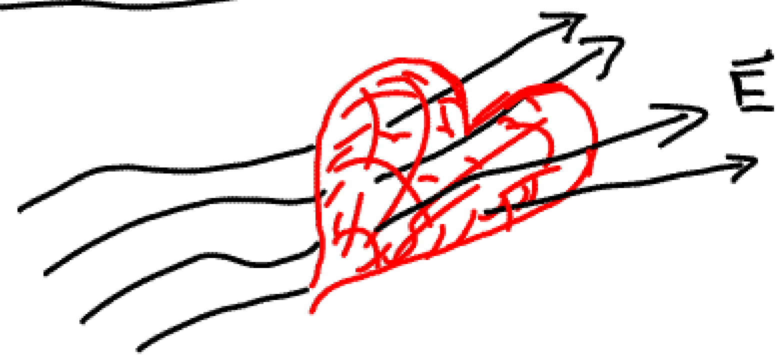
Physics 114 - February 14, 2006



Exam I
in ① week
→ here

questions? issues?

Last Time - Energy + Potential
in Electrostatics

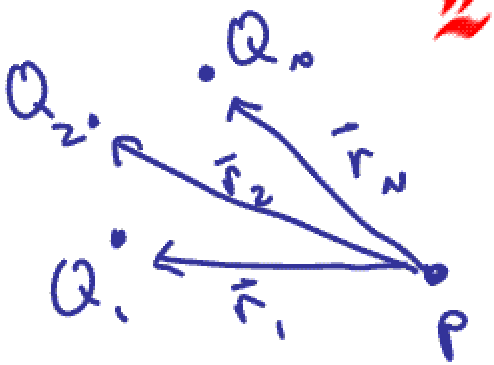
Potential difference $= W/q$

in units of Volts $\equiv J/C$

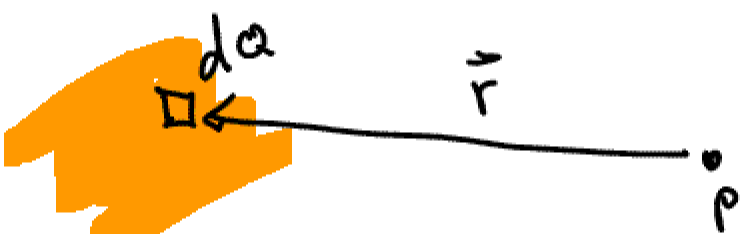
$$V_{\substack{pt\\chg}} = \frac{kQ}{r} \quad \text{where } V \to 0 \text{ at } \infty$$

