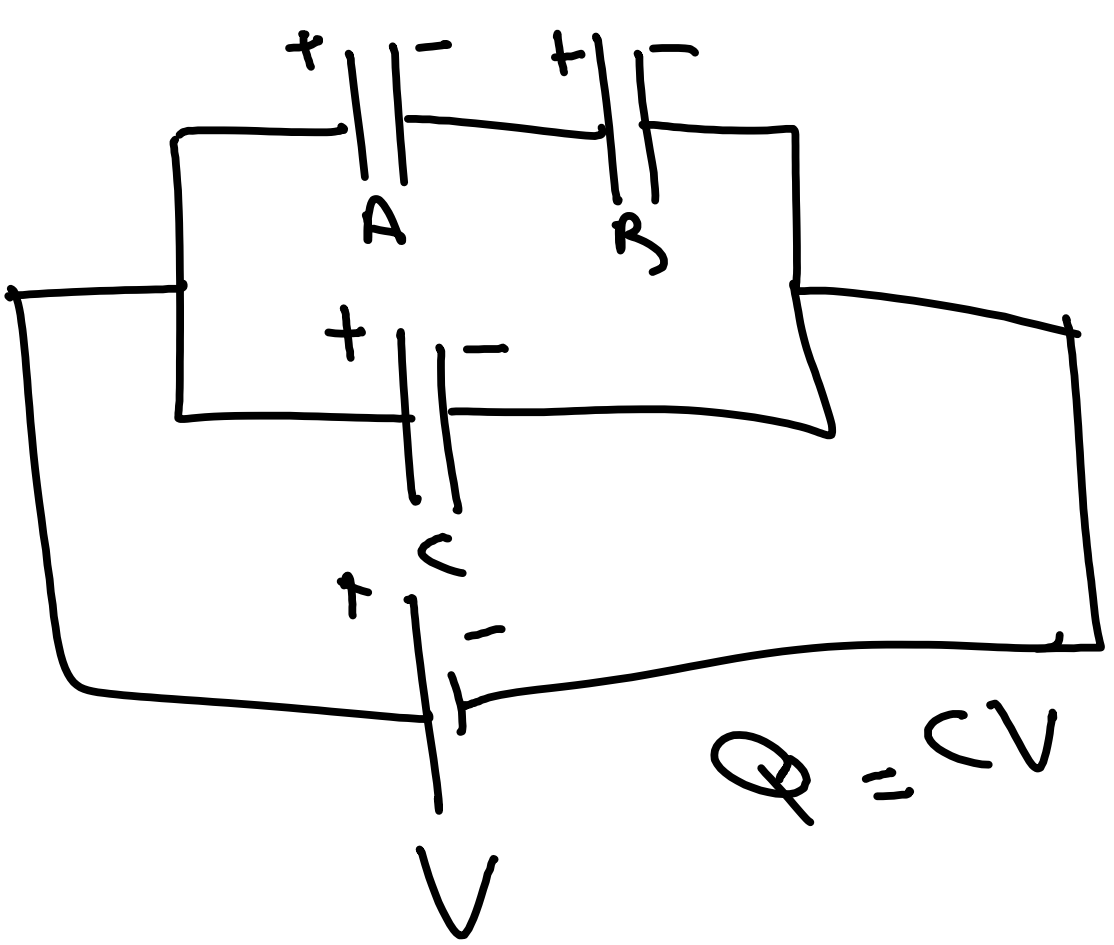
March 24, 2015



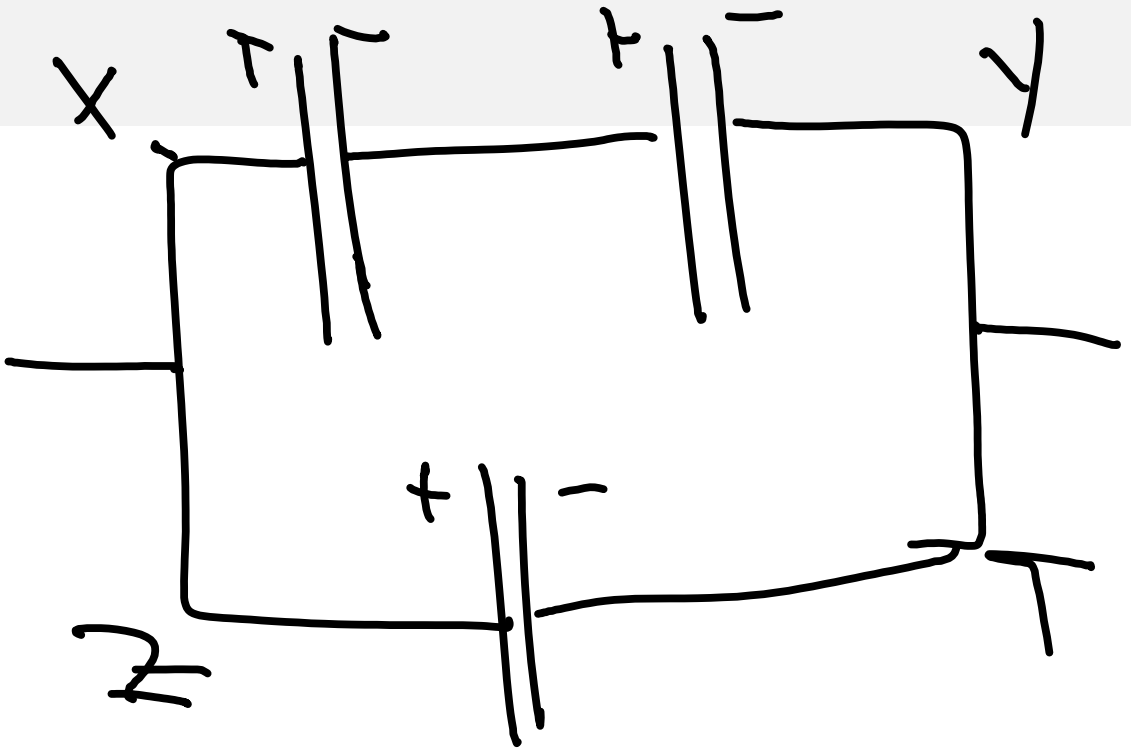
$Q = CV$

Q_A, Q_B, Q_C

$V_C = V$

$V_A = V_B = \frac{V}{2}$

