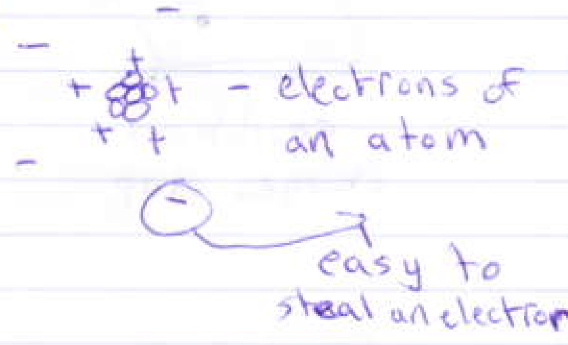
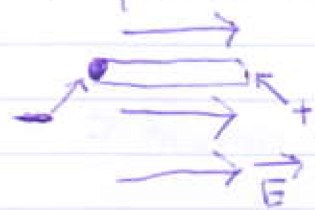
Jorge Vasquez

- Conductors ← materials trough which charge flows easily



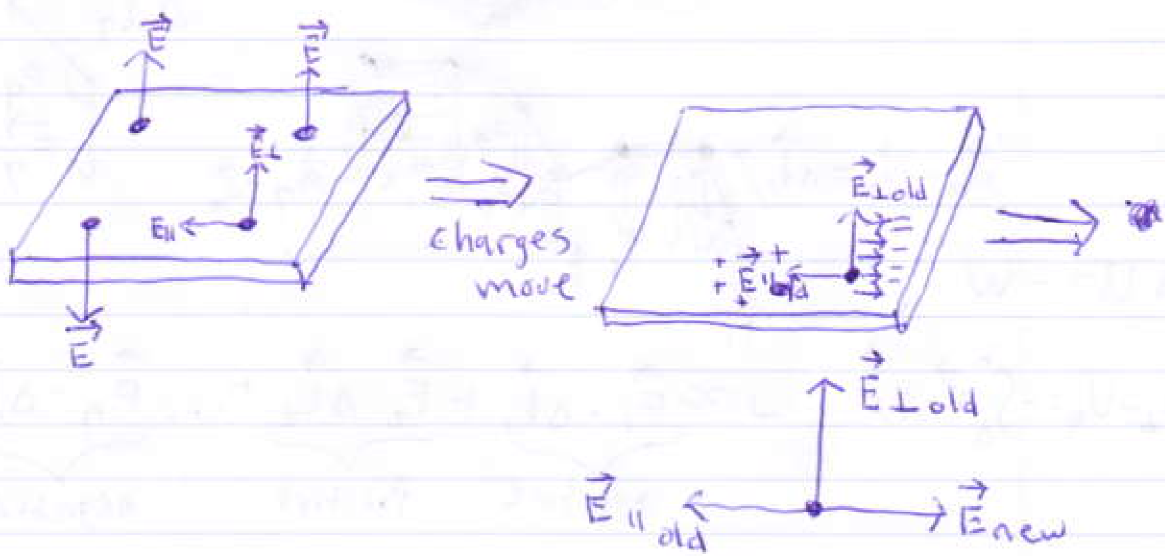
- Ch. 23
  Electric Potential (also on Monday)
  same as voltage

A perfect conductor

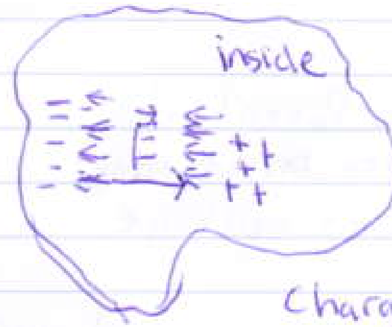


Basic facts about conductors

- $\vec{E}$ at the surface is $\perp$ the surface
- $\vec{E} = \vec{0}$ inside the conductor



equilibrium
charges stop



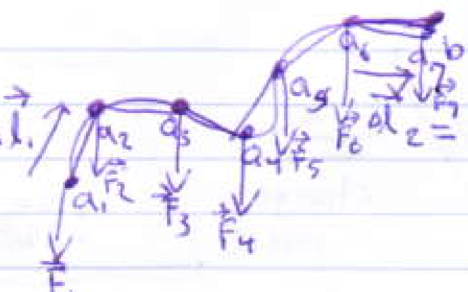
Charges quickly move out to cancel out internal $\vec{E}$

$W = F \cdot d$ for constant F

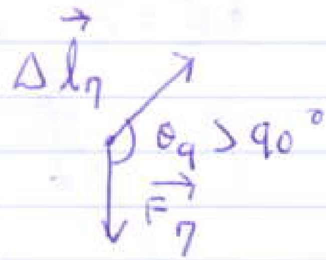
↑ distance along direction of force

$$W = \int_a^b \vec{F} \cdot d\vec{l}$$

$\vec{a}_2 - \vec{a}_1 = \Delta \vec{l}_1$



$\Delta \vec{l}_2 = \vec{a}_7 - \vec{a}_8$



$\Delta U = -W$

$U_b - U_a = -\int_a^b \vec{F} \cdot d\vec{l}$ $\quad W \approx \underbrace{\vec{F}_1 \cdot \Delta \vec{l}_1}_{\text{negative}} + \underbrace{\vec{F}_2 \cdot \Delta \vec{l}_2}_{\text{Positive}} + \ldots \underbrace{\vec{F}_7 \cdot \Delta \vec{l}_7}_{\text{negative}}$