Potential is a scalar quantity

Important



$$V_p = \sum \frac{kQ_i}{r_i}$$



$$V_p = \int_{vol} \frac{k\,dQ}{r}$$

Electric potential is path independent

Electric force is conservative

$\vec{E} = 0$ in Conductor

→ Conductor is all at same Potential

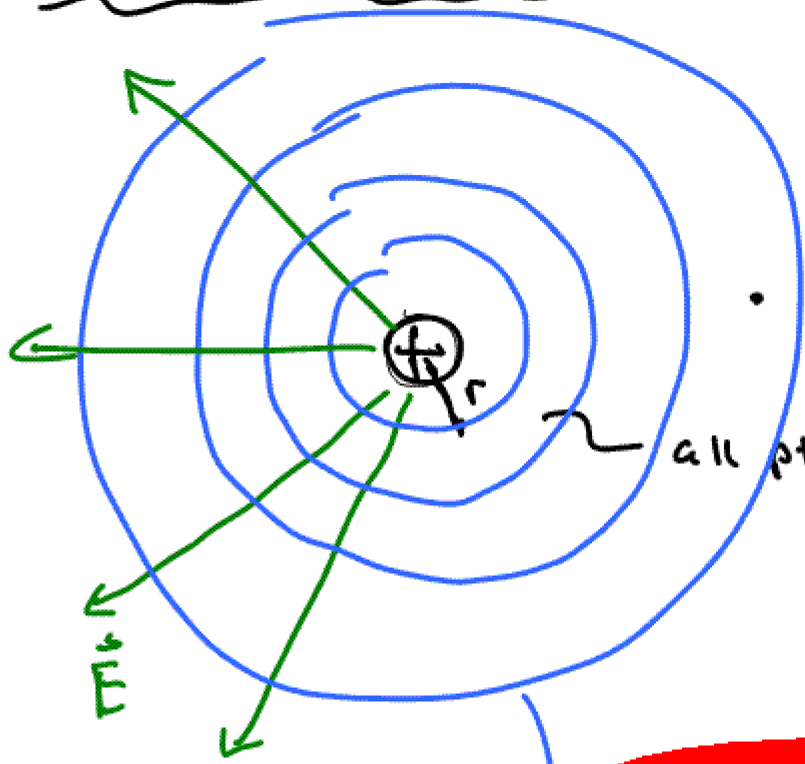
Equipotential

Can Get E from V

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

Equipotential lines