$Q_A = Q_B < Q_C$


X
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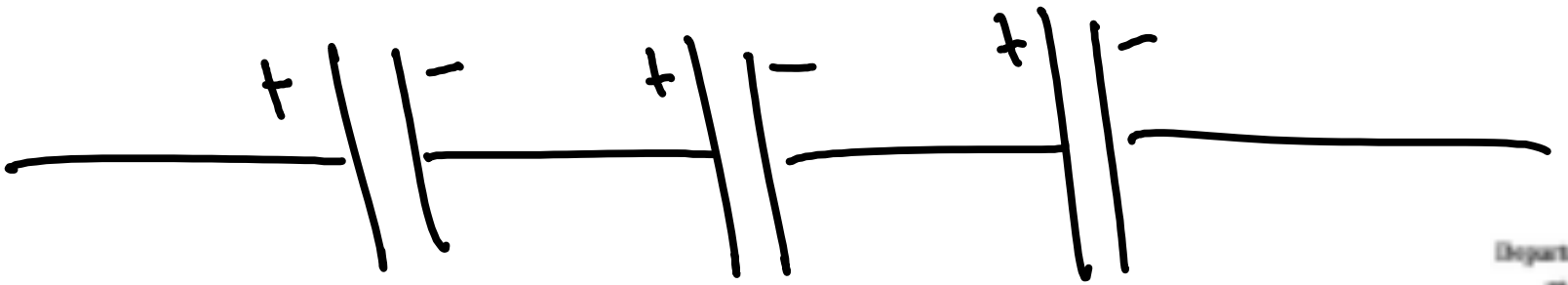
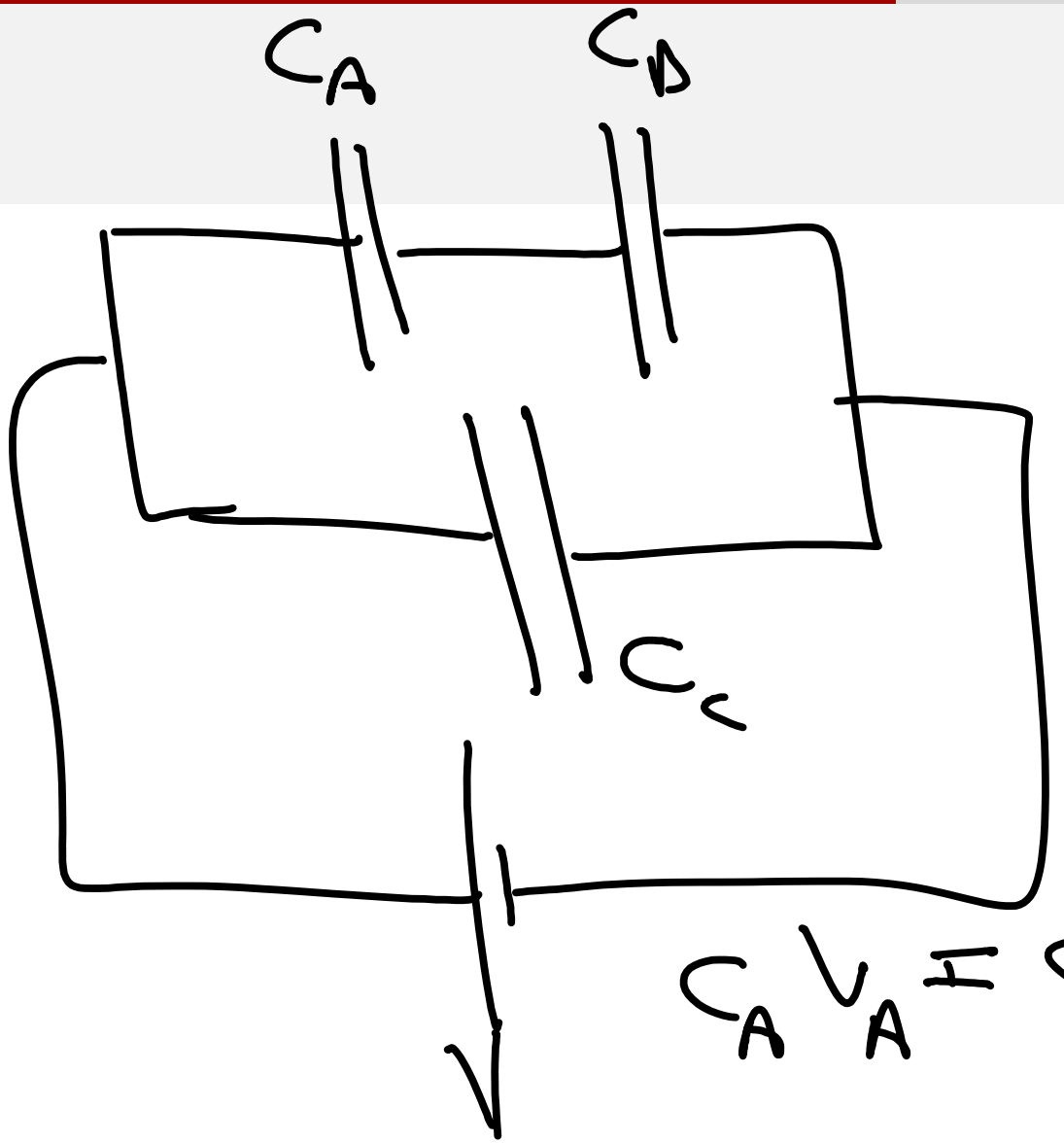




