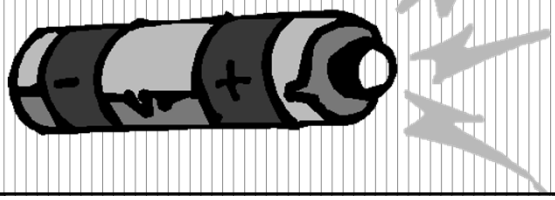
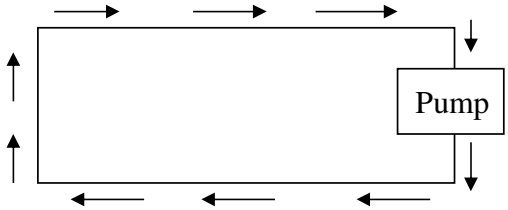
Current and Resistance



1

Electric Current

- movement of electrical charge
  - flows between two points of different potential (voltage)

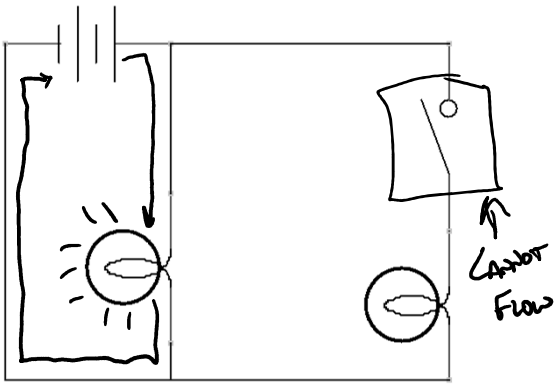


  - maintained by a type of charge pump, which continuously changes the potential
- Electrons flow from "-" to "+"
- Conventional Current goes from "+" to "-"

2

Electrical Circuit

- A closed electrical loop in which charge can flow
- Must have a high potential and low potential for current to flow



3

Sources of Current

- Each source maintains a potential difference across their terminals by converting other forms of energy to electrical energy
  - Batteries
    - Converts chemical energy into electric energy
  - Photovoltaic Cell (Solar Cell)
    - Converts light into electrical energy
  - Generators
    - Converts mechanical energy into electric energy

4

Moving Charge

- Charges are not created or destroyed, only transferred from one side of the pump to the other
- Current (I) can be found using:

$$I = \frac{\Delta Q}{\Delta t}$$

- Ampere
  - amount of charge moved in a circuit every second
    1 C/s = 1 Amp
  - measured with an ammeter

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Current Kills

The Damage Caused by Electric Shock	
Current	**Possible Effects**
1 mA	mild shock can be felt
5 mA	shock is painful
15 mA	muscle control is lost
100 mA	death can occur

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Sample Problem

- The amount of charge that passes through the filament of a certain light bulb in 2.00 seconds is 1.67 C. Determine the current in the light.

$I = \frac{Q}{t} = \frac{1.67}{2} = .835\,A$

Answer: 0.835 A

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Moving Charges

- Conventional Current
  - flow of positive charge through a circuit
- Power
  - rate at which energy is used or converted to another form of energy

$$P = IV$$
$$E = Pt$$

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Resistance

- The opposition to the flow of electric charge
- In a wire:
  - Longer wires have more resistance
  - Thicker wires have less resistance
  - Different materials affect the resistance
- Resistor
  - Carbon granules are mixed with varying amounts of clay can be molded into cylinders having a finite resistance.
  - Used to control the amount of current in a conductor

Measured in Ohms (Ω)

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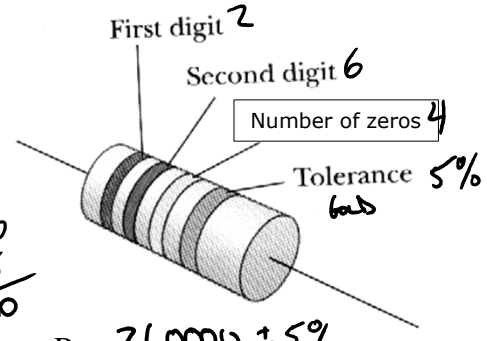
Resistors



260000 × .05 = 13000

R = 260000 ± 5%

Range = 260000 − 13000 to 260000 + 13000

247000Ω to 273000Ω

Color	Number	Tolerance
Black	0	
Brown	1	
Red	2	
Orange	3	
Yellow	4	
Green	5	
Blue	6	
Violet	7	
Gray	8	
White	9	
Gold		5%
Silver		10%

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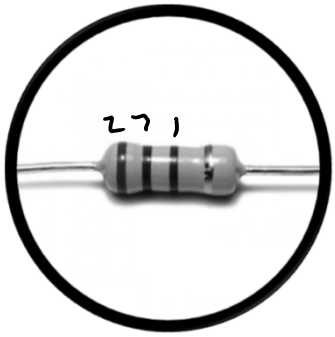
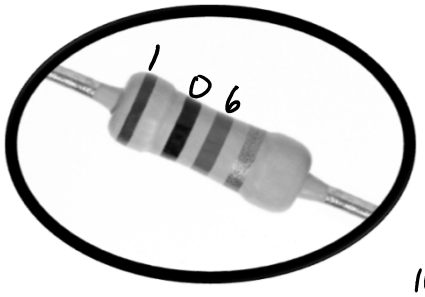
Example Resistors





270
x .05
13.5

R = 270Ω ± 5%

Range = 276.5Ω to 283.5Ω

R = 10000000 ± 5%

Range = 9500000Ω to 10500000Ω

10000000
x .05
500000

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Resistance (Ohms Law)

- The ratio of the potential difference across a conductor to the current it carries is constant.
- This constant is the resistance in the circuit.

$$R = \frac{V}{I} \quad \text{or} \quad V = IR$$

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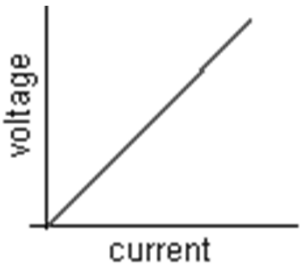
Ohmic Materials

- Follows Ohm's Law and will have a constant slope on a V vs. I graph



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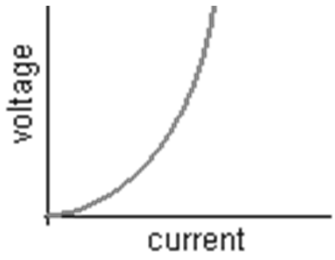
Non-Ohmic

- **Do not** follow Ohm's Law and **will not** have a constant slope on a V vs. I graph



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Sample Problem

- A steam iron has a current of 6.4 A running through it when connected to a 120V outlet. What is the resistance of the iron?

$V = IR$

$120 = (6.4)R$

$R = \frac{120}{6.4} = 18.75\,\Omega$

Answer: 18.75Ω

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