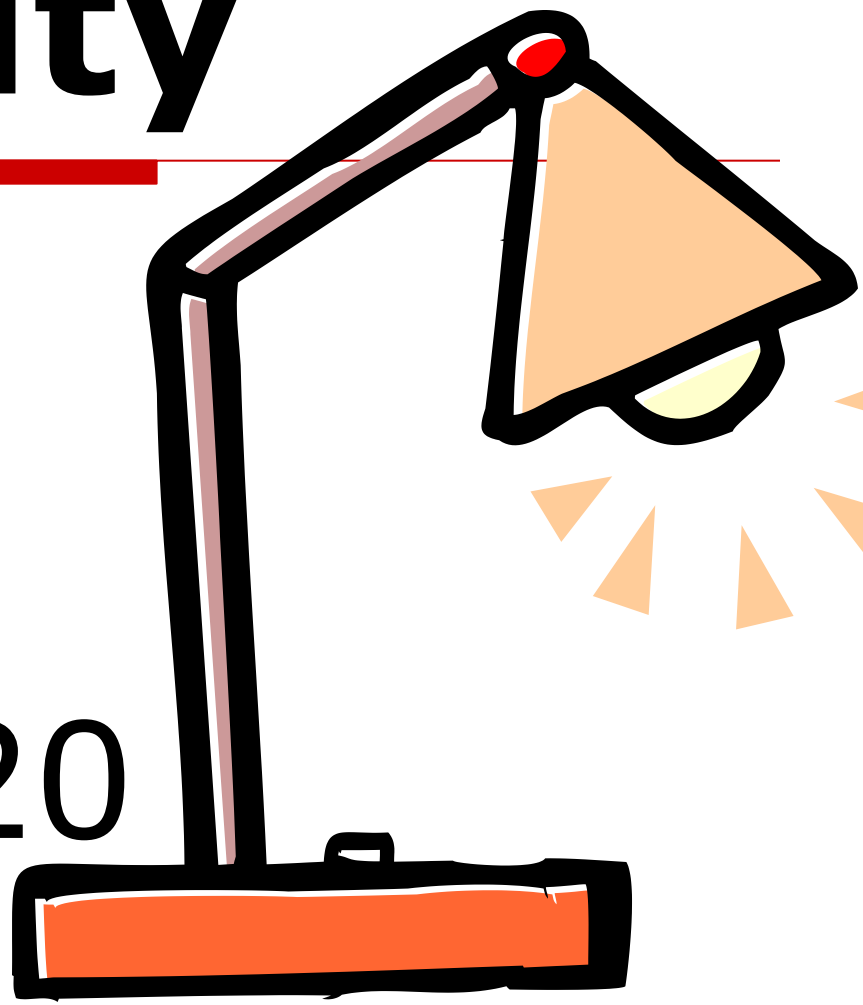
Electricity

P. Sci.

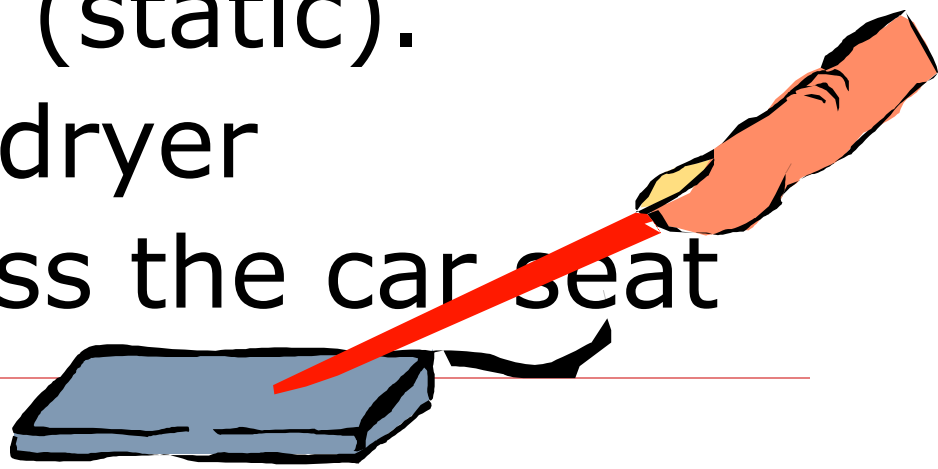
Unit: 7

Chapter: 20



Static Electricity

- Created when electrons are transferred between objects
- Ex: shoes moving across carpet on a dry day generates charges (static).
- Ex. Clothes in a dryer
- Ex. Sliding across the car seat



Negative & Positive Charges

- Two types of charges are positive(+) and negative(-)
- Come from atomic particles in an atom: electrons (-), protons (+), neutrons (neutral)
- Like Charges repel and Unlike (Opposite) charges attract
- Positive & Negative = attract
- Positive & Positive = repel

Try this:

- Get two pieces of tape about 5-6 cm in length
- Place each of them on the desk and remove them quickly
- Bring the two pieces of tape close together