$$Q = CV$$

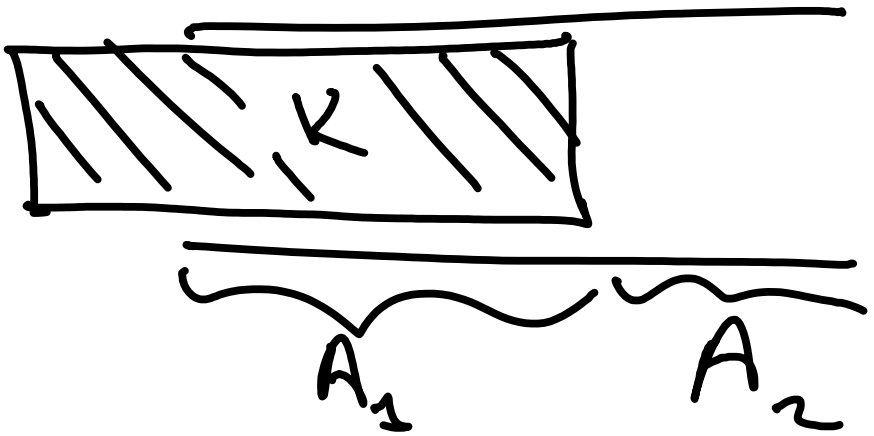
$$V_C = V$$

$$V_A + V_B = V$$

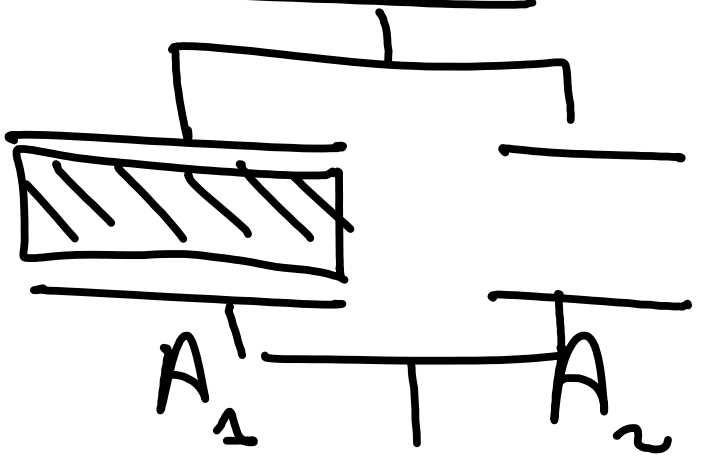
$$V_A, V_B < V$$

$$C_A V_A = C_B V_B \Rightarrow Q_A = Q_B$$

Force acting on a dielectric



$=$



$$A_1 + A_2 = A$$

$$C^0 = \varepsilon_0 \frac{A}{d}$$

$$C_1 = K \frac{A_1}{A} C^0$$

$$C_2 = \frac{A_2}{A} C^0$$

$$C_1 = K\frac{A_1}{A}C^0$$

$$C_2 = \frac{A_2}{A}C^0$$

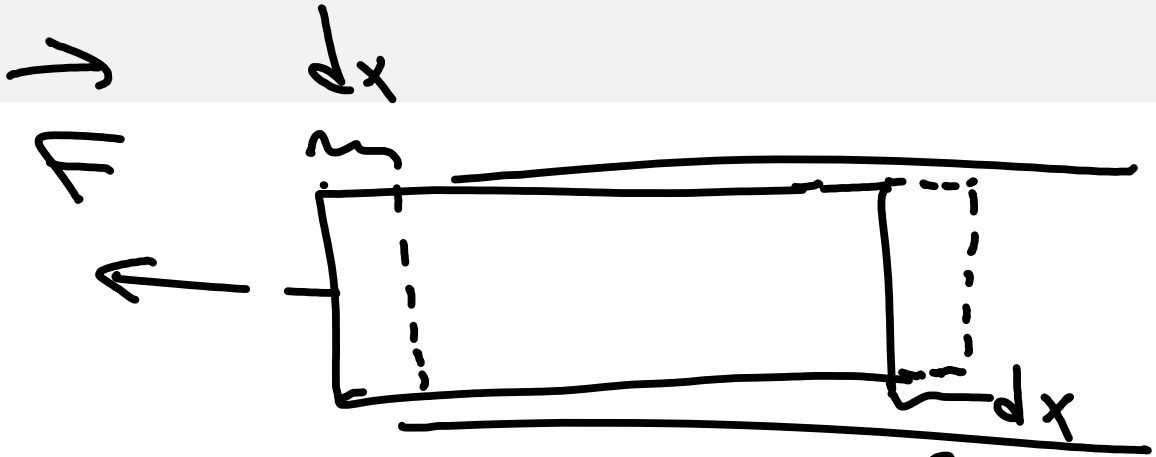
} in parallel

$$C = C_1 + C_2$$

