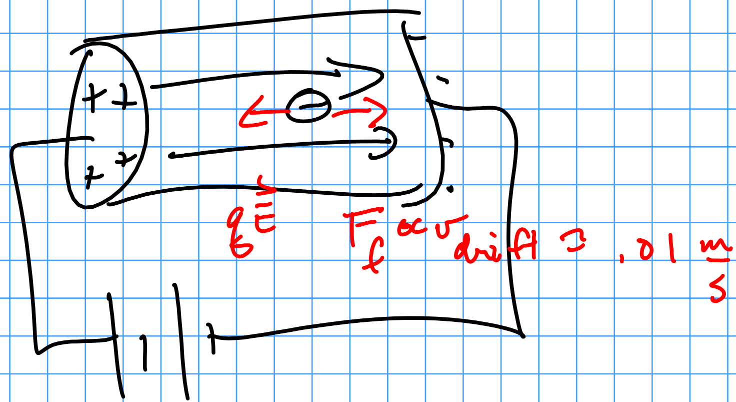
Ohms Law

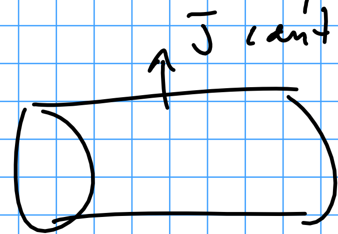


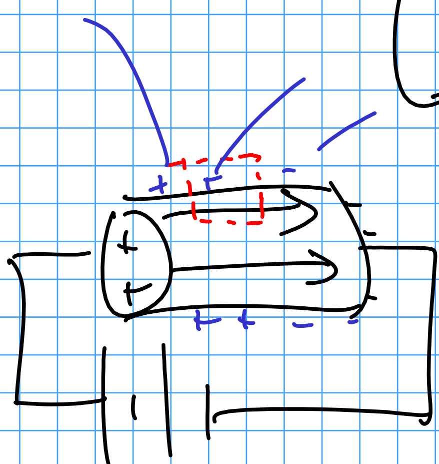
$$v_d \propto E$$

$$\vec{J} = \sigma \vec{E} = \rho \vec{v}$$

Inside conductor $\quad \nabla^2 V = 0$

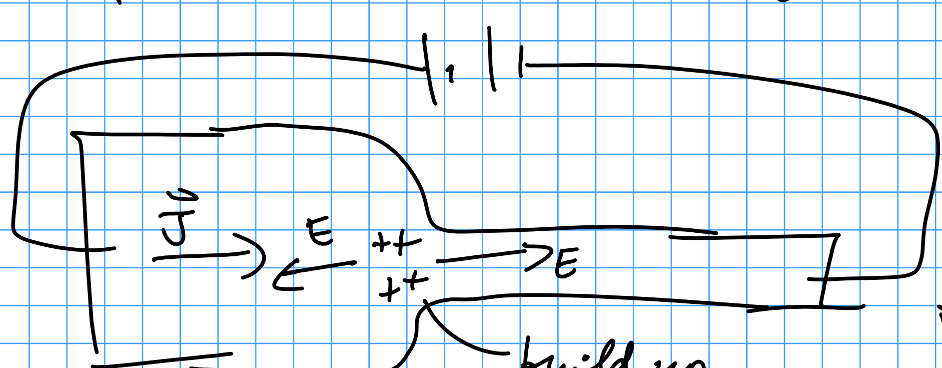
$\vec{J}$ can't flow out $\Rightarrow E_\perp = 0$ in conductor