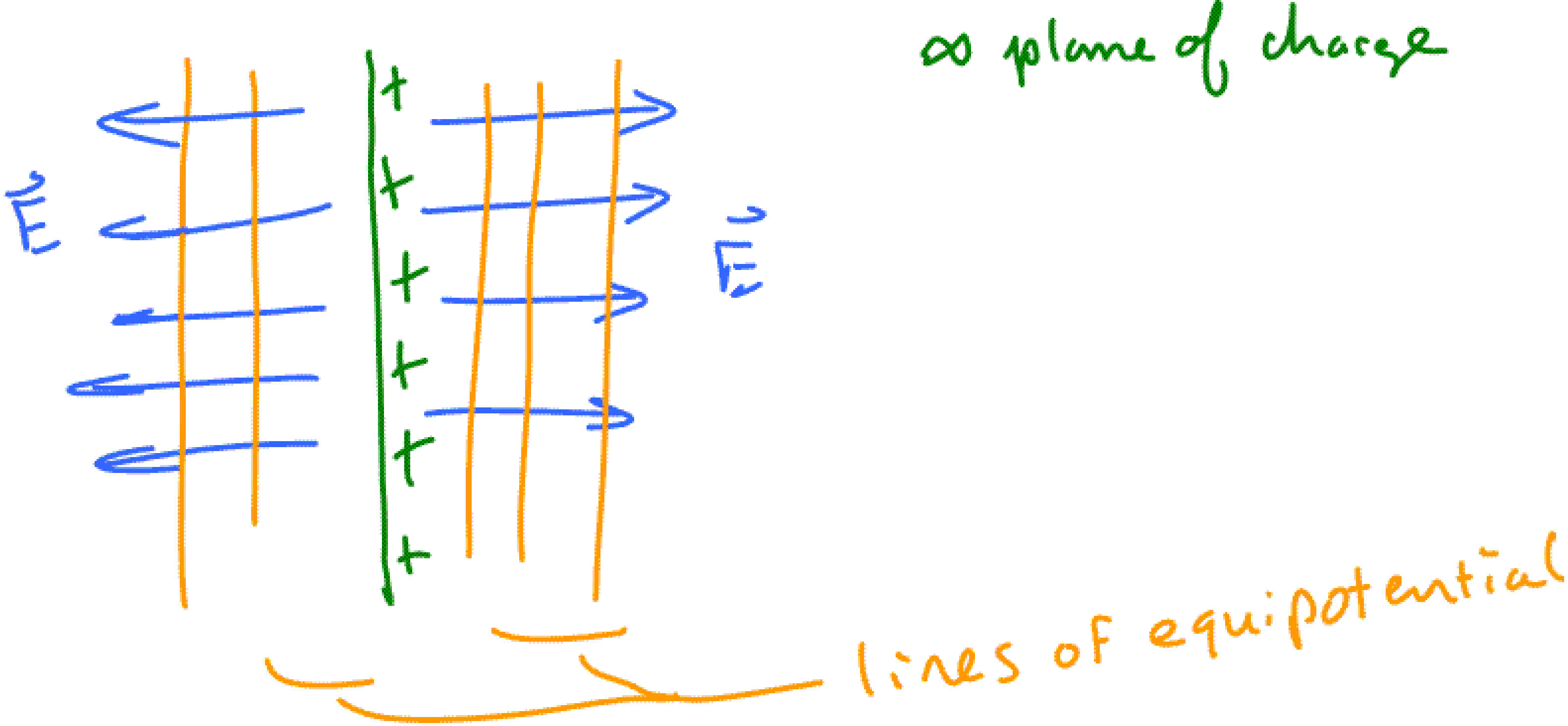
$$V_p = \frac{kQ}{r}$$

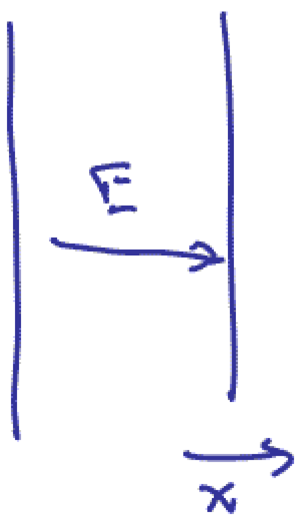


all pts at same r have same potential

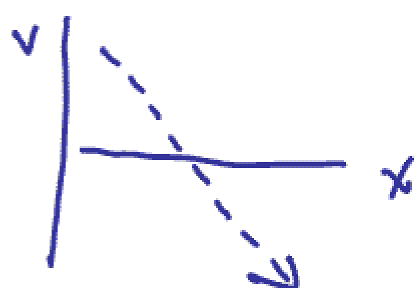
Equipotential lines $\perp$ $\vec{E}$

$E = -dV/dx$

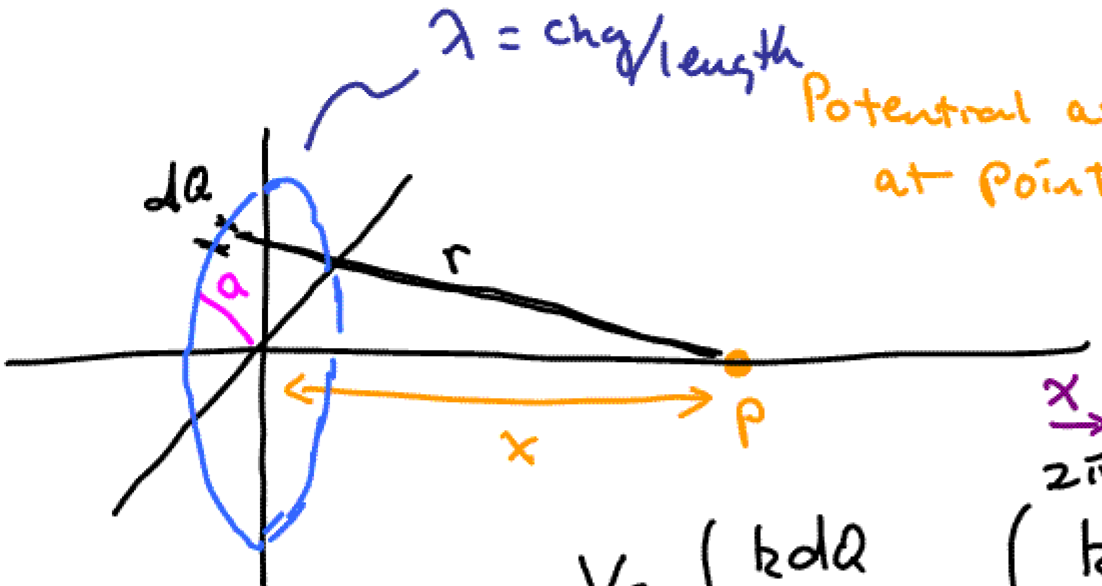




$$E_x = -\frac{dV}{dx}$$



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



Potential at P?
at point x on x-axis

$$dQ = \lambda\,ds$$

$$V = \int \frac{k\,dQ}{r} = \int_0^{2\pi a} \frac{k\,\lambda\,ds}{r}$$

$$V_p = \frac{k\lambda}{\sqrt{x^2+a^2}} \int_0^{2\pi a} ds = \frac{k\lambda\,2\pi a}{\sqrt{x^2+a^2}}$$

$$\frac{dV}{dx} = -k\lambda 2\pi a \, \frac{1}{2}(x^2+a^2)^{-3/2} \, 2x$$

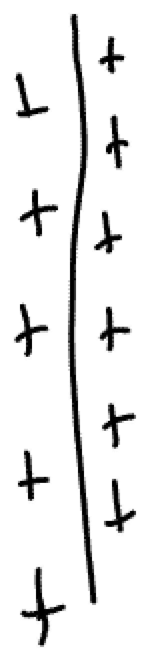
$$E_x = -\frac{dV}{dx} = +\frac{k\lambda 2\pi a \, x}{(x^2+a^2)^{3/2}}$$