$$C = \frac{(KA_1 + A_2)}{A}C^0$$

$$C = \frac{Kx + (L-x)}{L}C^0$$

$$U = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$$



$$U = \frac{1}{2} QV = \frac{1}{2} CV^2 = \frac{1}{2} \frac{Q^2}{C}$$

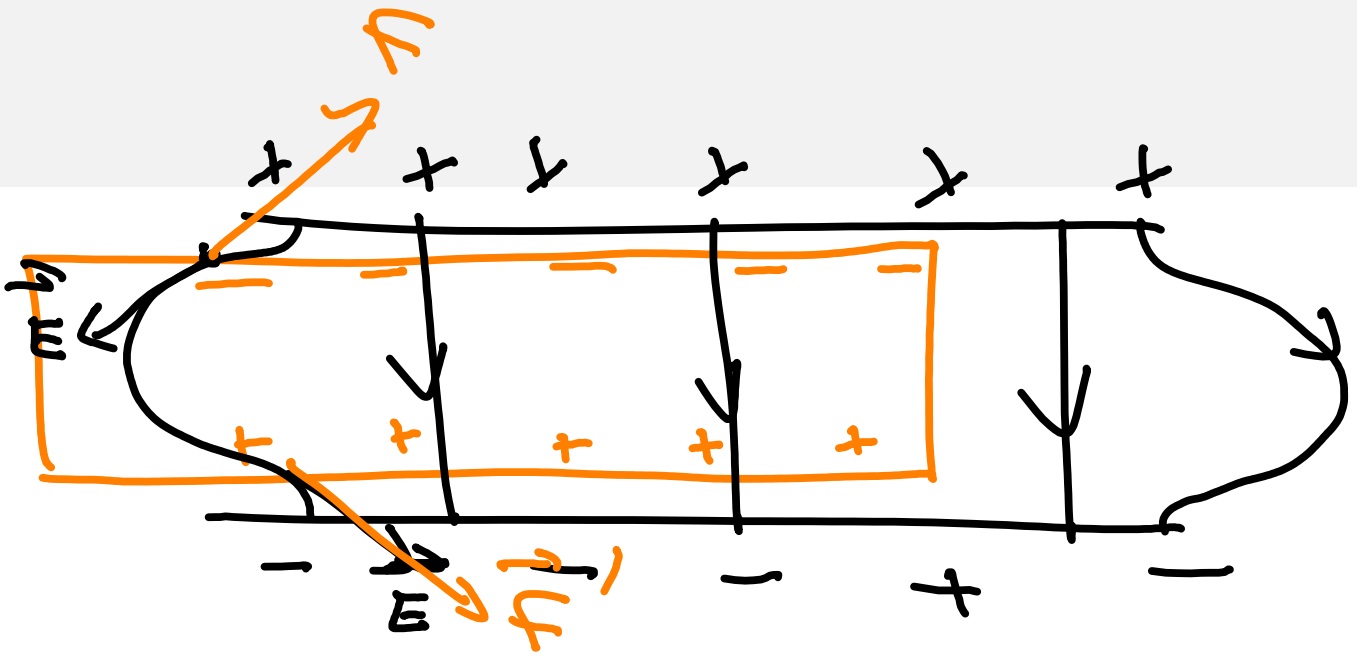
$$dU = \vec{F} \cdot d\vec{l} = -F\,dx$$

$$\boxed{F = -\frac{dU}{dx}}$$

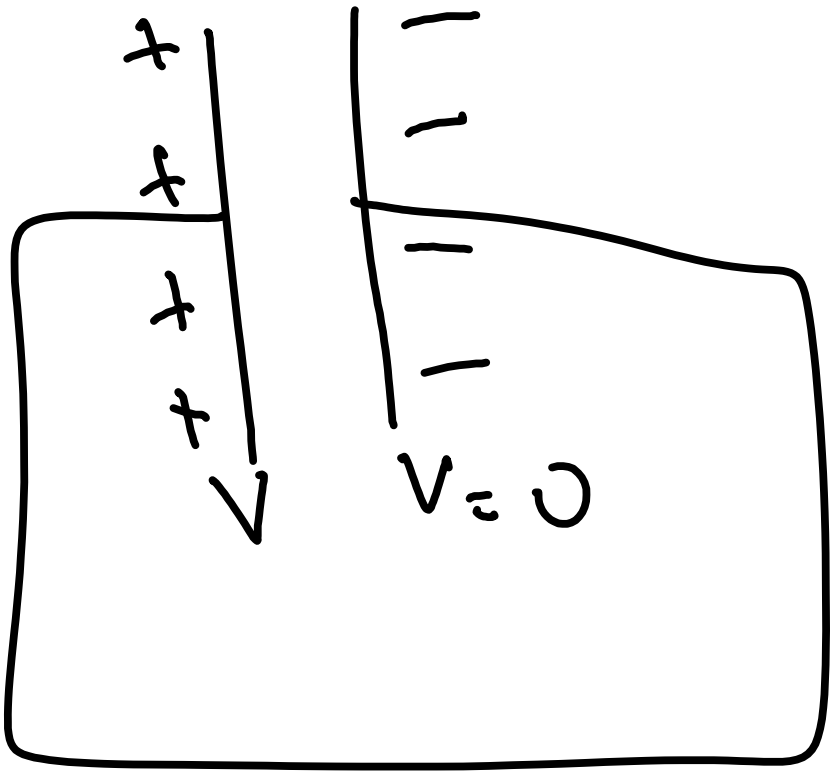
$$\frac{dU}{dx} = \frac{d}{dx}\frac{1}{2}\frac{Q^2}{C} = -\frac{1}{2}\frac{Q^2}{C^2}\frac{dC}{dx}$$