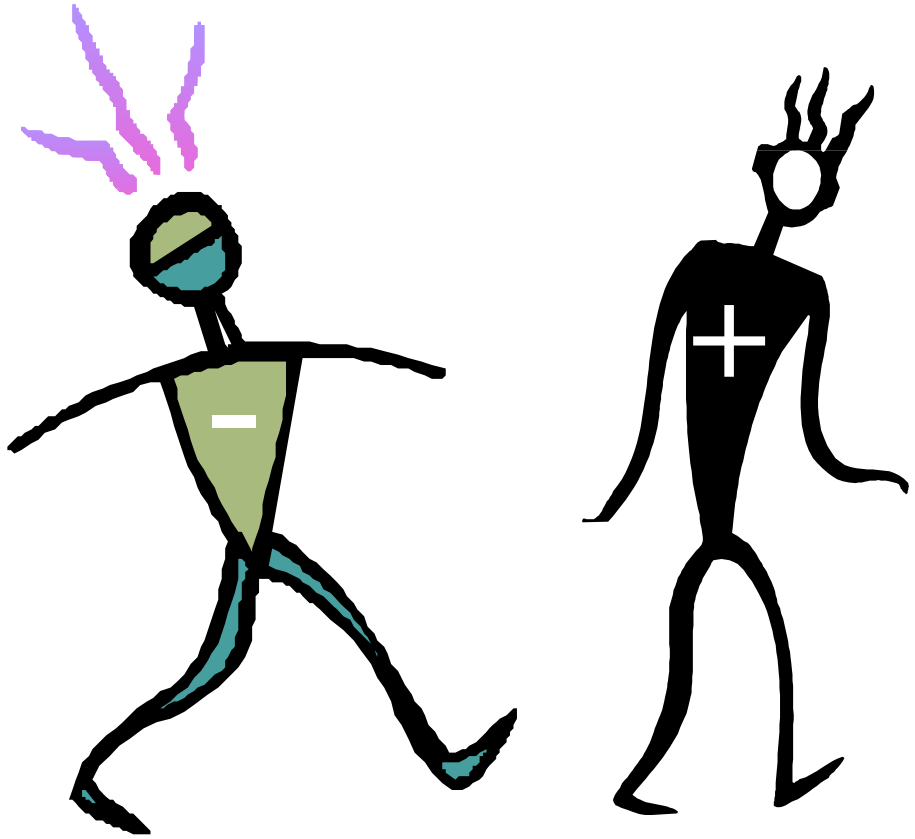
- What happens?

Continue:

- Take one of the pieces of tape and place on the desk again, then place the second piece on top of the first.
- Remove both pieces and separate.
- Bring the two pieces close together.
- What happens?
- Why? Explain the difference.

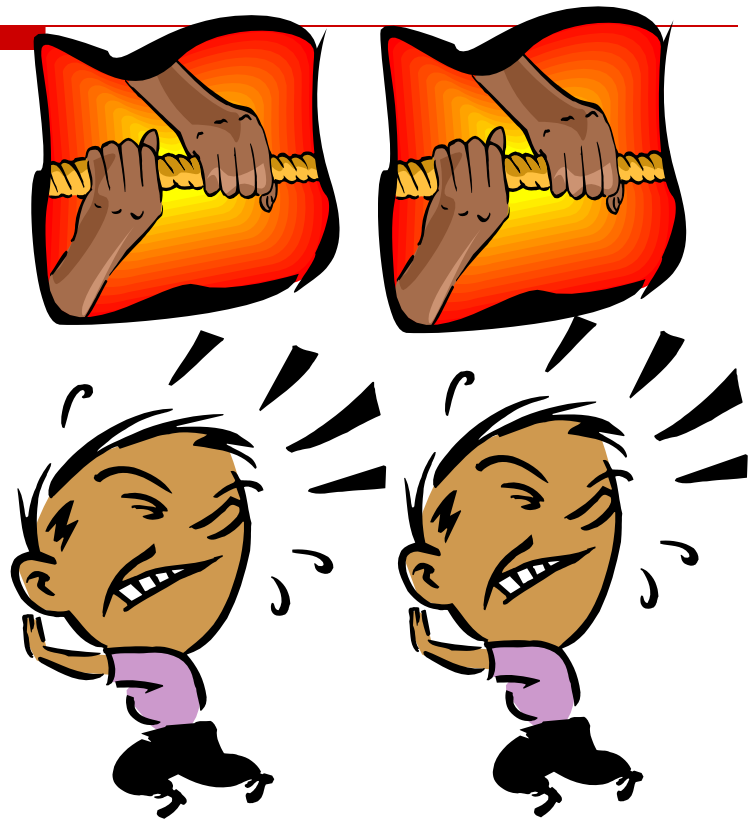
Electric Charge

- SI Unit for electric charge is coulomb (C)



Electric Force

- The force of attraction or repulsion between objects due to charge.



