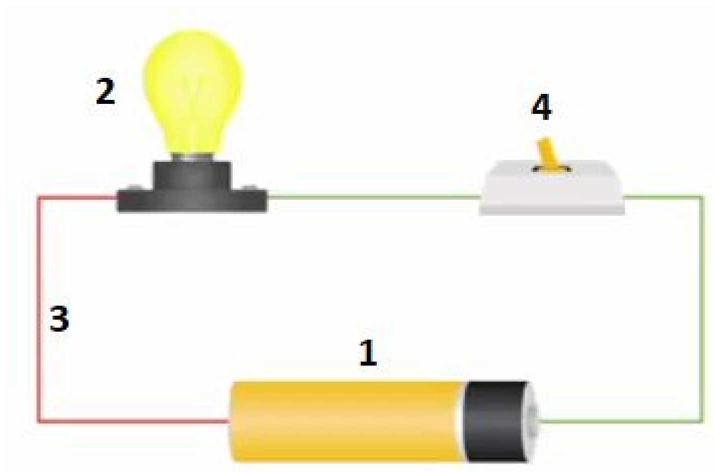
Electric Circuits Notes

- Electric circuits have 4 features
  - 1. Source of electrical energy
    - Ex. battery
  - 2. Devices to use the electrical energy
    - Ex. light bulb
  - 3. Conducting wires
  - 4. Switch

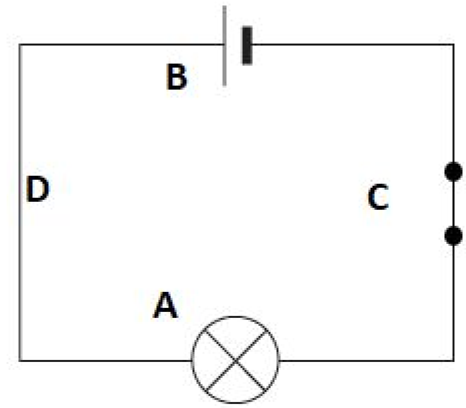


- Circuit diagrams - drawings that represent an electric circuit
  - Common symbols used:

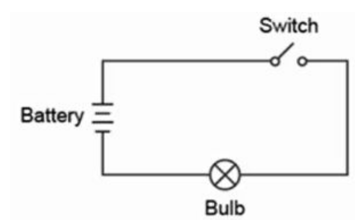
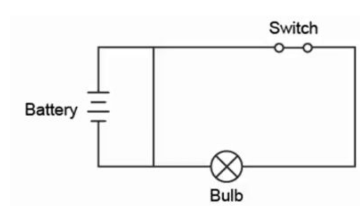
Wire	Bulb	Open switch	Resistor
Closed switch	Ammeter	Battery	Voltmeter

- When resistors resist the flow of electrical energy they turn it into 1 of 3 things
  - 1. Light
    - Ex. light bulb
  - 2. Mechanical energy
    - Ex. motor
  - 3. Thermal energy
    - Ex. space heater
    - All resistors due this in some form even if it’s not their main purpose
      - Ex. A light bulb gets hot

- Question: Identify the parts of the circuit diagram labeled A, B, C, and D.

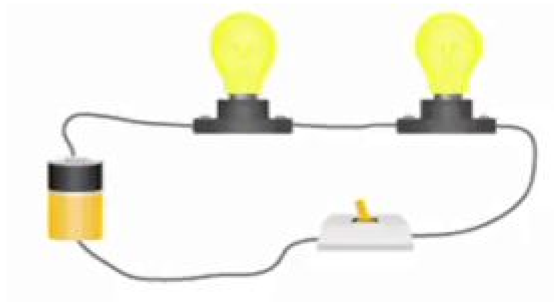


  - A. bulb
  - B. battery
  - C. closed switch
  - D. wire
- Electric circuits fall under 3 main categories

Type	Definition	Example
Open circuit	A noncontinuous loop that prevents the flow of current	
Closed circuit	A continuous loop that allows the flow of current	
Short circuit	A disrupted circuit in which the current bypasses its proper path	

  - Question: Arrange the type of circuit in order of current flow from least to greatest.
    - Open, closed, short
- Series circuit - there is only one path for the current to flow

