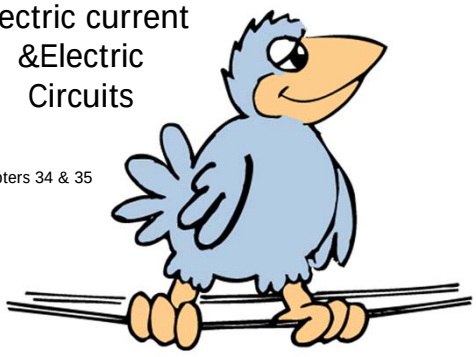
Electric current &Electric Circuits

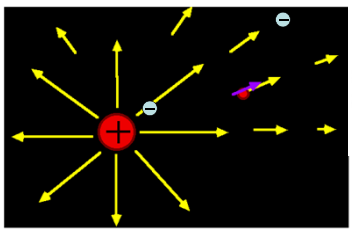
Chapters 34 & 35

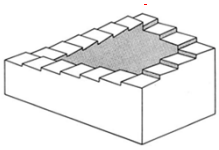


First Lab

- Sparky 1.

From Static to Current



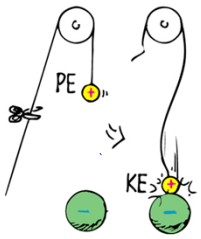


Just like the “Your power” Activity, gain PEg

- Moving the charge from “A” to “B” changes its electrical PE. (Like compressing a spring)

35.1

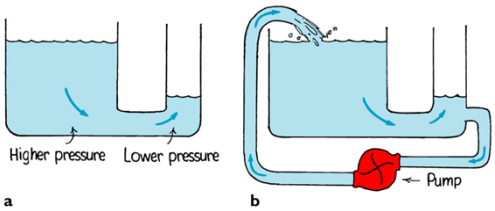
The difference in electric field strength (electric potential) causes charges to flow through a circuit.



35.1

Just like water will flow from a difference in pressure,..

A difference in electric potential must exist for charge (electrons) to flow



35.1

Voltage; a steady flow of charge

- Definition of Cells, Wet, Dry (batteries)
  - Chemical reaction: Redox - reaction
  - Cells in parallel
  - Cells in series
- Generation of Voltage "EMF" electromotive force
- Photo-Voltaic
- Hydrogen cell
- Piezio-electric
- Thermocouple

electrochemical cells

35.2

Niagra Falls, NY

- **"5,000 horsepower generators at the first power plant at Niagra Falls, the 'father' of the modern electric power plant. This plant opened in 1895...was the first big plant to generate and transmit current by means of Tesla Polyphase System."**

35.2

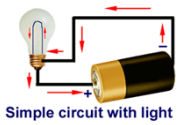
Original Westinghouse Generators at Niagra Falls, Oct. 27, 1953:

- "The three generators in the foreground began operating fifty-eight years ago in the world's first large power installation – The Edward Dean Adams power station of Niagra Mohawk Power Corporation. Built by the Westinghouse Electric Corporation and rated at 5,000 electrical horsepower..."

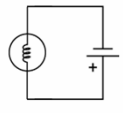
Check out photo by visit Niagra Falls

35.2

Charge Flow is "Current"

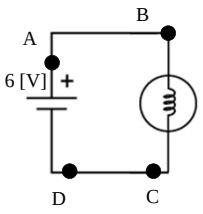


Simple circuit with light



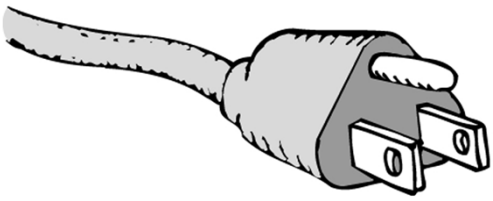
- Electric circuit requires
  - Voltage source
  - Conductor
  - Load
    - Resistor
    - Light bulb
    - Toaster
    - Etc.

35.1



Consider points	△ in electrical PE?	Voltage ?	Will cause current?
A & B			
B & C			
C & D			
D & A			
C & C			

35.2



- Ever notice that the third prong on a plug is longer that the pair of flat prongs?
- Electricians place on hand behind the back when beginning work in a electrical panel.
- Muscular reflex.

35.2

Electric resistance

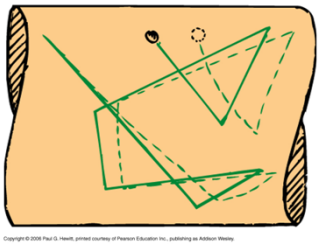
35.2

Repairing High-Voltage Power Lines

- Haverfield Corporation, PA.
- is a commerical company initially established to provide to electric utilities general purpose aircraft charter service using helicopters. In 1984, Haverfield patented a work platform that is attached to the helicopter so that a lineperson can work on energized lines from the platform as the helicopter hovers adjacent to the power line. The site contains a series of lines people at work.

35.2

Speed and source of electrons



- Where does the charge come from that move in the circuit of your house?