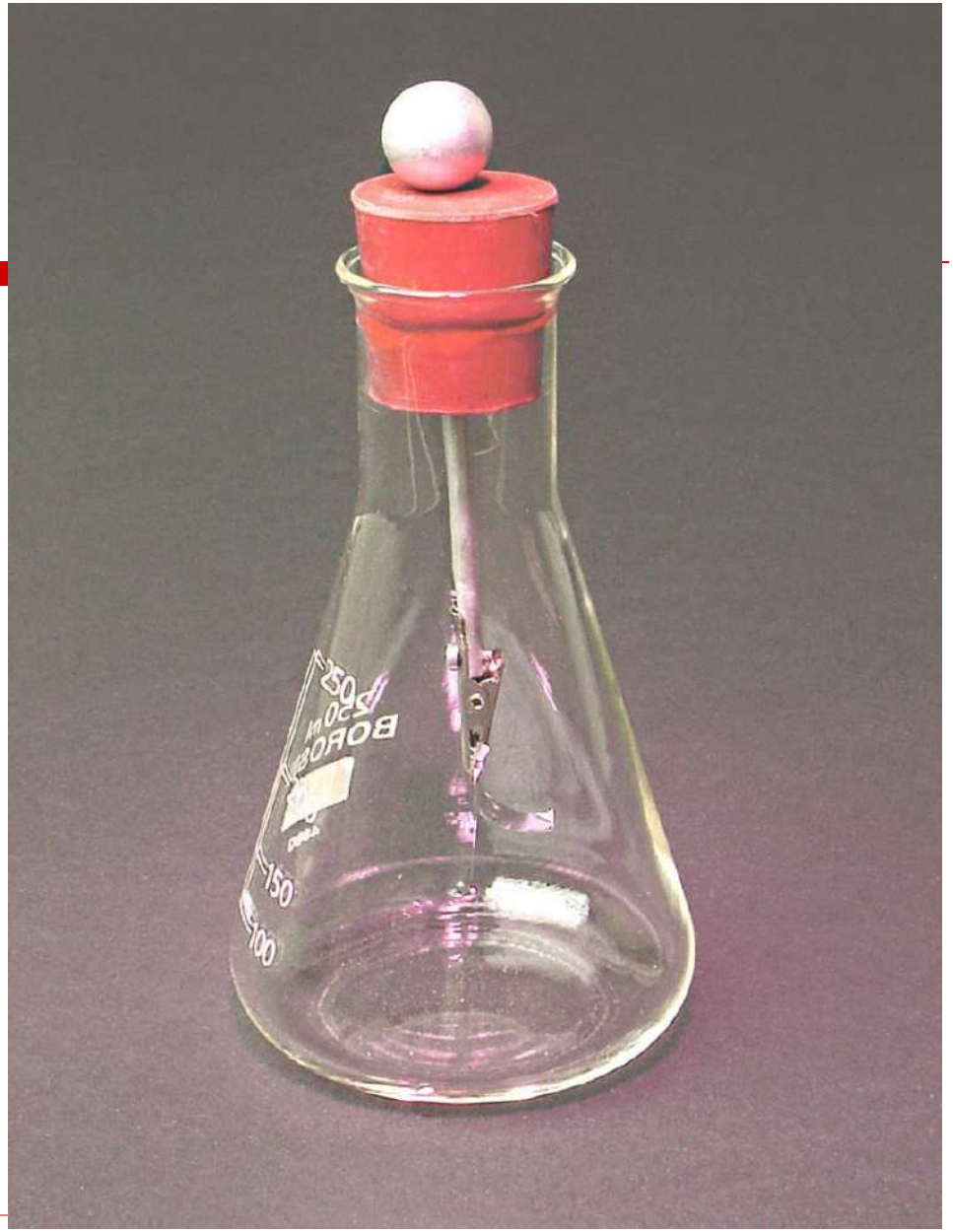
- It depends on charge and distance.

Electric forces

- Electrical forces are much greater than gravitational forces because they can overcome gravity.
- Electrical forces can also attract or repel, unlike gravity.
- Electrical forces exert force over a distance.
- A device called an electroscope can be used to show charges.

Electroscope

- Insert picture



Charging by Friction

- Involves rubbing two objects together
- One object loses electrons, one object gains electrons
- They become charged oppositely
  - Ex. Sliding across the car seat
  - Rubbing a balloon on your hair
  - Clothes in a dryer
  - Shoes on carpet

Charging by Friction

- Materials get charged due to movement of electrons (e^-) from one material to other.
- The materials that receive e^- become negative and the materials that give e^- become positive.

Charging by Conduction

- Involves two objects touching.
- Charges transfer between two objects
- Become charged alike and therefore the objects repel each other
- http://www.regentsprep.org/Regents/physics/phys03/aelecla b/escope.htm

Charging by contact

- Done by touching a neutral object with a charged object

Without Friction

Charging by Induction

- Bringing a charged object near, but not touching another object
- Causes the electrons to either repel from a negative object or attract to a positive object
- http://regentsprep.org/Regents/physics/phys03/aeleclab/induct.htm

Conductors Vs Insulators

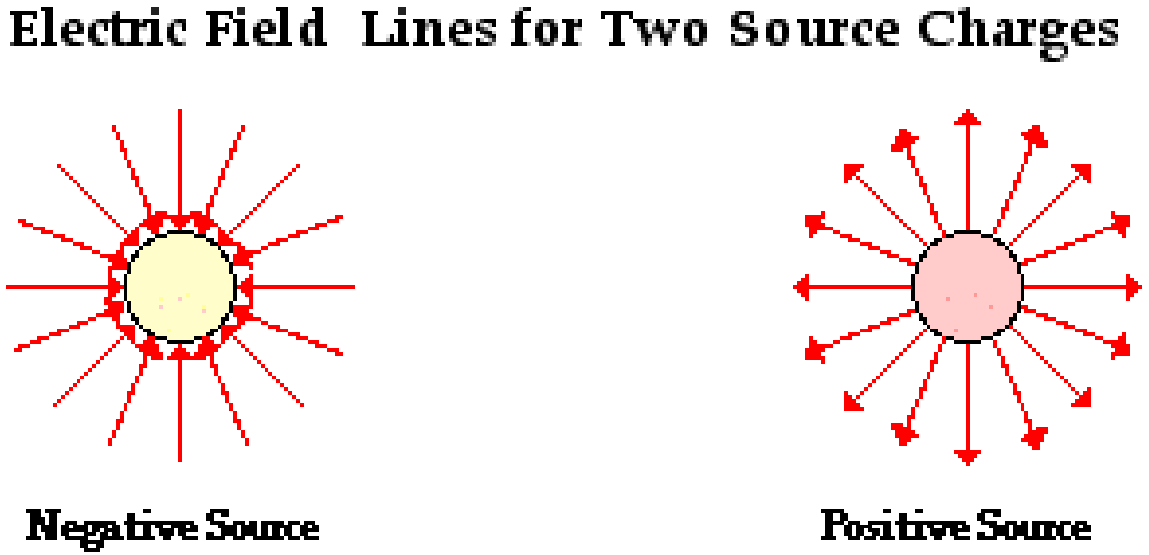
CONDUCTORS	**INSULATORS**
Materials that allow electric charge to flow freely	Materials that do not allow free flow of charge
Ex: metals in the cords of electric wire	Ex: plastic, silk, wool, rubber

