# Electric Current

**Electric Current is charge in motion**

# Electric Current from batteries

In 1780s Volta found certain combinations of metals, such as zinc and silver, produced an electric current that caused a separation of the leaves of an electroscope.

Example: Carbon electrode and zinc electrode in sulfuric acid. Zinc ions enter the acid; electrons flow from zinc electrode (-) to carbon electrode (+). Thus, a potential difference is established between the two electrodes.

# Electric Current

- Electric current is “FLOW OF CHARGE.”
- 1 amp = 1 Coulomb/sec

- Analogy: speed = distance/time
- flow of traffic = cars/time
- current flow = charge/time

# How many electrons are in 1 amp?

- 1 amp = 1 Coulomb/1 second

- How many electrons in 1 Coulomb?

# Example

- What is the electric current in a conductor if 240 coulombs of charge pass through it in 1.0 minute?

# Direction of Current

- When the conventions of positive and negative charge were invented 200 years ago, it was assumed that POSITIVE charge flowed in a wire. So, conventional flow of charge is using positive charge flowing from positive to negative.
- Electron current is the opposite direction of conventional current.

# Potential Difference drives an electric current

- To produce an electric current in a circuit, you need a potential difference.
- Example: battery
- Analogy: flow of water acted upon by gravity.
- the greater the height, the greater
- the current. An increase in height
- causes a greater flow of water.

# Resistance

- Materials offer “resistance” to the flow of current.
- Analogy: resistance to current is like friction.
- like friction, resistance causes heat
- which is a loss of energy.

# Resistance = Voltage/Current

- Resistance is measured in ohms.
- R = V/C
- Ohms = volts/amps

# Good Conductors (low resistivity)

- Silver (1.59 x 10^(-8) resistivity)
- Copper (1.68 x 10^(-8) resistivity)
- Gold (2.44 x 10^(-8) resistivity)

# Semiconductors

- Carbon ( 3 – 60 x 10^(-5) resistivity)
- Germanium (1 – 500) x 10^(-3) resistivity)
- Silicon (0.1 – 10 resistivity)

# Insulators (poor conductors)

- Glass
- Hard rubber

# Minimize Resistance in a wire

- Thick
- Short
- cold

# Maximize Resistance in a wire

- Long
- Thin
- hot

# Resistance Calculation

- Resistance = (resistivity)(length/area)

- Example: calculate the resistance of an aluminum wire that is 0.20 meter long and has a cross sectional area of 1.00 x 10^(-3) square meter.
- R = (resistivity)(length/area)
- = 2.65 x 10^(-8) (.20 m)/(1.00 x 10^(-3))
- = 5.30 x 10^(-6)

# Ohm’s Law

- $V = I \times R$
- $I = V/R$
- $R = V/I$

# Example

- If the potential difference across a 30 ohm resistor is 10 volts, what is the current?
- IR = V  so, I = V/R = 10/30 = 0.33 amps

# Group Activity

- Calculate the missing parameter using Ohm's Law (IR = V)

| | Volts | Resistance (ohms) | Current (amps) |
|---|---|---|---|
| 1. | 120 | 40 | ? |
| 2. | 120 | ? | 8 |
| 3. | 120 | ? | 50 |
| 4. | ? | 6 | 18 |
| 5. | ? | 24 | 96 |