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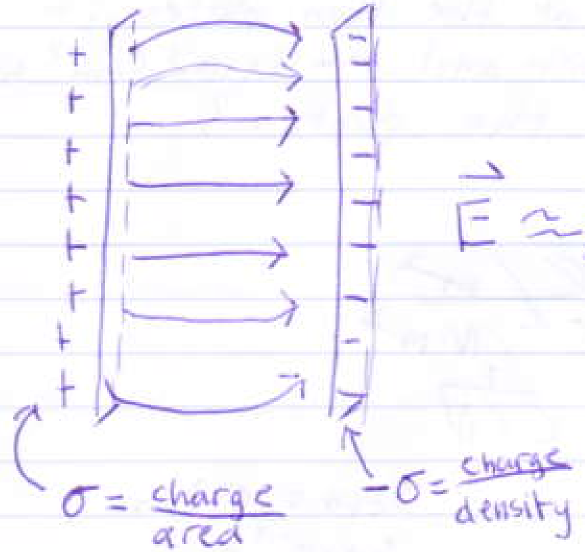
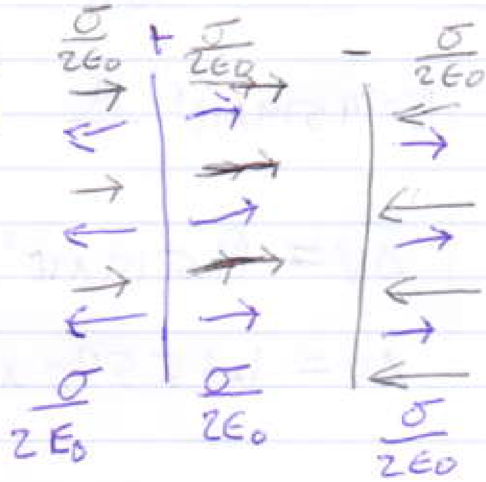


$$\vec{E} \simeq \frac{\sigma}{2\epsilon_0} + \frac{\sigma}{2\epsilon_0} = \frac{\sigma}{\epsilon_0}$$

in the middle



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

$V = \frac{U}{q}$ $U = qV$

if $\vec{F}$ constant

$$\Delta V = \frac{\Delta U}{q} = \frac{-W}{q} = \frac{-Fd}{q} = -Ed$$

$W = -q\Delta V$

unit of voltage is also written V, For volt

1 volt = 1 joule / coulomb = 1 Newton·meter/coulomb

In our example of the two plates, if they ar 3cm apart and $\sigma = 4\times10^{-5}\ C/m^2$ what is ΔV between the plates?

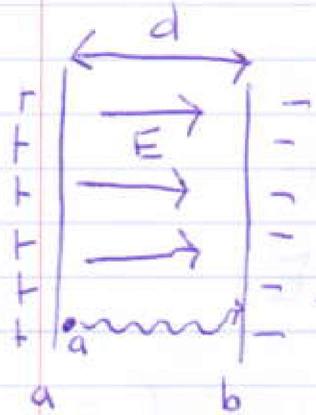
$$E = 4.519\times10^{6}$$

$$E = 4.519\times10^{6}\ \frac{1}{C/N} \qquad \frac{\cancel{C}/\cancel{m^2}}{C^{\cancel{2}}/N\cdot\cancel{m^2}} \qquad \frac{1}{C/N}$$

$$E = 4.519\times10^{6}\ \frac{N}{C} \qquad 3cm = .03m \qquad 3\times10^{-2}\,m$$

$$\Delta V = \left(4.519\times10^{6}\ \frac{N}{C}\right)\left(3\times10^{-2}\,m\right)$$

$$\Delta V = 1.35570\times10^{5}\ V$$



$$\Delta V = V_b - V_a = V_{ba} = -1.35\ldots\times10^{5}\ V$$

$$\text{or } \Delta V = V_a - V_b = V_{ab} = +1.35\ldots\times10^{5}\ V$$

less ambiguous

$$W_{ba} = \int_a^b \vec{F}\cdot d\vec{l} = -q\,V_{ba} = -q\underbrace{(V_b - V_a)}_{\text{negative}} = q\underbrace{(V_a - V_b)}_{\text{positive}}$$

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If $q = +e$, $= 1.60 \times 10^{-19}$ C
what is the work don by the electric force?

$$W = -q\Delta V$$

$$W_{ba} = 2.16 \times 10^{-14}\ C \cdot V = 2.16 \times 10^{-14}\ C \cdot \frac{N}{C}$$
$$= 2.16 \times 10^{-14}\ J$$

If the proton's speed is 0 at plate a, then at plate b, speed = ?

$$K = \frac{1}{2}mv^2$$

$$-\Delta U = W = \Delta K \qquad m = 1.67 \times 10^{-27}\ kg$$

$$\Delta K = \frac{1}{2}mv^2 - 0 \qquad N = \frac{kg \cdot meter}{second^2}$$

$$\parallel$$
$$W$$
$$\parallel$$

$$v^2 = \frac{2\Delta K}{m} = 2.58 \times 10^{13}\ \frac{meter^2}{second}$$

$$\boxed{v = 5.08 \times 10^6\ m/s}$$

$$2.16 \times 10^{-14}\ J = 2.16 \times 10^{-14}\ N \cdot m = 2.16 \times 10^{-14}\ \frac{kg \cdot meter^2}{second^2}$$