Electric Field

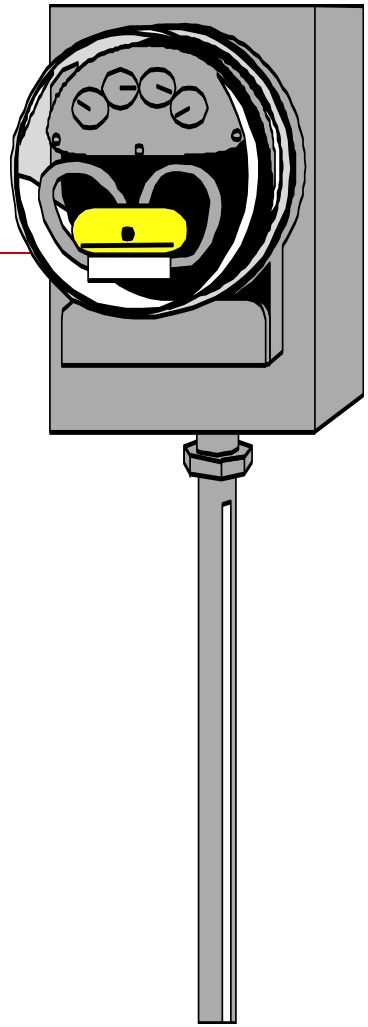
- The region around a charged object where other charges experience an electric force.
- It can be shown by drawing ***electric field lines.***

Electric Field Lines

- Scientists always use a positive field charge to draw lines around a charge object.



Electric Current

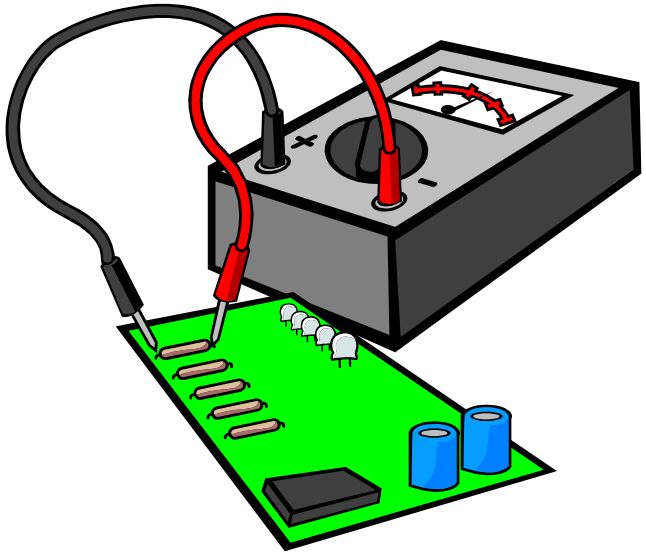


- The rate (how fast) that electric charges move through a conductor.
- SI unit for current is ampere, A
- 1A = 1C charge flow in 1sec

Potential Difference

- Remember Gravitational Potential Energy (GPE) – A ball will roll downhill from *High* GPE to *Low* GPE
- Electrical Potential Energy (EPE) – the change in potential energy per unit of charge.

Potential Difference cont.



- Potential difference is the change that occurs as a charge moves from one place to another in an electric field.

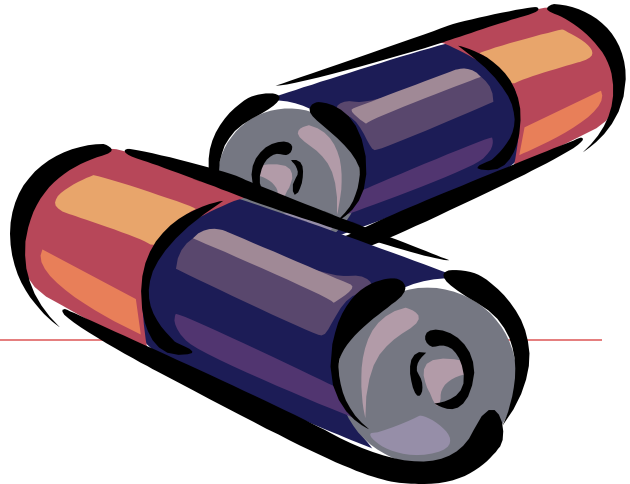
Potential Difference cont.

- Potential difference is measured in volts, V.
- 1V = 1 J/C
- PD is the change in the EPE divided by its charge.

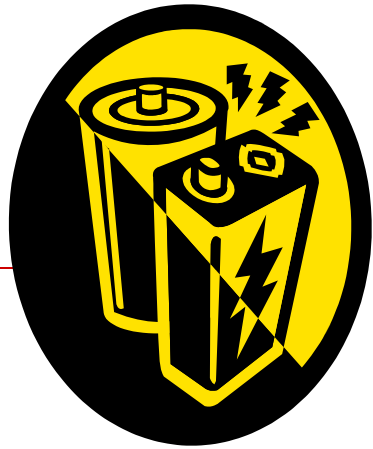
Batteries

- A way of converting chemical energy to electrical energy
- charges move from one terminal to another in the same direction.