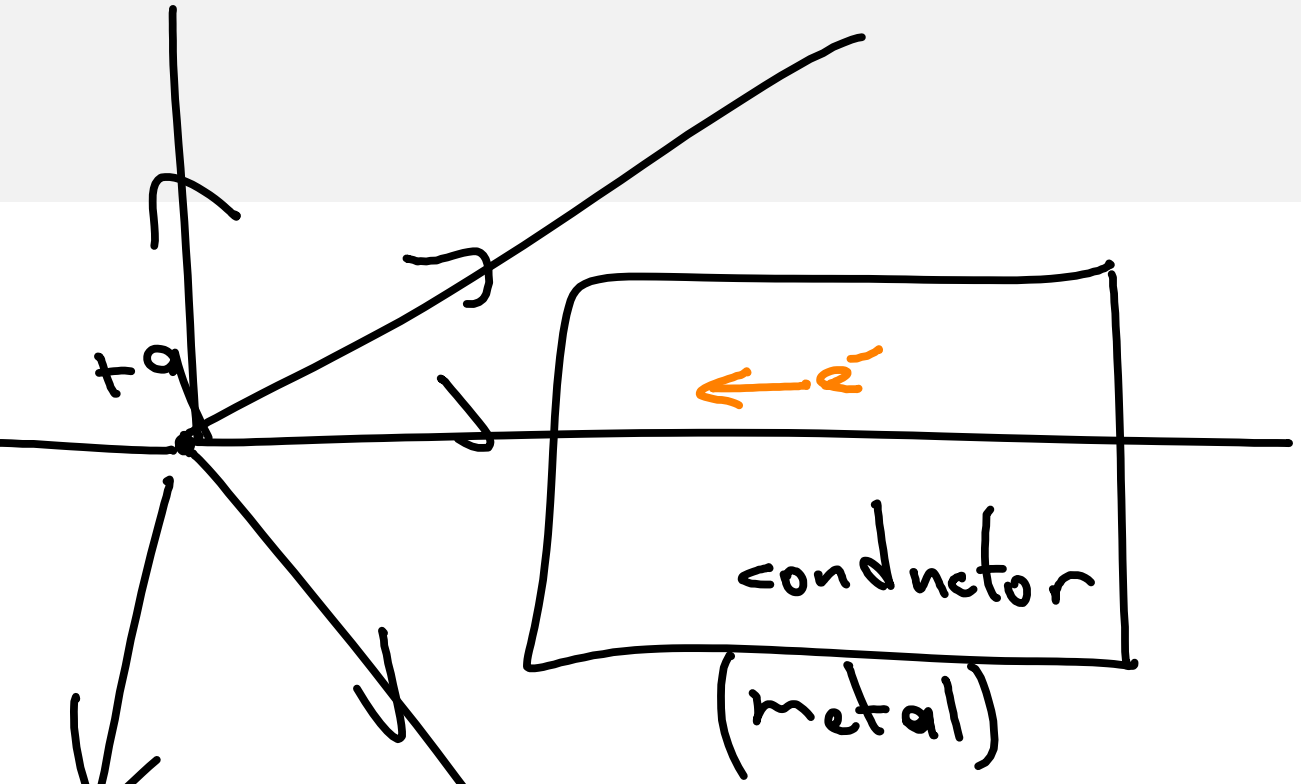
$$C = \frac{Kx + (L-x)}{L} C^0$$

$$\frac{dU}{dx} = -\frac{1}{2}\frac{Q^2}{C^2}\left(\frac{K-1}{L}\right)C^0$$

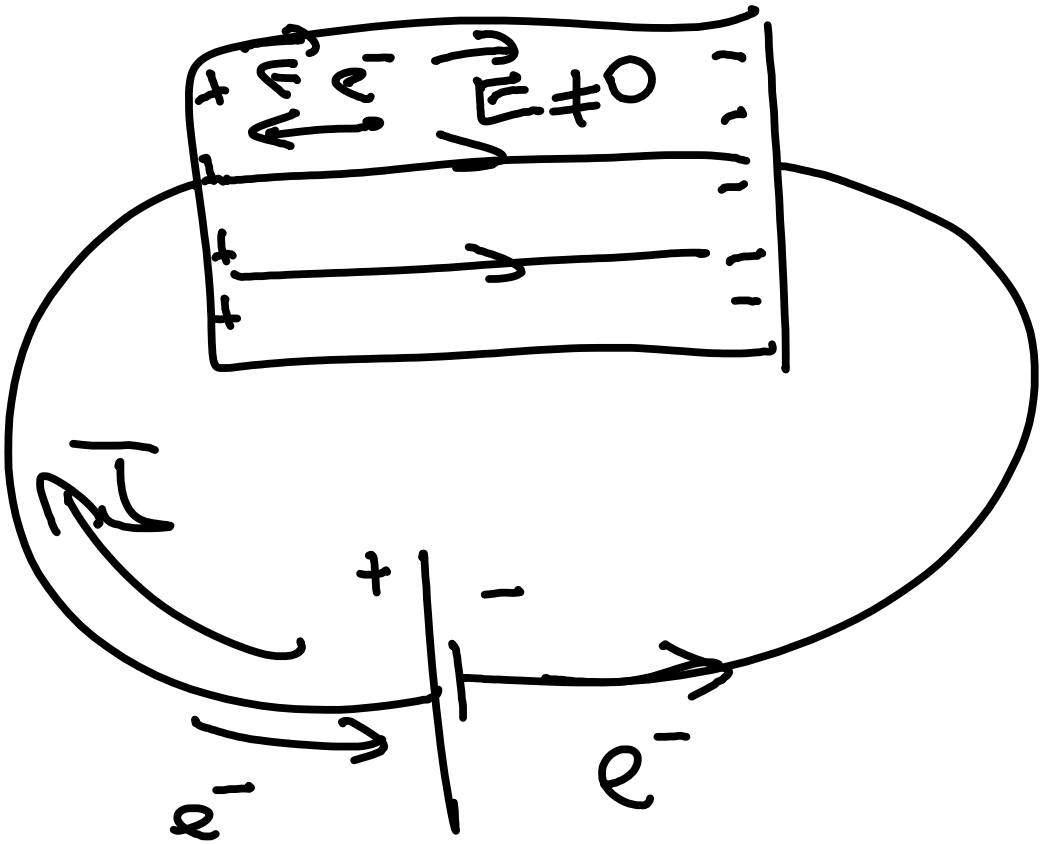

E
E

Currents & Resistors





: El. Field lines in the absence of conductor


+
+