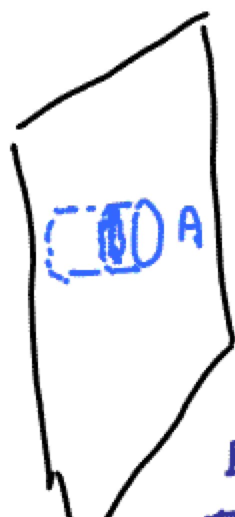
units go as $\frac{kQ}{r^2}$ okay ✓

I dropped this x during lecture — fix your notes

$V_p \qquad x \gg a$

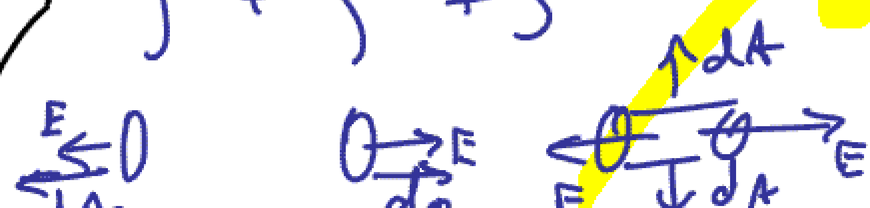
chg density $= \sigma$ a plane





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

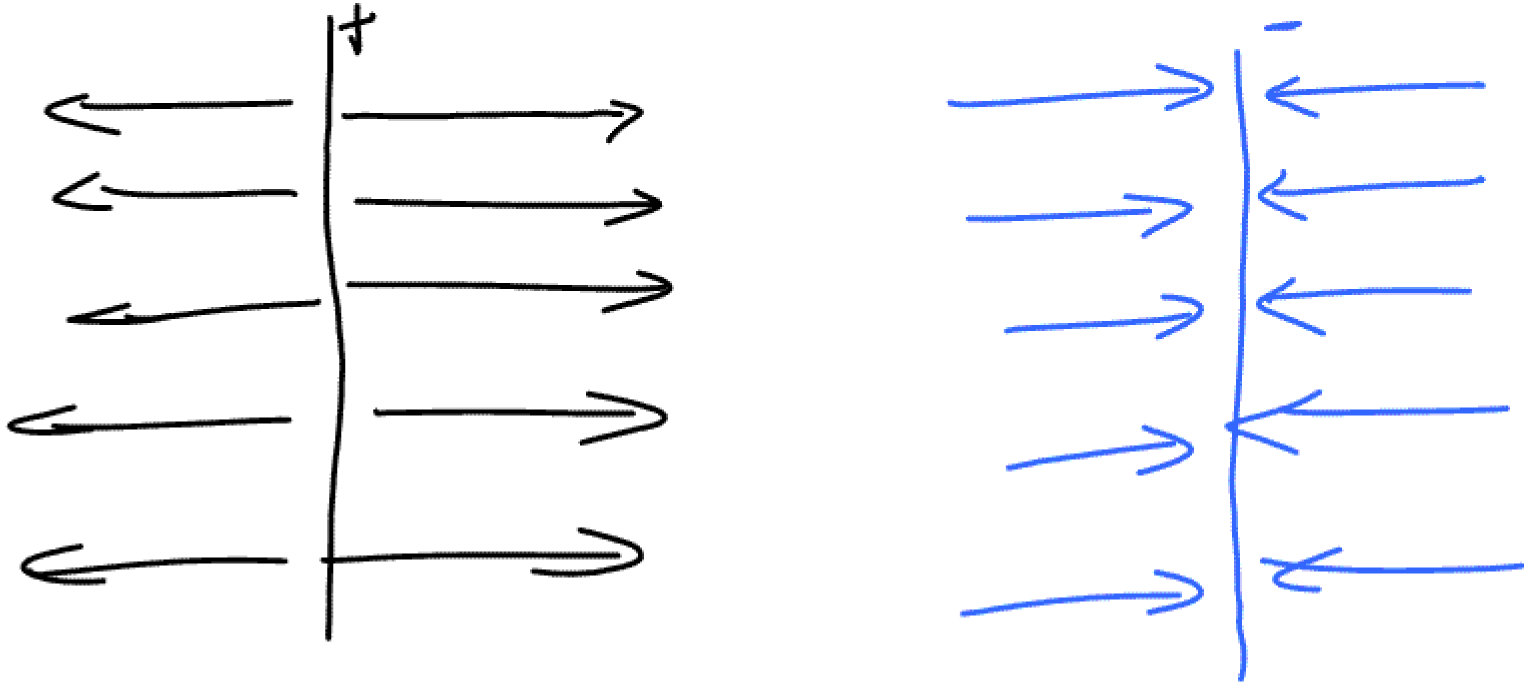
$$\int + \int + \int = 0$$

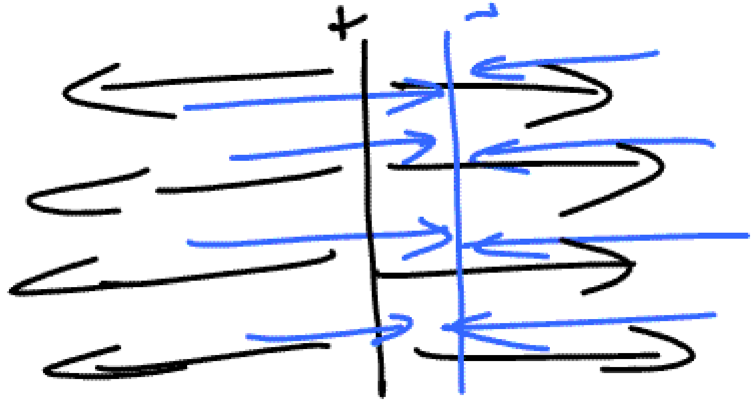


$$\oint E \cdot dA = 2|E|A = \frac{Q_{encl}}{\epsilon_0} = \sigma A$$

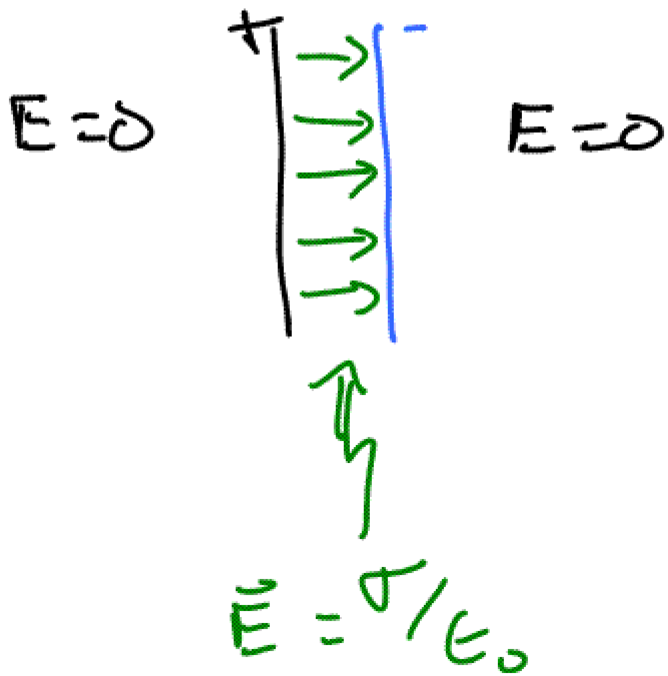
$$2|E|A = \frac{\sigma A}{\epsilon_0}$$

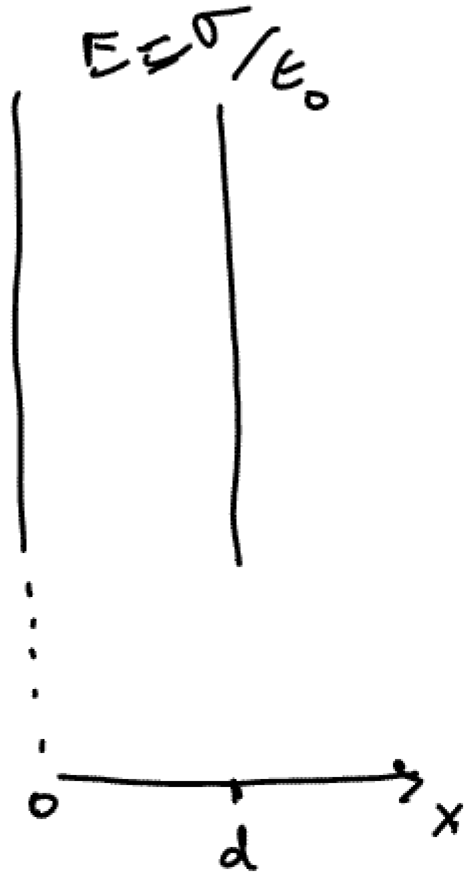
$$|E| = \frac{\sigma}{2\epsilon_0}$$





