,C\ \underbrace{\text{Coul}\cdot 1\text{ volt}}_{\text{Joules}}$$

C · are not the same

$$E = mc^2$$

$$\frac{eV}{c^2} \equiv \text{unit of Mass}$$

2 spheres
each w/ Radius R
One w/ +Q
one w/ −Q



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

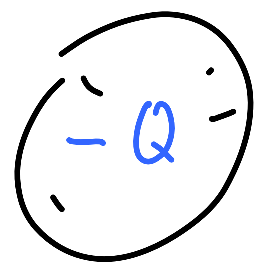
$$V_+ \propto Q$$

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

$$V_\pm \propto Q$$

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

$$V_- \propto Q$$



Capacitance is the const of proportionality

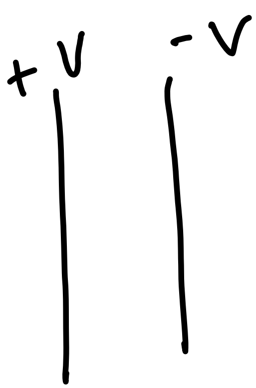
$V \propto Q$ depend on geometry

$Q_+ = C_+ V_+$ $Q_- = C_- V_-$

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

$$\boxed{Q = CV}$$

Cap. quantifies how much charge a system holds at given potential difference



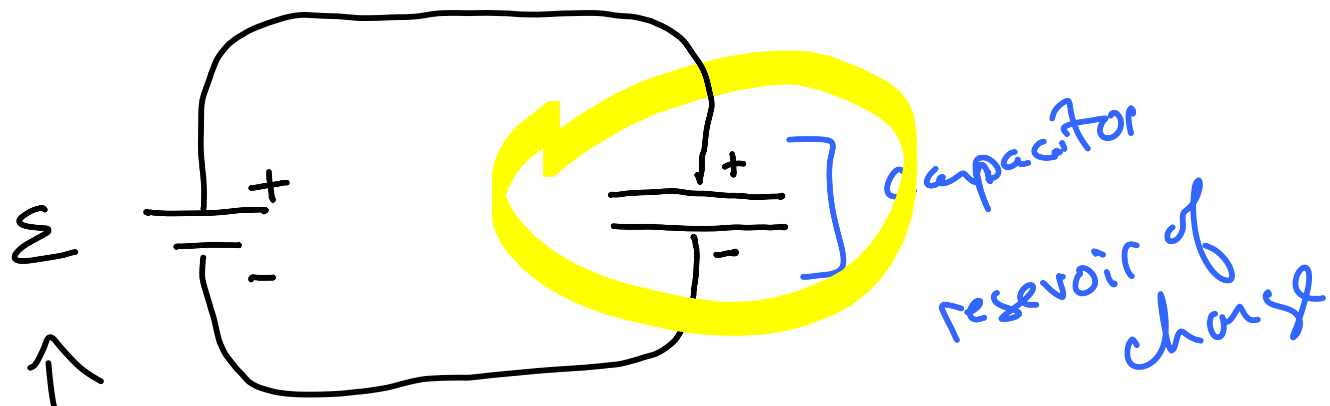
C calorie

C heat capacity

C coulomb

C speed of light

C , Capacitance → Farads

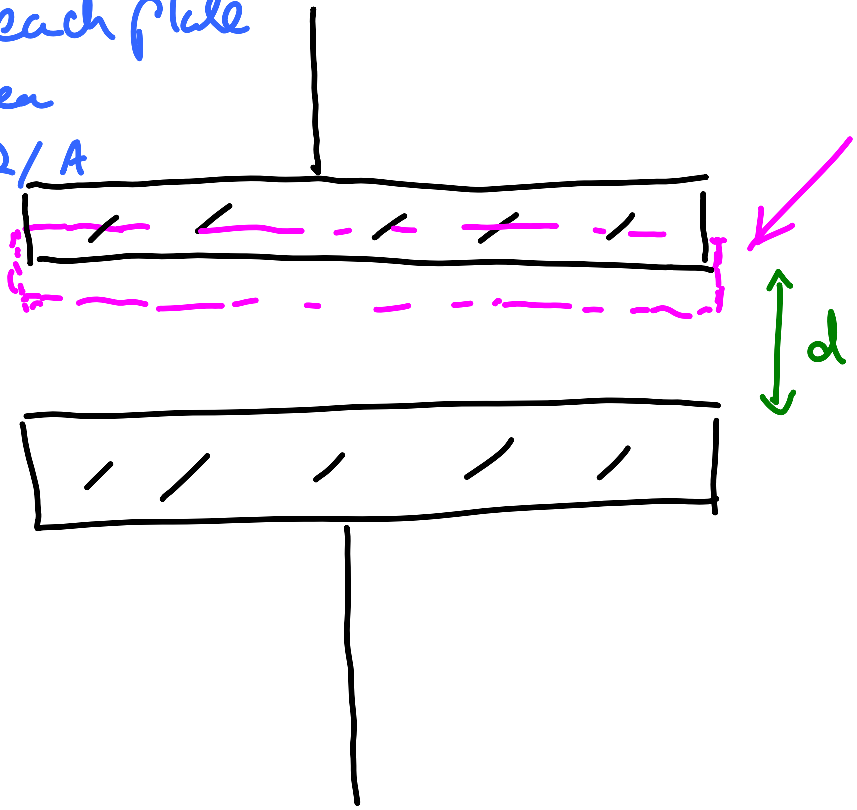


EMF = maintains a const pot. diff between its terminals

Q on each plate

A Area

$\sigma = Q/A$



gaussian surface

