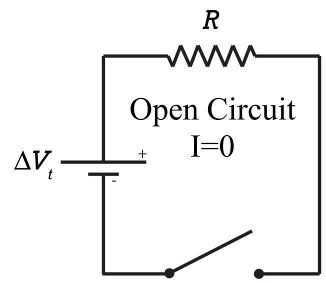
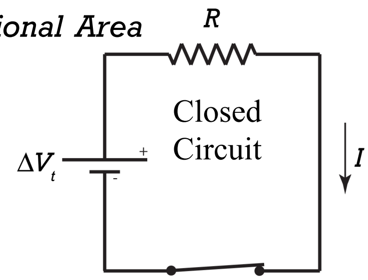
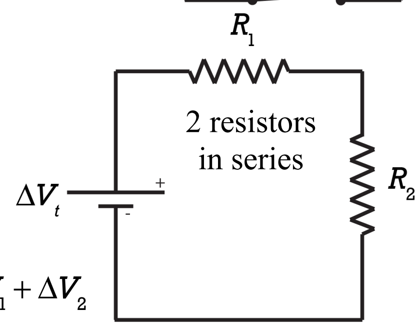
Flipping Physics Lecture Notes:
AP Physics 1 Review of *Electricity*
https://www.flippingphysics.com/ap1-electricity-review.html



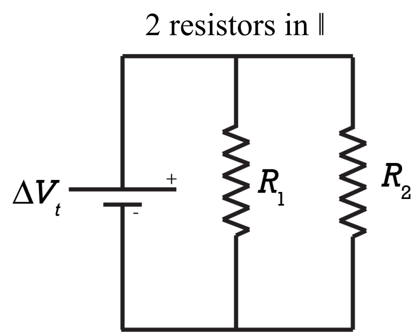
- Electric Current: The rate at which charges move.
  - $I = \frac{\Delta q}{\Delta t} \Rightarrow \frac{C}{s} = Amperes,\ Amps,\ A$
- Conventional current is the direction that positive charges "would" flow.
  - Even though it is usually negative charges flowing in the negative direction.
- Resistance, R: A resistor restricts the flow of charges.
  - $R = \frac{\rho \ell}{A};\ \rho = resistivity;\ \ell = length\ of\ wire;\ A = Cross\ Sectional\ Area$
  - Resistivity is a material property.



- Electric Potential Difference, $\Delta V = \frac{\Delta PE_{electrical}}{q}$
  - $\Delta V = IR \Rightarrow I = \frac{\Delta V}{R} \Rightarrow R = \frac{\Delta V}{I} \Rightarrow \frac{V}{A} = Ohm,\ \Omega$

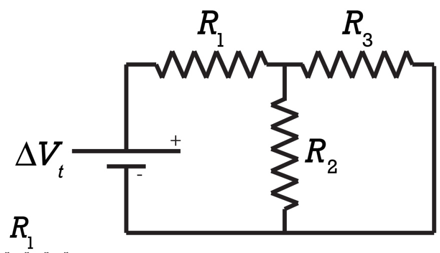


- Two resistors in series:
  - Using Kirchhoff's Loop Rule: $\Delta V_{loop} = 0$
  - $I_t = I_1 = I_2\ \&\ \Delta V_{loop} = 0 = \Delta V_t - \Delta V_1 - \Delta V_2 \Rightarrow \Delta V_t = \Delta V_1 + \Delta V_2$
    $\Rightarrow I_t R_{eq} = I_1 R_1 + I_2 R_2 \Rightarrow R_{eq} = R_1 + R_2 \Rightarrow R_{series} = R_1 + R_2 + R_3 + \ldots$

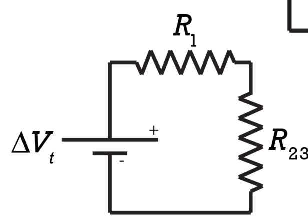


- Two resistors in parallel:
  - Using Kirchhoff's Junction Rule: $\sum I_{in} = \sum I_{out}$
  - $\Delta V_{loop} = 0 = \Delta V_t - \Delta V_1 \Rightarrow \Delta V_t = \Delta V_1$
  - $\Delta V_{loop} = 0 = \Delta V_t - \Delta V_2 \Rightarrow \Delta V_t = \Delta V_2$
  - $\Rightarrow \Delta V_t = \Delta V_1 = \Delta V_2\ \&\ \sum I_{in} = \sum I_{out} \Rightarrow I_t = I_1 + I_2$
  - $\Rightarrow \frac{\Delta V_t}{R_{eq}} = \frac{\Delta V_1}{R_1} + \frac{\Delta V_2}{R_2} \Rightarrow \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow R_{\parallel} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots\right)^{-1}$

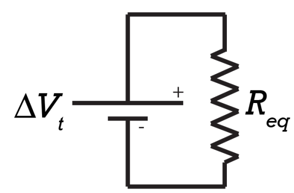
- Electric Power is the rate at which electric potential energy is being converted to heat and light. Also sometimes called the rate at which energy is dissipated in the circuit element.
    - $P = I\Delta V$ (the only equation for electric power on the equation sheet)
    - $P = I\Delta V = I(IR) = I^2R = \left(\frac{\Delta V}{R}\right)^2 R = \frac{\Delta V^2}{R} \Rightarrow P = I\Delta V = I^2R = \frac{\Delta V^2}{R}$
- Example Problem: Find the power dissipated in resistor #2.
  $R_1 = 1.0\Omega,\ R_2 = 2.0\Omega,\ R_3 = 3.0\Omega,\ \Delta V_t = 6.0V,\ P_2 = ?$



- Resistors 2 and 3 are in parallel:
    - $R_{23} = \left(\frac{1}{R_2} + \frac{1}{R_3}\right)^{-1} = \left(\frac{1}{2} + \frac{1}{3}\right)^{-1} = 1.2\Omega$



- Resistors 1 and equivalent resistor 23 are in series:
    - $R_{eq} = R_1 + R_{23} = 1 + 1.2 = 2.2\Omega$



- We can find the current through the battery, which is the same as the current through resistor 1:
    - $\Delta V_t = I_t R_{eq} \Rightarrow I_t = \frac{\Delta V_t}{R_{eq}} = \frac{6}{2.2} = 2.\overline{72}A = I_1$
- We can now find the electric potential difference across resistor 1:
    - $\Delta V_1 = I_1 R_1 = (2.\overline{72})1 = 2.\overline{72}V$
- Now we can find the electric potential difference across equivalent resistor 23, which is the same as the electric potential difference cross resistor 2:
    - $\Delta V_t = \Delta V_1 + \Delta V_{23} \Rightarrow \Delta V_{23} = \Delta V_t - \Delta V_1 = 6 - 2.\overline{72} = 3.\overline{27}V = \Delta V_2$
- We have what we need to find the electric power in resistor 2:
    - $P_2 = \frac{(\Delta V_2)^2}{R_2} = \frac{(3.\overline{27})^2}{2} = 5.35537 \approx 5.4\ \frac{J}{s} \approx \boxed{5.4 watts}$