Parallel plates

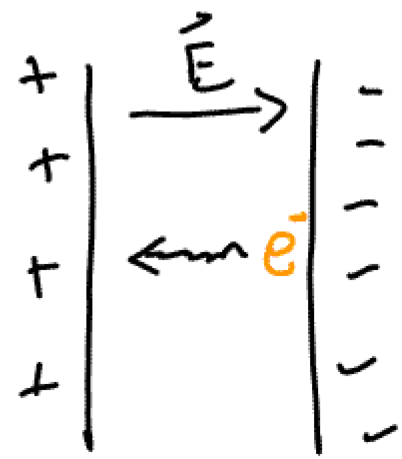




$$V_{\text{bet plates}} = -\int \vec{E} \cdot d\vec{s} = -|E|d$$

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

$\Delta V = 1$ Volt



How much Energy is gained by e^-

Pot diff = work/charge   work $\equiv$ energy

$1\,V = 1$ Joule/Coul $q\Delta V$

$q_{e^-} = -1.6 \times 10^{-19}\,C$ $|q_{e^-}| = |e|$

e^- gains 1 electron-Volt

$1\,eV = 1.6 \times 10^{-19}$ Joules

The electron-Volt is a unit of energy that is convenient to use in Science that involves small #'s of charged particles

→ Atoms, chemistry, nuclear physics