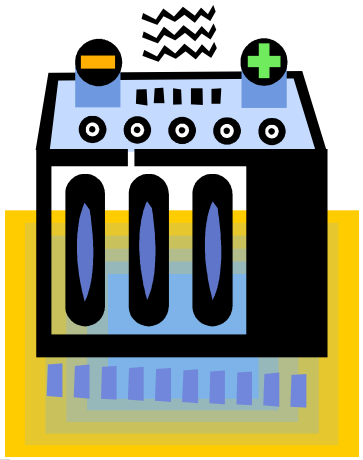
(Direct current or DC)



Electric Current from Batteries



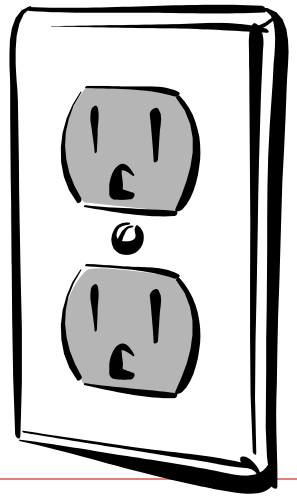
- Dry cells – flashlights
- Wet cells – cars

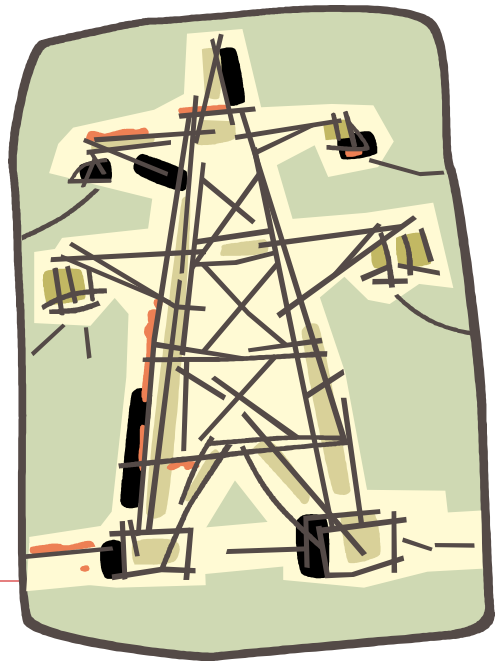


- Electrons flow from negative to positive terminals – the rate of its flow determines current.

Electricity from Generators

- Called alternating current (AC)
- Used in our homes
- Current changes direction 60 times in one second (60 Hz)

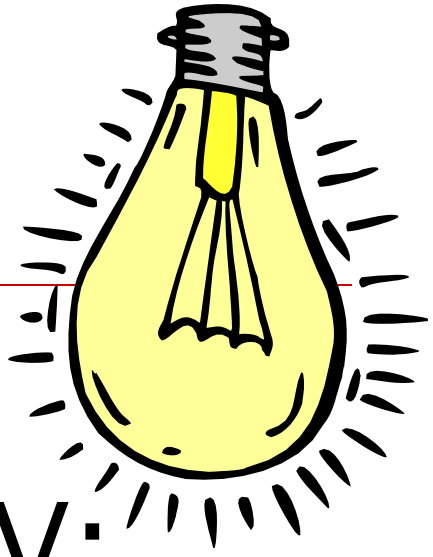




Electrical Resistance

- The difference in the current between two conductors is due to their resistance.

Resistance cont.

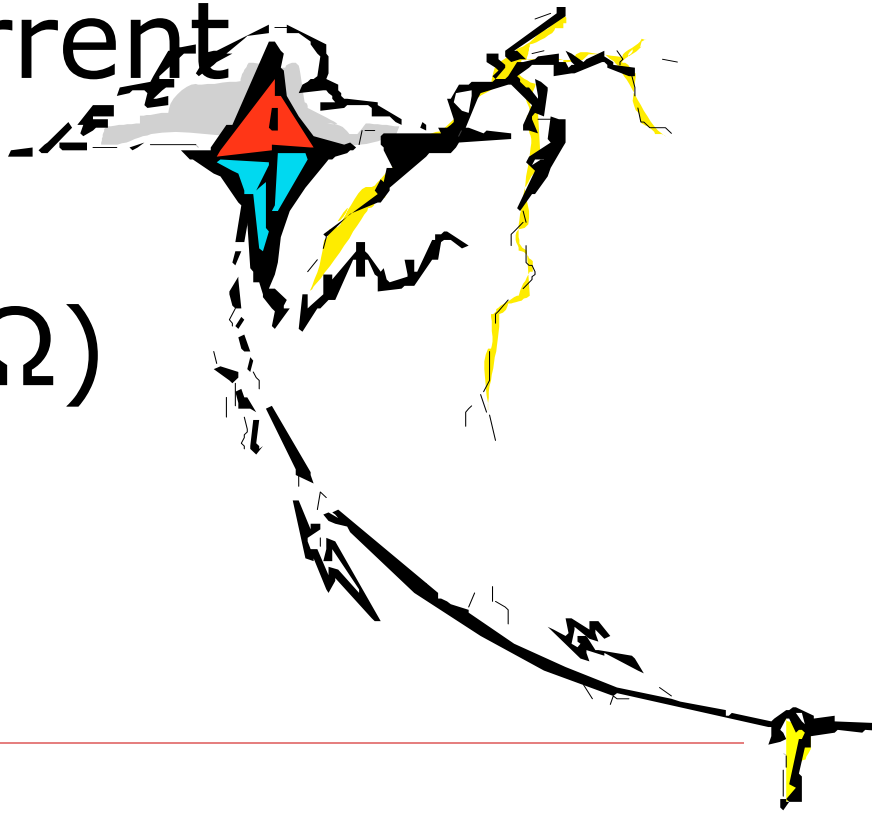


- With a voltage of 120 V:

- And a 40 W bulb (dimmer- high resistance)
- And a 100 W (brighter- low resistance)

Calculating Resistance

- Resistance = $\frac{\text{voltage}}{\text{current}}$
- R = V/I
- SI Unit is ohm (Ω)



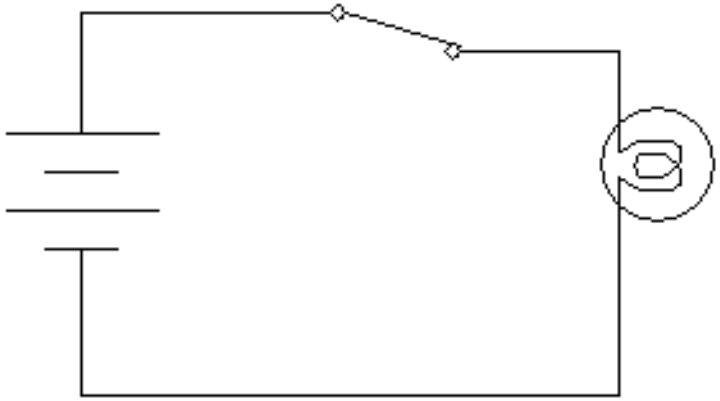
Resistance cont.

