EE 247B / ME 218 Discussion 2

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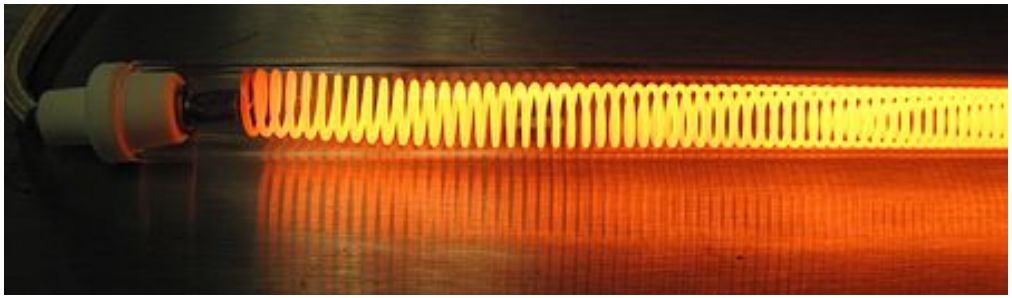
Logistics

- Discussion will remain Wednesdays 12 – 1pm
- I will be out the next two weeks – back on Feb. 16th
- Will be available via Piazza, email, Skype (if need be), etc.
- OH & discussion will still be held
  - Led by Alper Ozgurluk

Thermal/Electrical Hybrid Circuits

- The circuit problems we've looked at have been mostly thermal
- Inputs have been convenient power sources (like lasers)
- Is this actually useful? How is thermal energy typically coupled into a thermal body/MEMS?

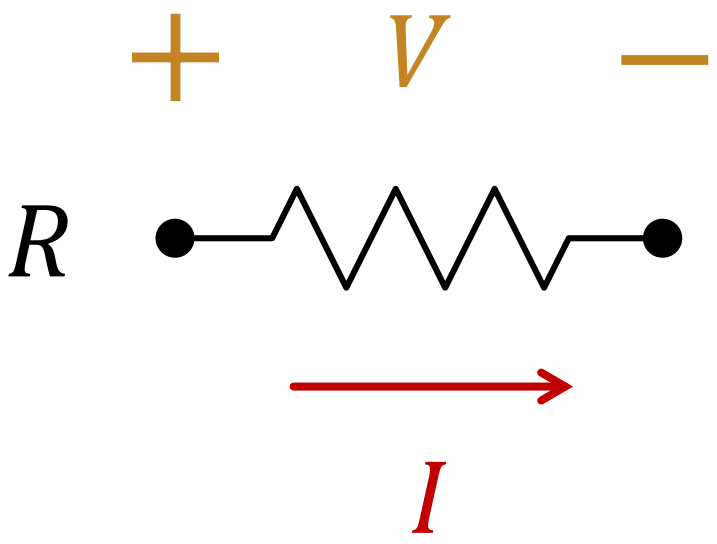


Electrical power through resistive heating!

Power Dissipated in a Resistor

- Remember Ohm's law!

$$V = I \cdot R \ , \quad I = \frac{V}{R}$$

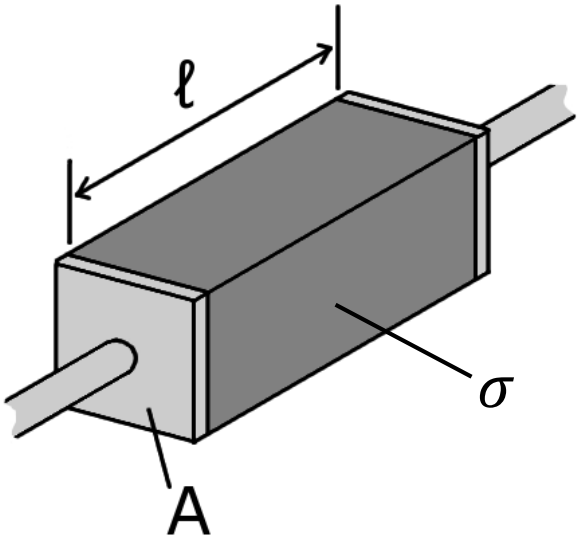


$$P = I \cdot V$$

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

Most of this energy is thermal!

Reminder: Electrical Resistance



$$R = \frac{l}{\sigma \cdot A}$$

resistance (Ω)

length (m)

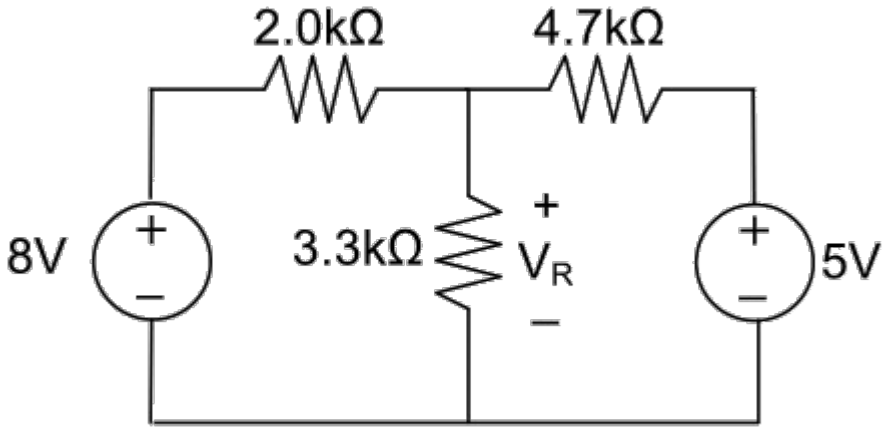
conductivity ($(\Omega \cdot m)^{-1}$)

cross-sectional area (m^2)

Reminder: Superposition

How do we handle circuits with multiple inputs (i.e., sources)?

1. Pick a source to analyze
2. Suppress (turn off) all other inputs
   - Set either V or I to zero
   - This means short-circuiting voltage sources & open-circuiting current sources
3. Find the output of interest for the modified circuit
4. Repeat steps 1-3 for all sources
5. Sum all resultant outputs to find total output due to all sources



Thermal Ckt. Example

- V_A represents a step function voltage source (can think of it as switching the voltage on at some time, t)
- Find the time-constant of the circuit
- Find the steady-state temperature on the shuttle if the final value of V_A is 1V