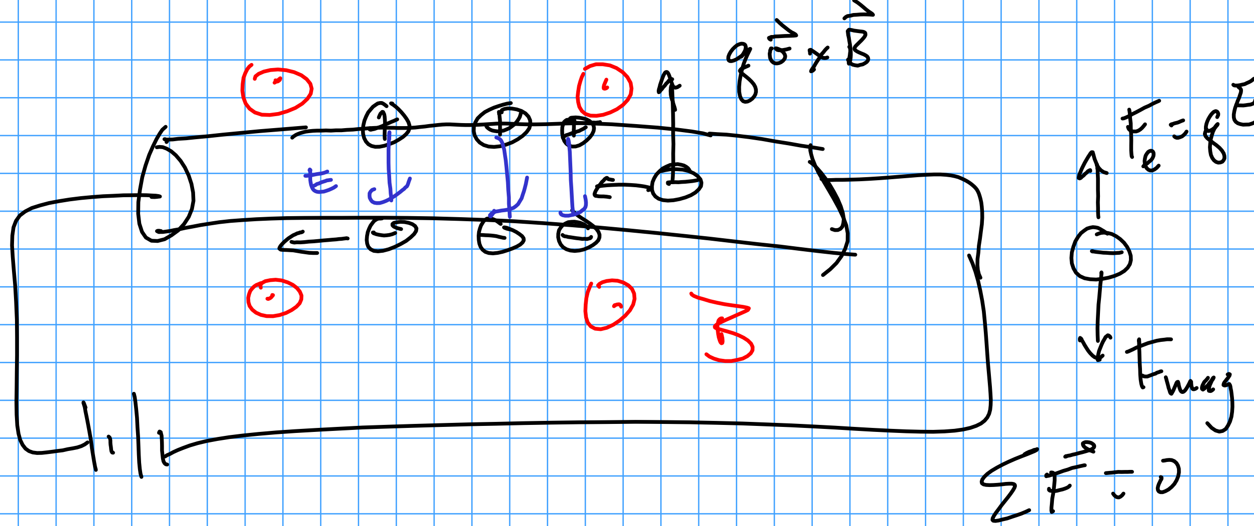


$$\nabla \times \vec{E} = 0$$

$$\underbrace{\int \nabla \times \vec{E} \cdot d\vec{a}}_{0} = \oint \vec{E} \cdot dl$$

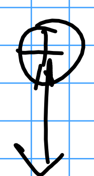


ρ const & flow of an incompressible fluid



$$J = \underbrace{\rho}_{\text{neg}} v = -\rho_{elec} v_0 - \hat{x}$$

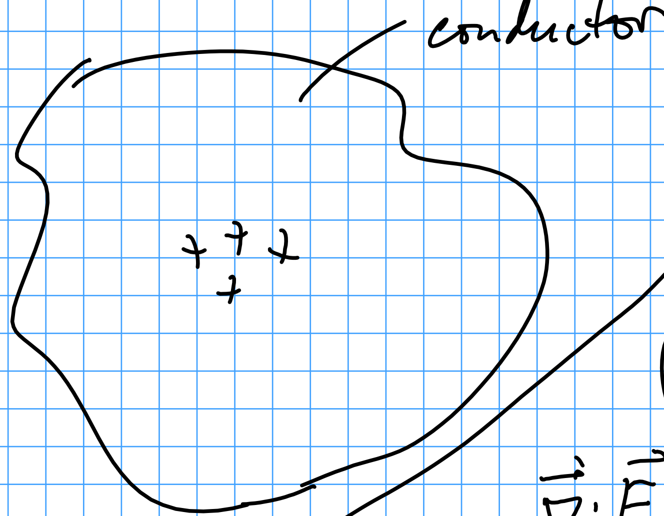
force that moves wire (+ charge of the lattice)



Electric force from the electrons
that are moving

E in wire

$$\boxed{\cancel{q} vB = \cancel{q} E}$$



$J = \sigma E$

$\rho \vec{v} = \sigma \vec{E}$ Ohm's Law

$\vec{\nabla}\cdot\vec{E} = \rho/\epsilon_0$ Gauss's Law (Coulombs)

$\vec{\nabla}\cdot\vec{J} = -\frac{\partial\rho}{\partial t}$ Cons. charge

$$\vec{\nabla}\cdot\vec{J} = \vec{\nabla}\cdot\sigma\vec{E} = \sigma\underbrace{\vec{\nabla}\cdot\vec{E}}_{\rho/\epsilon_0} = -\frac{\partial\rho}{\partial t}$$

near origin

$$\frac{\sigma}{\epsilon_0}\rho = -\frac{\partial\rho}{\partial t} \Rightarrow \rho = \rho_0 e^{-\frac{\sigma}{\epsilon_0}t}$$

$\sigma = 10^7\ \Omega\cdot m$ $\quad \epsilon$ in conductor $\to \epsilon_0 \approx 10^{-11}\frac{C}{N}$