Ch 24-26: Circuits

Season 3 Episode 2 - *beep boop*

In this episode of LARC Physics 3B, we're going to . . .

- Create a foundation to solve "Circuit" problems.

Lecture Review

Big Ideas: Resistivity and Electric Power

Key Words: DC circuits, resistance, cross-sectional area and length of wire, power consumption, rate of energy over time, Ohm's Law, voltage, current.

In today's session, we'll primarily focusing on two big concepts: Resistivity and Electric Power

Here are some important equations/concepts:

- By convention, current flows from the positive end to the negative end of the voltage source (e.g. battery).
- In reality, current flows from the negative end to the positive end as it's the electrons that are flowing. Conventional current is "incorrect" but we just go wit da flow y'know.
- $V = I\,R$, Ohm's Law, applicable to some device like a battery or a resistor
- Do capacitors have resistance?

  It turns out, we can say that $R = \infty$ for capacitors since they don't allow charge to flow across the circuit. Instead, charge builds up on the capacitor plates.
- In general, power P is defined as "rate of energy transfer over time"

$$P = \frac{\text{Change in Energy}}{\text{Change in time}} = \frac{\Delta E}{\Delta t} \sim \frac{W}{\Delta t}$$

  in the context of circuits, we have

$$P = I\,V = I^2\,R = \frac{V^2}{R}, \quad \text{using Ohm's law } V = I\,R \text{ to substitute}$$

- The resistance of a wire is given by

$$R = \rho\frac{\ell}{A}$$

  where ρ is the resistivity pertaining to the material, ℓ is the length of the wire, and A is the cross-sectional area of the wire.

Breakout-Room Activity (Student - Student)

How many kWh of energy does a 550 W toaster use in the morning if it is in operation for a total of 6.0 min? At a cost of 9.0 cents/kWh, estimate how much this would add to your monthly electric energy bill if you made toast four mornings per week.

Answer: 7.9 cents/month

Breakout-Room Activity (Student - Student)

NOTE: This problem is pulled from your textbook in Example 26-5.

Consider the circuit shown in the diagram. The voltage of the battery and the resistance of each resistor are all given.

(a) Determine how much current is drawn from the battery. (i.e. Find the "total" current)

(b) Determine the current flowing through the $500\,\Omega$ resistor.

Answer: (a) $I = 17\,\text{mA}$, (b) $I = 10\,\text{mA}$