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e⁻
E≠0
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+
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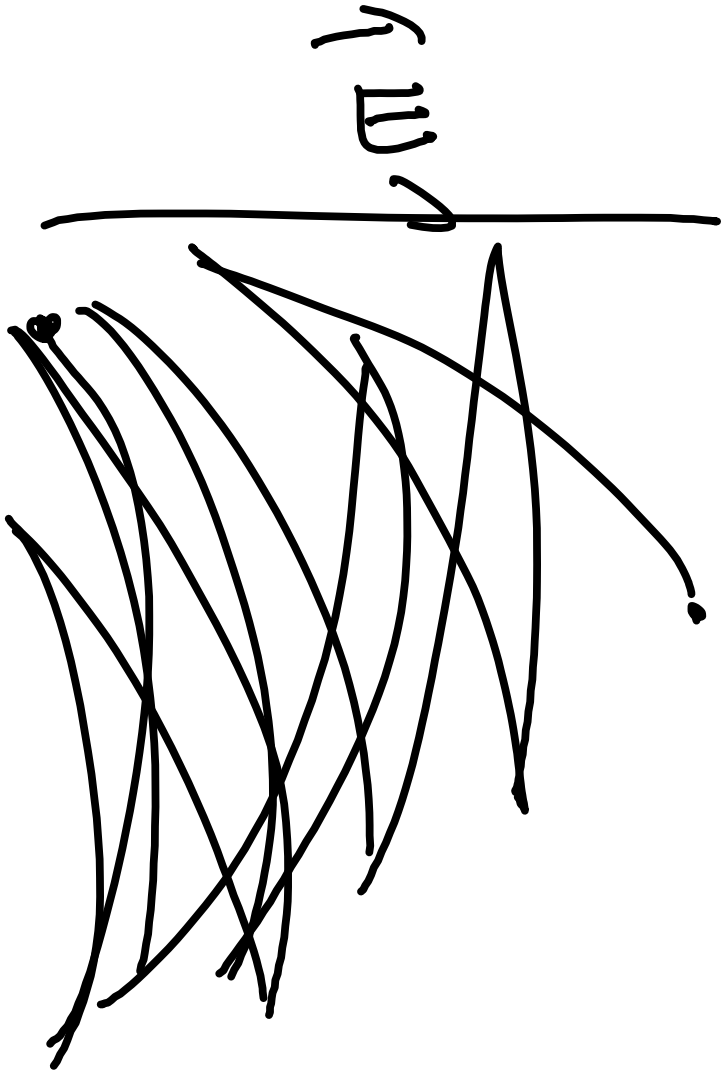
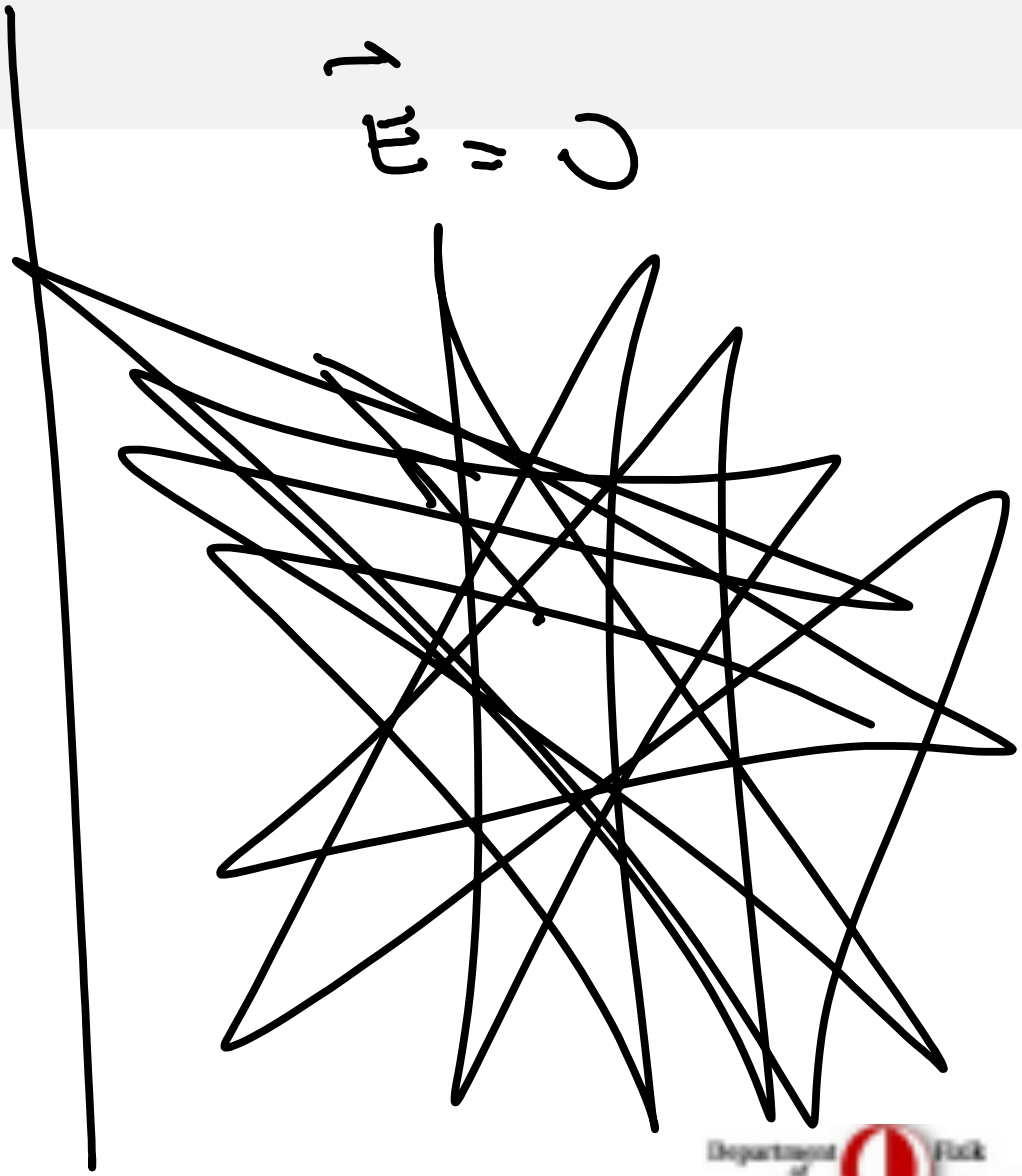
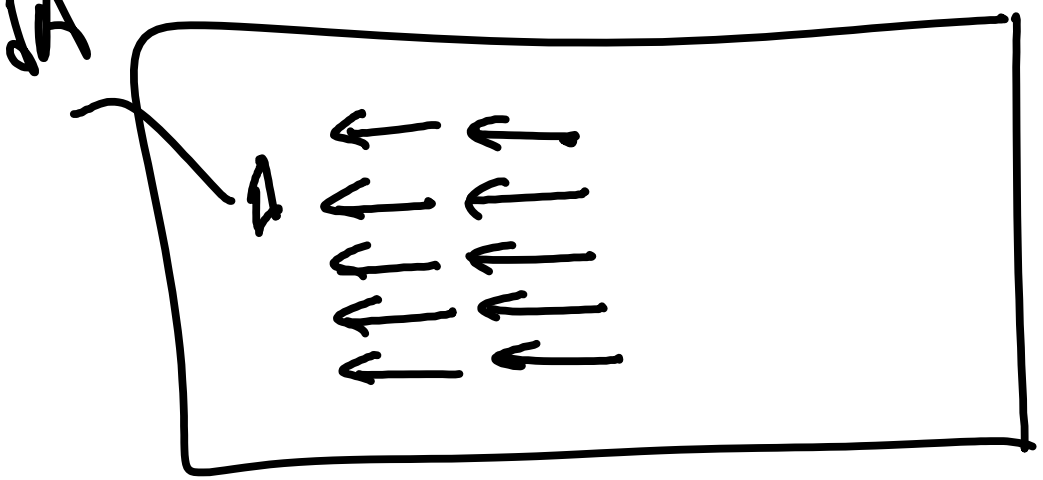
e⁻