- Everything is connected in a single path



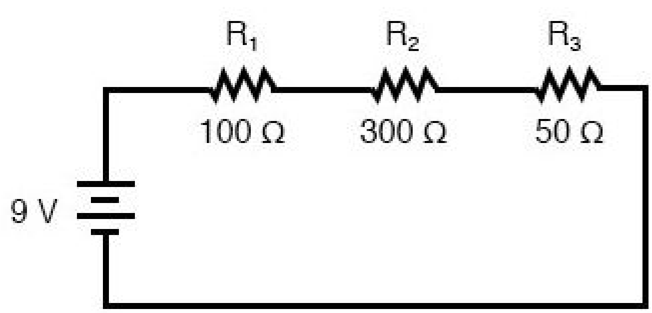
- Think of old Christmas lights. When one blows, the whole circuit is broken.
- As you add more and more bulbs to the circuit, each one gets dimmer.
  - Each bulb adds resistance, so it decreases the current
- They are simple to make though!
- Formula:

$$R_{eq} = R_1 + R_2 + R_3 + \ldots R_n$$

  - R_{eq} = equivalent resistance (total resistance)
    - Unit: Ω
  - R_n = resistance of nth resistor
    - Unit: Ω
- Formula:

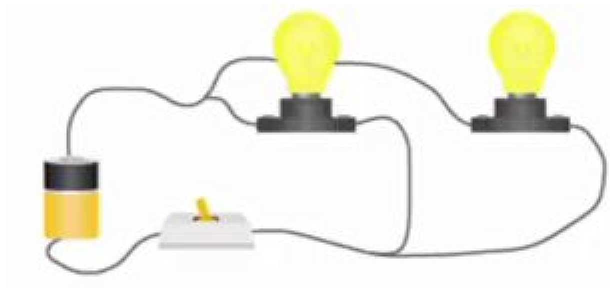
$$I = \frac{V}{R_{eq}} = \frac{V}{R_1 + R_2 + R_3 + \ldots R_n}$$

  - I = current
    - Unit: A
  - V = voltage
    - Unit: V
  - R_{eq} = equivalent resistance (total resistance)
    - Unit: Ω
- Question: Calculate the current for the circuit diagram below.



- Given: V = 9 V
  - R_1 = 100 Ω
  - R_2 = 300 Ω
  - R_3 = 50 Ω
- Unknown: I = ?
- Equations: I = $\frac{V}{R_{eq}}$ and $R_{eq} = R_1 + R_2 + R_3$
- Substitute: I = $\frac{9\ V}{R_{eq}}$ and R_{eq} = 100 Ω + 300 Ω + 50 Ω
- Solve: I = $\frac{9\ V}{450\ \Omega}$ = 0.02 A and R_{eq} = 450 Ω

- Parallel circuits - there are multiple branches for the current to travel



  - If one branch is broken, the current can flow through the other branches instead
  - These are like the new Christmas lights. If one bulb goes out, the other sections of the tree stay lit.
  - All the bulbs shine at maximum brightness no matter what happens in the other branches.
  - They are more difficult to build.
  - Formula:

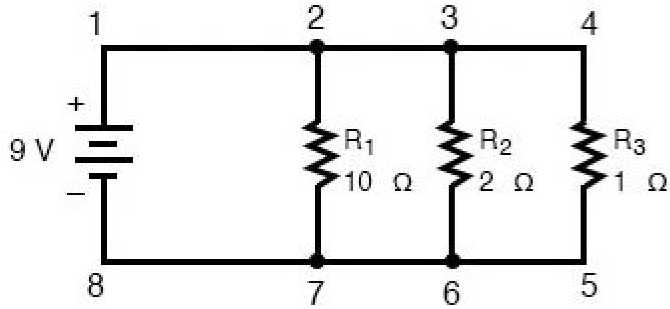
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots \frac{1}{R_n}$$

    - R_{eq} = equivalent resistance (total resistance)
      - Unit: Ω
    - R_n = resistance of nth resistor
      - Unit: Ω
  - Formula:

$$I = I_1 + I_2 + I_3 + \ldots I_n$$

    - I = total current
      - Unit: A
    - I_n = current in nth branch
      - Unit: A

- Question: Calculate the current for the circuit diagram below.



  - Given: V = 9 V

    R_1 = 10 Ω

    R_2 = 2 Ω

    R_3 = 1 Ω

  - Unknown: I = ?
  - Equations: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ and $I = \frac{V}{R_{eq}}$
  - Substitute: $\frac{1}{R_{eq}} = \frac{1}{10\,\Omega} + \frac{1}{2\,\Omega} + \frac{1}{1\,\Omega}$ and $I = \frac{9\,V}{R_{eq}}$
  - Solve: $\frac{1}{R_{eq}}$ = 0.1 Ω + 0.5 Ω + 1 Ω and $I = \frac{9\,V}{R_{eq}}$

    $\frac{1}{R_{eq}}$ = 1.6 Ω and $I = \frac{9\,V}{R_{eq}}$

    R_{eq} = 0.625 Ω and $I = \frac{9\,V}{R_{eq}} = \frac{9\,V}{0.625\,\Omega}$ = 14.4 A