- Conductors = low resistance
- Insulators = high resistance
- Semi-conductors = intermediate
- Super conductors = zero resistance (below a certain temperature)

Circuits

- One or more closed-loop paths through which charges can be conducted.
- There are of two types –
  1) Open Circuit
  2) Closed Circuit

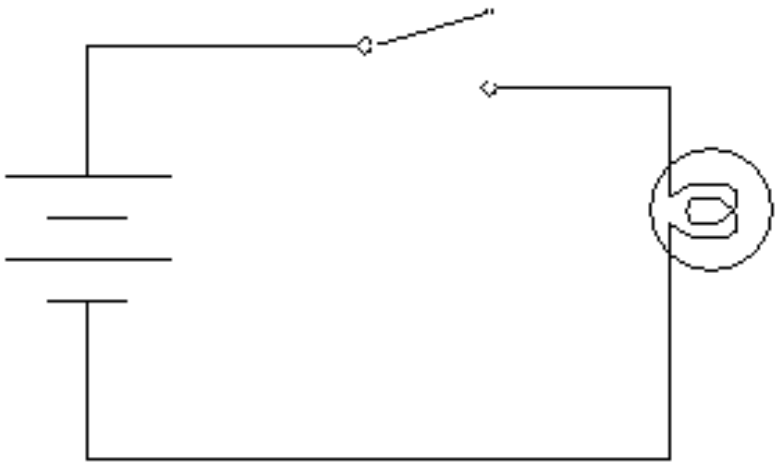
Closed Circuit



- an unbroken path of conductors through which electric current flows
- A switch can be used to open or close a circuit

Open Circuit

- circuit with a break in the conductive path, so no current flows

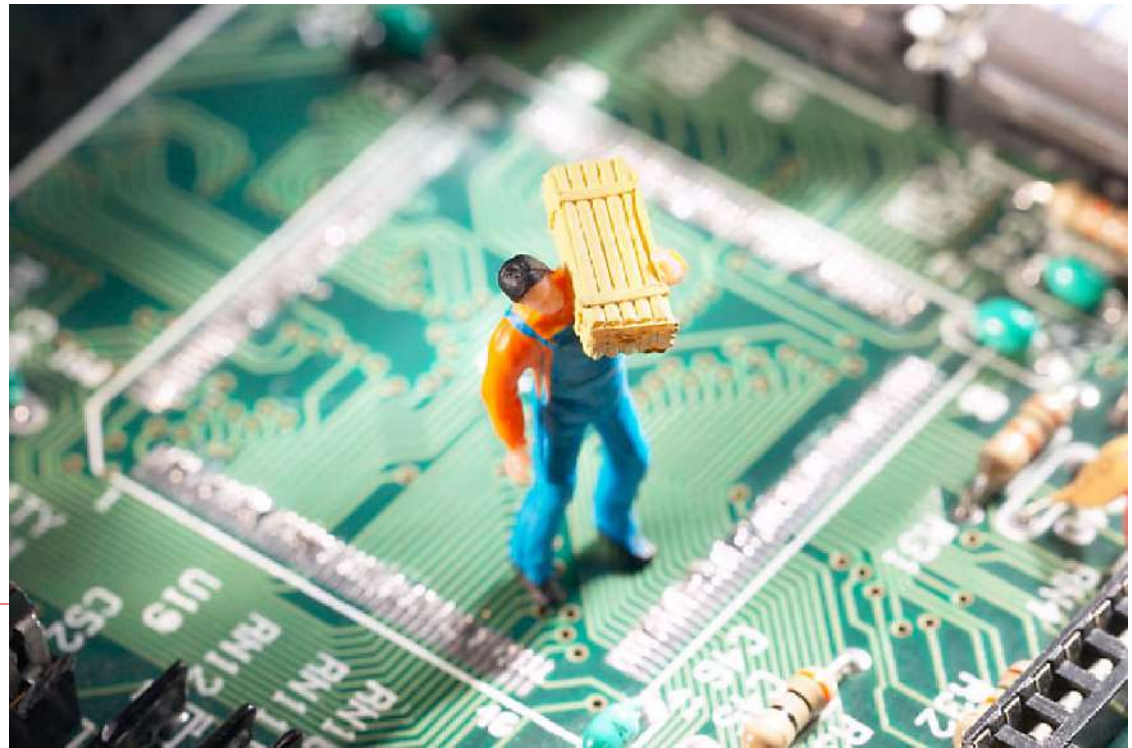


Schematic Diagram

- A diagram depicting the construction of the circuit or electrical apparatus.
- They use standard symbols.
- A circuit can be drawn by using a combination of the symbols.

Schematic Diagram cont.