$\oint \vec{E}\cdot d\vec{A} = |E|\,A$

Find expression for capacitance

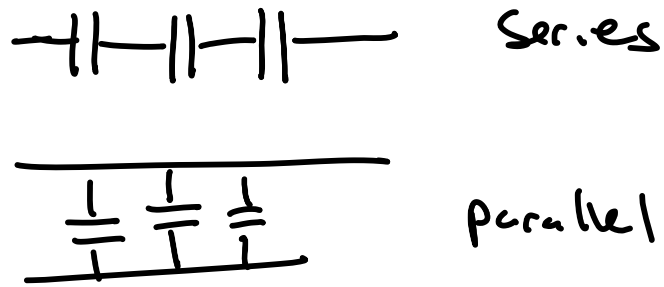
$$\oint \vec{E}\cdot d\vec{A} = \frac{Q_{enc}}{\epsilon_0} \qquad |E|\,A = \frac{\sigma A}{\epsilon_0}$$

$$V = Ed$$

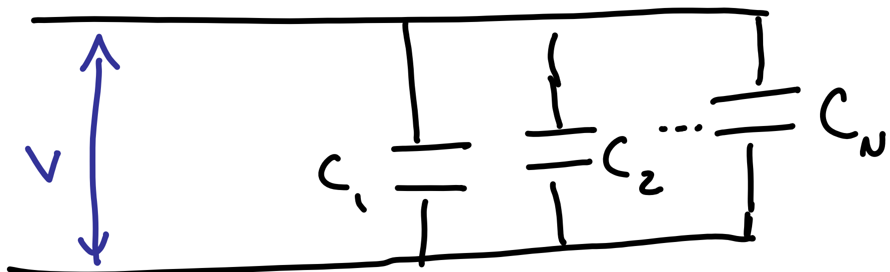
geometry

$$C \equiv \frac{Q}{V} = \frac{\sigma A}{Ed} = \frac{\sigma A}{\frac{\sigma}{\epsilon_0} d} = \underbrace{\frac{\epsilon_0 A}{d}}_{\text{geometry}}$$

Multiple capacitors in Circuit



Parallel



$Q_1 = C_1 V$ $\quad$ $Q_2 = C_2 V$ $\quad$ $Q_N = C_N V$

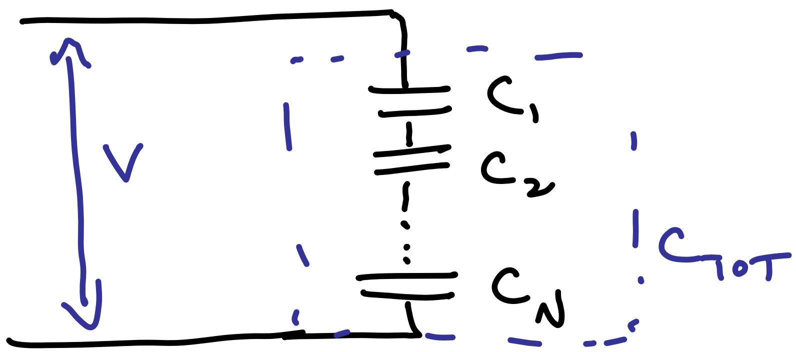
$$Q_{TOT} = Q_1 + Q_2 + Q_3 \cdots + Q_N$$

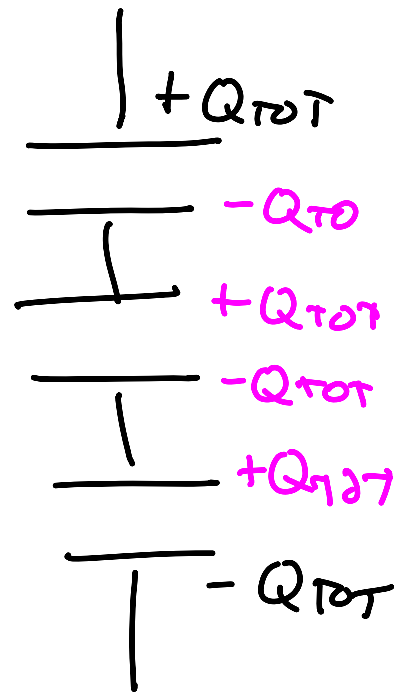
$$C_{TOT} V = C_1 V + C_2 V + \cdots + C_N V$$

$$C_{TOT} = \sum_i C_i$$

Capacitors in parallel

Series





$$Q_{TOT} = C_{TOT} V$$

$$V = V_1 + V_2 \cdots V_N$$

$$\frac{Q_{TOT}}{C_{TOT}} = \frac{Q_{TOT}}{C_1} + \frac{Q_{TOT}}{C_2} + \cdots + \frac{Q_{TOT}}{C_N}$$

$$\frac{1}{C_{TOT}} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots + \frac{1}{C_N}$$

$$\frac{1}{C_{TOT}} = \sum_i \frac{1}{C_i}$$

capacitors in series