PHYS 231 - Sept. 6, 2023

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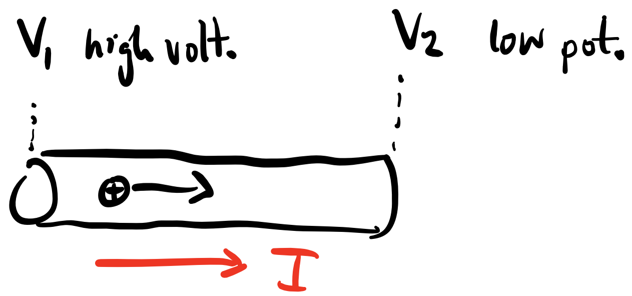
https://cmps-people.ok.ubc.ca/jbobowsk/phys231.html

Basic Electronics for Scientists & Engineers
- Dennis L. Eggleston

Consider a conductor with a voltage difference across it.



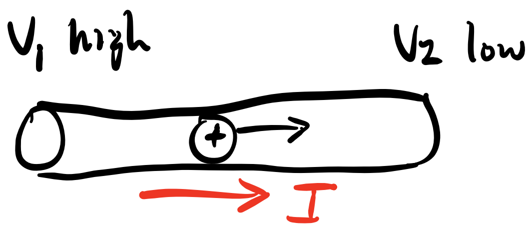
pos. charges flow from high to low volt.

Crossing resistor from left to right.

$$\Delta V = V_2 - V_1 < 0 \text{ (neg)}$$

When cross resistor in dir'n of current $\Delta V < 0$.

$$\Delta V = -IR$$ when travel in dir'n of current.

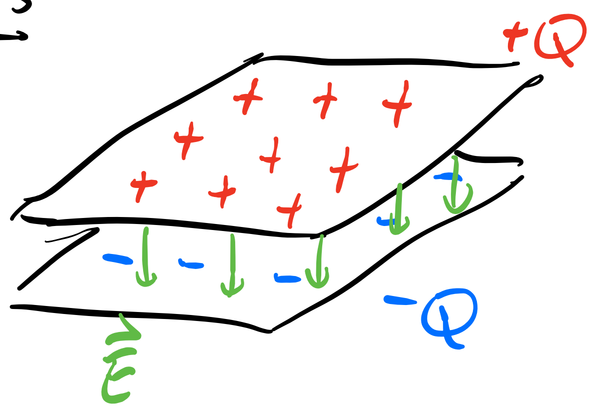


If cross resistor from right to left (in opp. dir'n of I), then

$$\Delta V = V_1 - V_2 > 0 \text{ (pos.)}$$

$\Delta V = +IR$ when travel against the current.

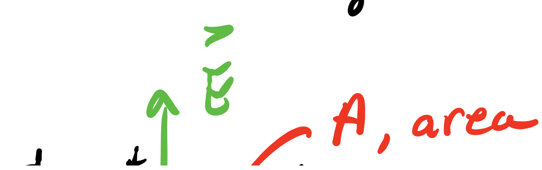
Capacitors

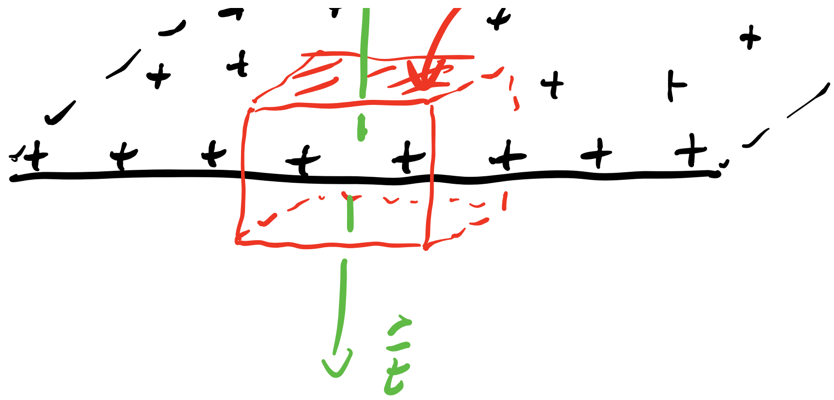


Find $\vec{E}$ due to a sheet of charge can be found using Gauss's Law

$$\oint \vec{E} \cdot d\vec{A} = \frac{q_{encl}}{\varepsilon_0}$$

side view of sheet of charge:





For sheet of charge

$$\oint \vec{E}\cdot d\vec{A} = 2EA$$

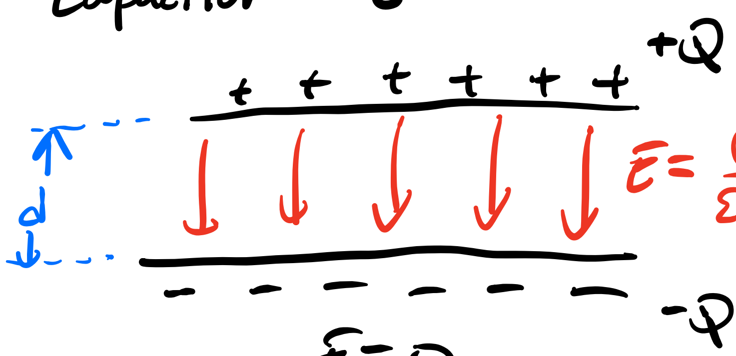
$$q_{encl} = \sigma A$$

(σ: charge per unit area)

$$2EA = \frac{\sigma A}{\varepsilon_0}$$

$$\boxed{E = \frac{\sigma}{2\varepsilon_0}}$$

Capacitor $E = 0$

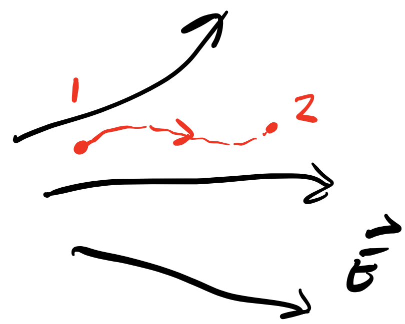


$$E = \frac{\sigma}{\varepsilon_0} = \frac{Q}{\varepsilon_0 A}$$

$E = 0$

Definition of capacitance $C = \dfrac{Q}{\Delta V}$

$$|\Delta V| = \int_a^b \vec{E} \cdot d\vec{l}$$



For our capacitor

$$|\Delta V| = \int_{top}^{btm} \vec{E} \cdot d\vec{l} = \frac{Q}{\varepsilon_0 A} d$$

$$\therefore \quad C = \frac{Q}{|\Delta V|} = \varepsilon_0 \frac{A}{d}$$

Parallel-Plate capacitor.