PHYS 5C:

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Date April 21, 2017

I. Electric Currents and Resistance

- $\frac{\Delta Q}{\Delta t} = I$ average current
- $\frac{\mathrm{dQ}}{\mathrm{dT}} = I$ instaneous current
  Units: $\frac{\text{columns}}{\text{second}} = \text{Ampere}(A/\text{Amp})$
- Currents flow in conductors

  Apply external E to move charges. There is a potential difference between the two ends

  V=El if E uniform
- We have been saying E=0 inside a conductor, but charges are no moving
- Why don't the charges accelerate constantly

  Force on charge q: $F = \mathrm{qE} = \mathrm{ma}$
- A given E produces a drift speed, hence current
- If a current is linear, that material ohmic

  If current is uniformly distrubuted current density is $J = \frac{I}{A}$

II. Ohm Law

- $J = \sigma E$
- Where σis conductivity of the material
  $\frac{1}{\sigma}$ is the resitivity(ρ)
- $V = \mathrm{El} = \left(\frac{j}{\sigma} l\right) = j\rho l = \frac{I}{A}\rho l = I\frac{\rho l}{A}$
- $V = \mathrm{IR} \Rightarrow I\left(\frac{\rho l}{A}\right)$
- R resistance units: ohms Ω=$\frac{V}{A}$
- ρ units $\Omega \times m$
- σ: (Ω*m)$^{-1}$
- $V_{\text{battery}} = V_{\text{resistor}} \quad V = \mathrm{IR} \Rightarrow I = \frac{V}{R}$