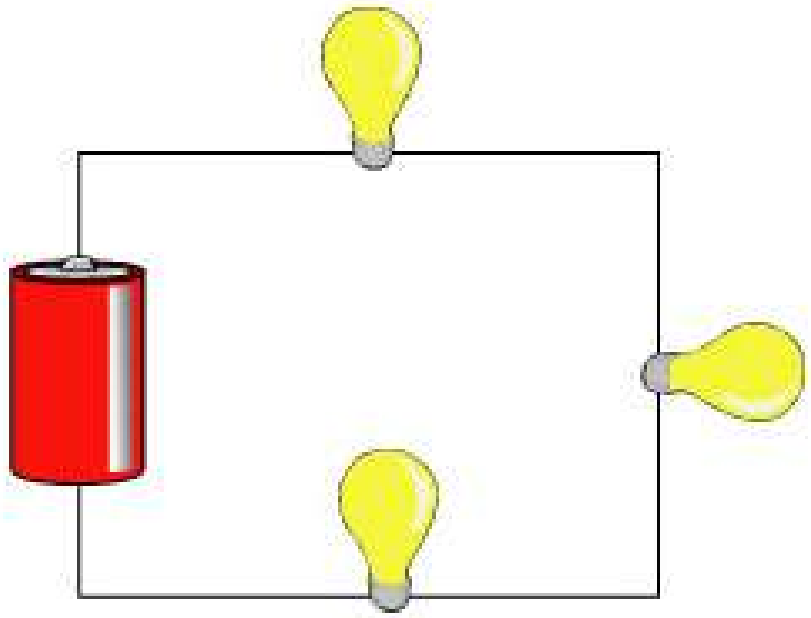
- For symbols look at page #



Series Circuit

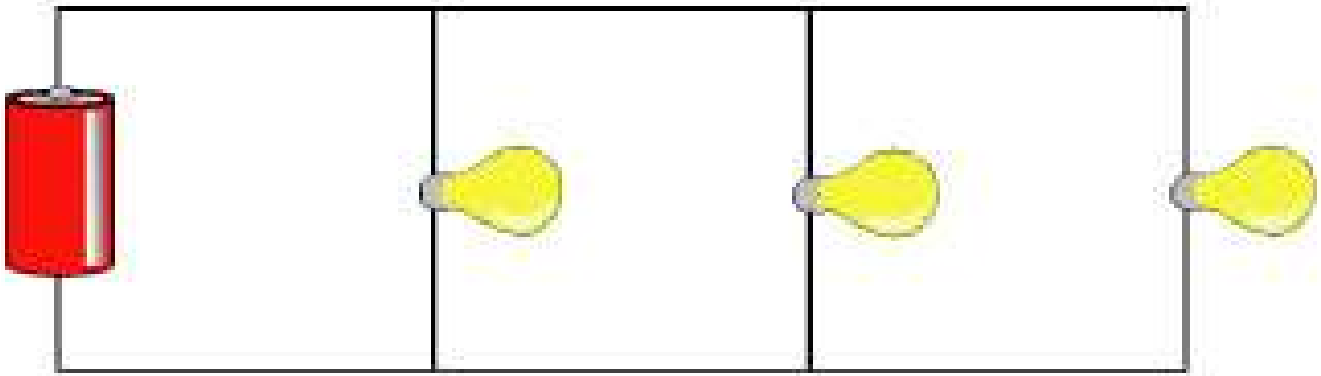
- Single path of current.
- Even one break can cause the circuit to fail.
- I (same),

V (differ)



Parallel Circuit

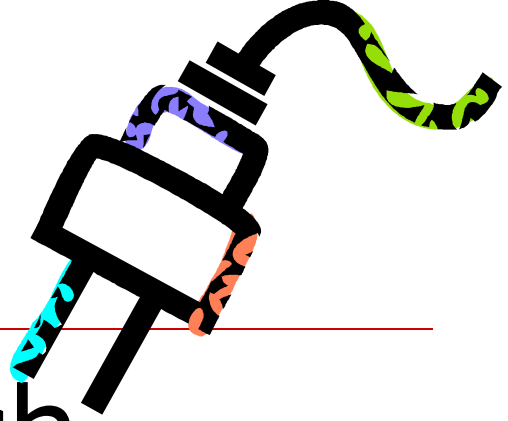
- Multiple paths of current.
- A break in one path doesn't interrupt the flow of current in other paths



Electrical Energy

- Energy related to charges whether moving or at rest
- It is required to run electrical devices.

