ECE 30
Day 11 Notes

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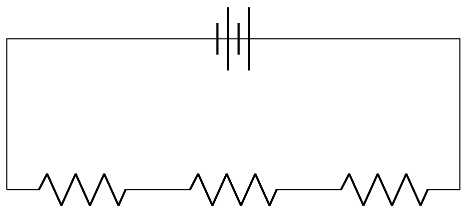
Agenda

- Series and Parallel Circuits
- Kirchoff's Rules
- Electric Circuits

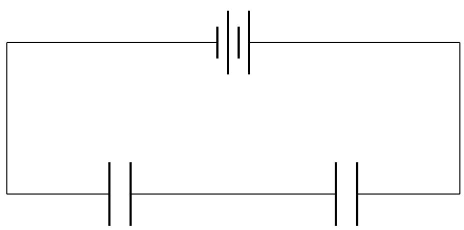
Series and Parallel Circuits



$$V = iR_1 + iR_2 + iR_3 = v_1 + v_2 + v_3$$

$$V = i(R_1 + R_2 + R_3) = iR_{eq}$$

Resistors in series are equivalent to a resistor with the sum of their resistances. Resistance adds in series.



The first capacitor charges to Q_1, and its other half charges to $-Q_1$, the next plate ends up charging to Q_2 and its other plate charges to $-Q_2$. Since Q_2 gets its charge from the first capacitor $Q_1 = Q_2$.

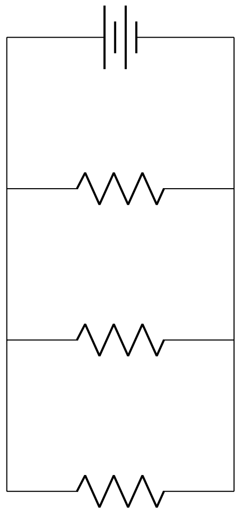
The charge is the same when capacitors are in series.

$$v = v_1 + v_2 = \frac{Q}{C_{eq}} = \frac{Q_1}{C_1} + \frac{Q_2}{C_2}$$

Therefore:

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

Capacitors in series have smaller capacitance.



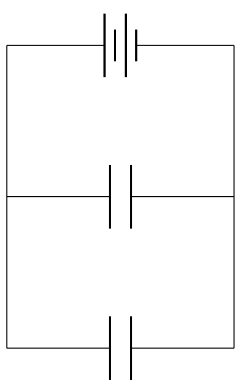
$$v_1 = v_2 = v_3 = v$$
$$i = i_1 + i_2 + i_3$$

$$\frac{v_1}{r_1} + \frac{v_2}{r_2} + \frac{v_3}{r_3} = i = \frac{v}{r_{eq}}$$

Dividing using the first equation:

$$\frac{1}{r_{eq}} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}$$

Parallel resistors reduce the overall resistance. Mirror to Capacitors in series.



The equivalent charge is the sum of the charges of each capacitor.

$$Q_{eq} = Q_1 + Q_2$$

The voltage differences must be the same.

$$v_1 = v_2 = v$$

The total charge:

$$Q = Q_1 + Q_2$$

$$c_{eq}v = c_1v_1 + c_2v_2$$

$$c_{eq} = c_1 + c_2$$

Capacitors in parallel add.

Kirchoff's Rules

1. The algebraic sum of currents flowing into any junction in a circuit is always zero. (every current flowing in is balanced by current flowing out).

   Currents are a vector field with a divergence equal to zero. Similar to water.

2. Algebraic of all potential differences (voltage) in a closed circuit loop is always zero.

   The voltage lift across a battery must equal the voltage drop across the circuit. A closed circuit cannot elevate or reduce the total potential across the entire circuit.

3.