$v_d \sim E$ $\quad \vec{E}$ $\quad 0.02\ mm/s$



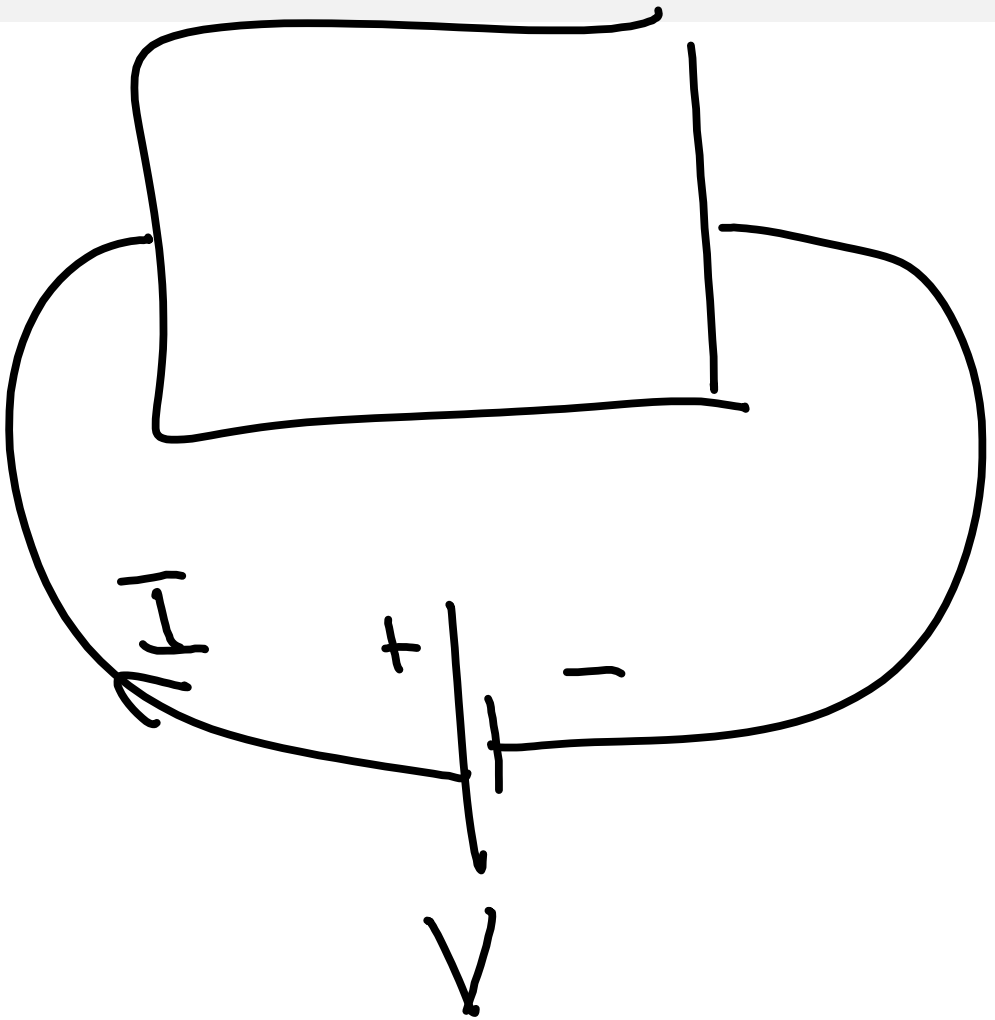
$$\frac{dQ}{dt} = n_e \vec{v}(-e) \cdot d\vec{A}$$

$$\vec{J} \equiv -e n_e \vec{v}_d$$

current density.

$$\int \vec{J} \cdot d\vec{A} = I : \text{current}$$

cross-sectional area



$$I \propto V$$

$$I \equiv \frac{V}{R}$$

R: resistance.