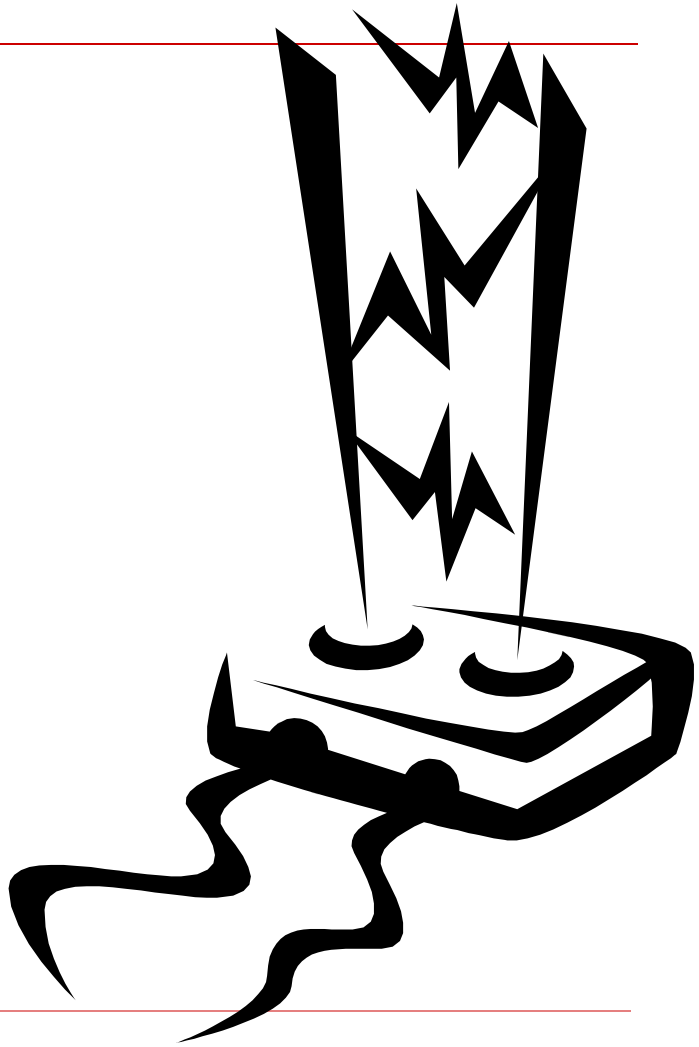
Electric Power



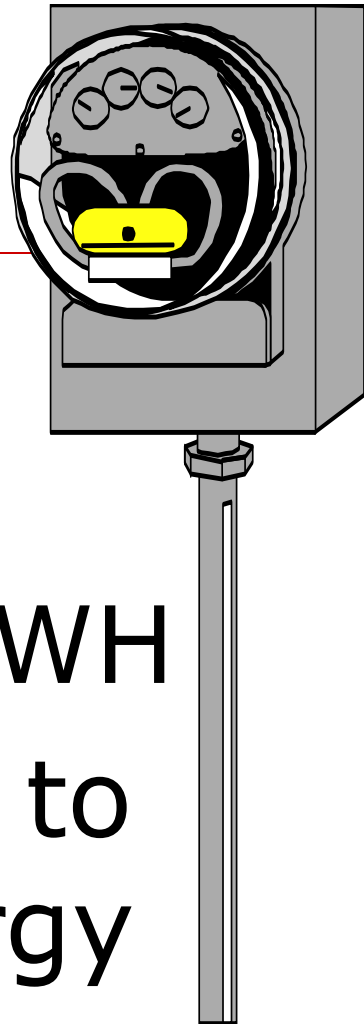
- It is the rate at which electrical work is done.(P)
- Power = Current x Voltage
- P = IV
- The SI Unit of Power is Watt (W).

If V = IR and P = IV

- Then:
  - $P = I^2R$



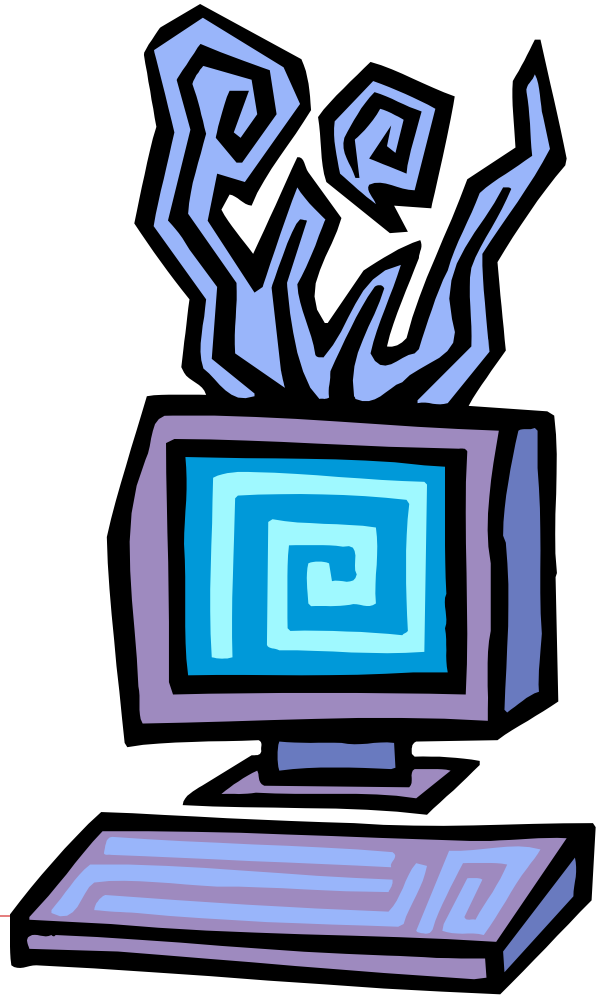
Calculating kW.h



- 1 kW.h = 3.6×10^6 J
- Cost of energy may vary between 5 to 20 cents / KWH
- Electrical meters are used to determine how much energy is used in given time.

Overload & Short Circuit

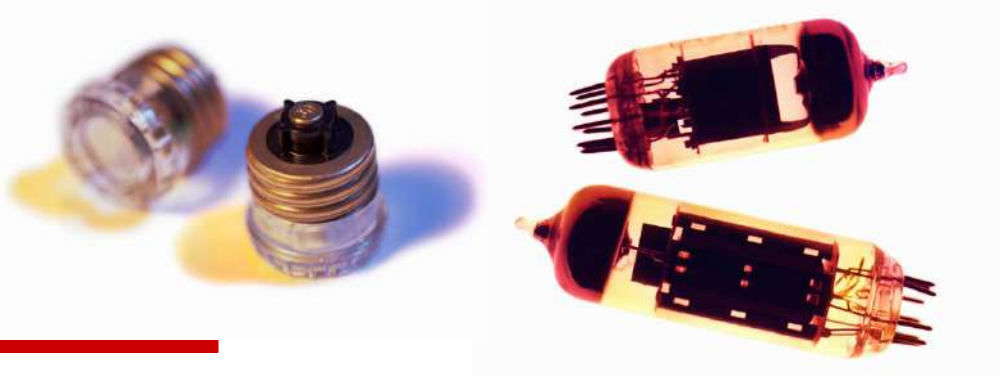
- Overloaded Circuits can cause fire as they carry more than a safe level of current.



Short Circuits cont.

- Worn insulation causes two wires to touch causing an alternating path of current called a *short circuit*.
- Grounding appliances reduces the risk of shock from short circuit.

Fuses



- a ribbon of wire with a low melting point in an electrical device used to prevent overloading or short circuit.
- It melts and blows out (opens the circuit) when the current exceeds the limit.

Circuit Breakers

- Made of magnet and bimetallic strip that respond to circuit overload by opening the circuit.
- It acts as a switch and can be reset by turning the switch back on.