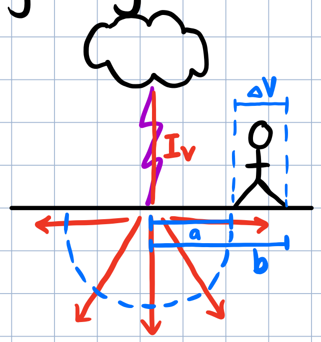
More Electricity

- Lightning!



$$\Delta V = V_a - V_b = \int_a^b \vec{E}\cdot d\vec{s} = \int_a^b \rho\vec{J}\cdot d\vec{s} = \int_a^b \frac{\rho I}{2\pi r^2}\hat{r}\cdot dr\,\hat{r} = \frac{\rho I}{2\pi}\int_a^b \frac{dr}{r^2} = \frac{\rho I}{2\pi}\left(\frac{1}{a}-\frac{1}{b}\right)$$

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

current density

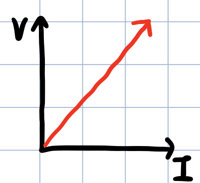
resistivity

- Resistivity, ρ, is a function of material and temperature:

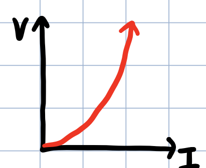
  $\rho = \rho_0(1+\alpha\Delta T)$ where $\rho_0 = \rho$ @ $20°C$, $\Delta T = T - 20°C$, α = thermal resistivity constant

  Because $R = \rho\frac{L}{A}$, $R = R_0(1+\alpha\Delta T)$

- Graphs:
  - $\alpha \approx 0$ (Ohmic resistor)

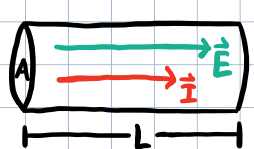


  - $\alpha \neq 0$ (Non-Ohmic resistor)



Electrical Power

- Consider the following:



$EL = \Delta V \rightarrow \begin{matrix}\Delta U = q\Delta V \\ dU = q\,dV\end{matrix} \rightarrow dP = \frac{dU}{dt} = q\frac{dV}{dt} = I\,dV \rightarrow P = I\Delta V = IV$

So $P = IV = I^2R = \frac{V^2}{R}$

- Keep in mind that in a circuit, $P_{battery} = P_{device}$