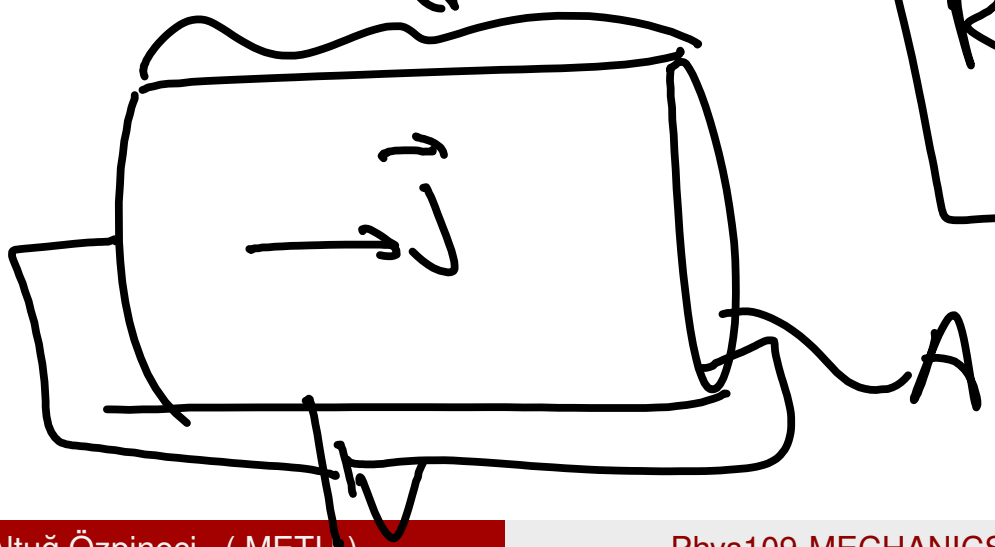
$$\vec{J} = -e n_e \vec{v}_d = \sigma \vec{E}$$

$-e$: charge of an electron.

σ: conductivity

$[J] = \frac{C}{m^2}\frac{m}{s} = \frac{C}{sm^2}$

$$I = JA = \sigma A E = \frac{\sigma A}{d} V \equiv \frac{V}{R}$$



$$R = \frac{1}{\sigma}\frac{d}{A}$$

$\rho \equiv \frac{1}{\sigma}$: resistivity

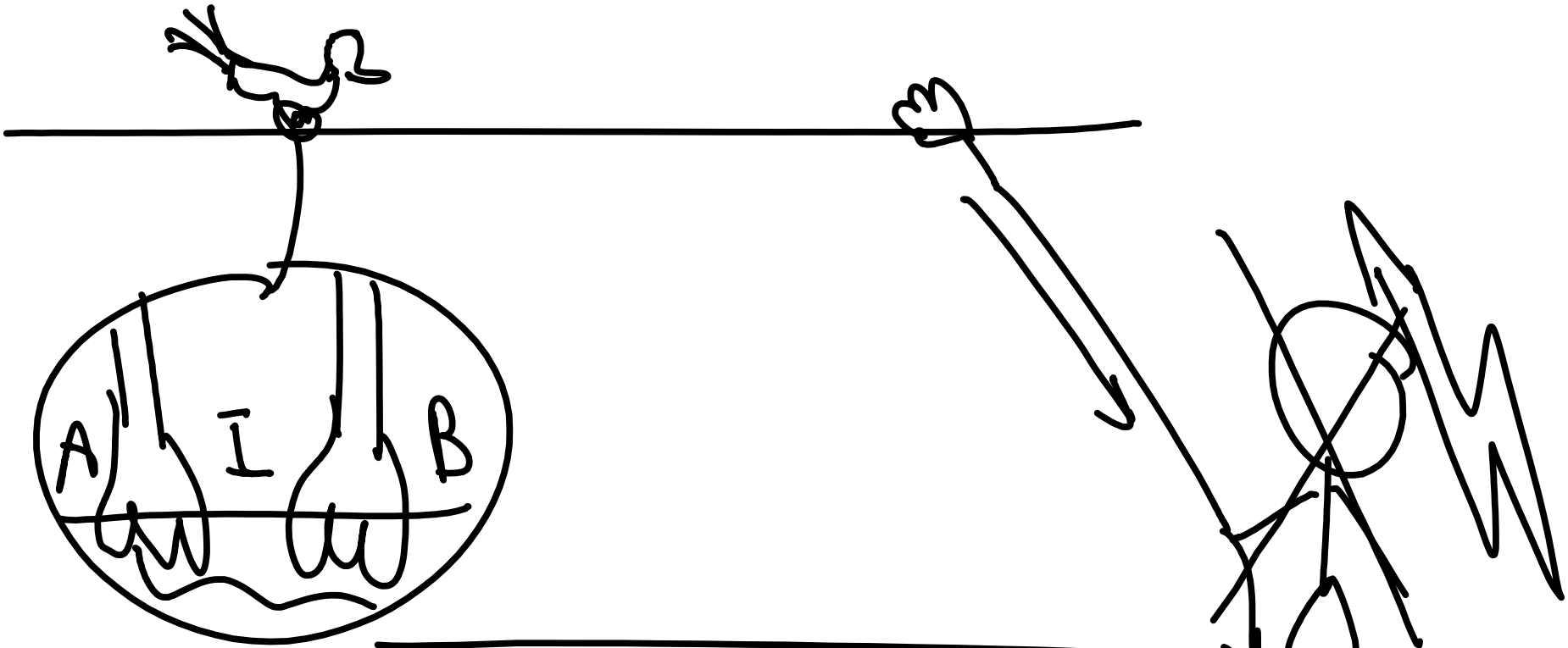
$$\frac{dQ}{dt} = \vec{j} \cdot \vec{dA}$$

$$[\vec{j}] = \frac{C}{s\,m^2}$$

$$[R] \equiv \Omega$$

$$[I] = \frac{C}{s} \equiv \text{Ampere} = A$$

$$[R] = \left[\frac{V}{I}\right] = \frac{\text{Volt}}{C/s} = \frac{V\,s}{C}$$



$$V = IR$$

$$V_{AB} = I_{wire} R_{wire} = I_{bird} R_{bird}$$

$$I_{bird} = I_{wire} \frac{R_{wire}}{R_{bird}}$$