Flow of charge is "Current"

35.2

Flow of charge is "Current"

- Measured in Amperes [A]
- 1 coulomb of charge flowing in one second is 1 “amp.” or 1 [A]
- Amperes is a measure of how many electrons flow in one second. Just like stream flow

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

35.2

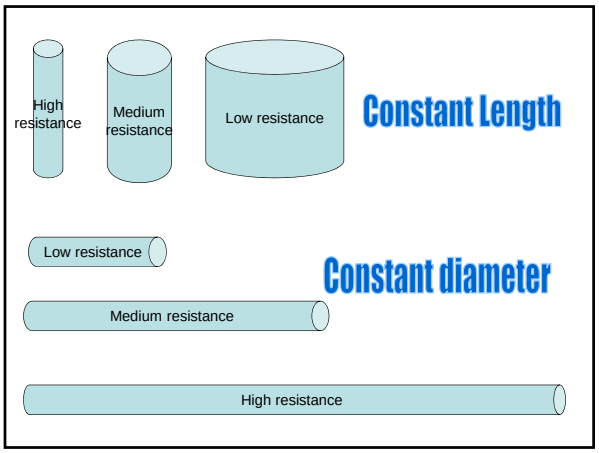
Example

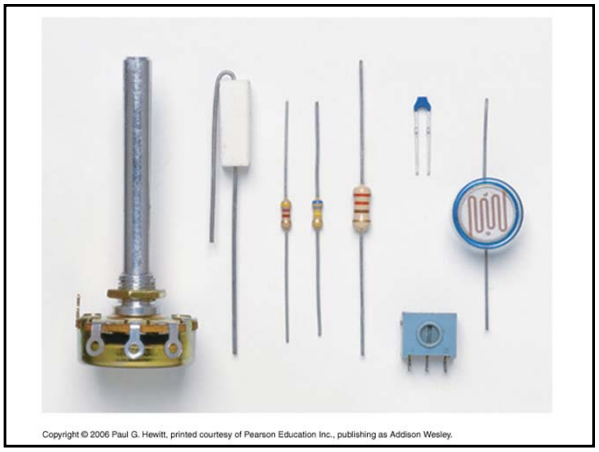
- Household current in a circuit cannot generally exceed 15 [A] for safety reasons. What is the maximum amount of charge that can flow through this circuit in a house during the course of a 24.0 hr day?

- Worksheet
  - "Electric Circuits and Electrical Current"
  - 15 min.

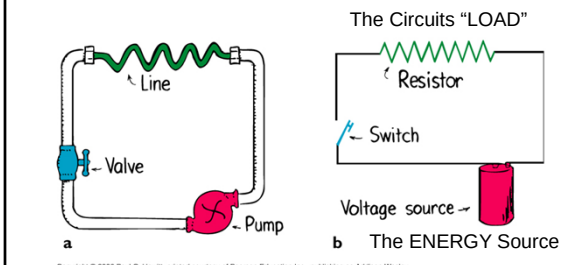
Electric resistance

- Opposition to the flow of charge
- The amount of charge that flows through a circuit depends on the electric push as well as the electrical resistance to the push.
- The current in a circuit depends on the voltage as well as the `resistance.


High resistance
Medium resistance
Low resistance
Constant Length
Low resistance
Constant diameter
Medium resistance
High resistance


Copyright © 2006 Paul G. Hewitt, printed courtesy of Pearson Education Inc., publishing as Addison Wesley.

Ohm's Law


Line
Valve
Pump
a
The Circuits "LOAD"
Resistor
Switch
Voltage source
b
The ENERGY Source
Copyright © 2006 Paul G. Hewitt, printed courtesy of Pearson Education Inc., publishing as Addison Wesley.

Ohm's Law

$$V = IR$$

V is voltage
I is current
R is resistance

Ω

omega

the Physics Classroom

- Worksheet
  - "Electrical Resistance"
  - 15 min.

Electric power

- Power is Work / time
  - Joules / Second
  - Watt
  - Kilowatts, Kw
- Energy
  - Kilowatt-hours Kwhr
  - 17 cents / Kwhr

Power formula

$$P = IV$$

V is voltage
I is current
P is power

Watts

Electrical Power

V is voltage
I is current
P is power

Watts

Energy from Electrical power

$$PE_e = IV*t$$

V is voltage
I is current
PE_e is energy
t = time

Joules

- Worksheet
  - "Electrical Power and Energy"
  - 15 min.

SchoolPower ...Naturally

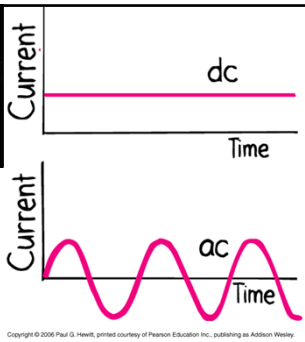
"Classroom power usage"
School Power Naturally
Activity

SchoolPower ...Naturally

"Allocating Energy from a Photovoltaic System"
Activity

SchoolPower ...Naturally

"Relating Power and Energy"
1 period Lab



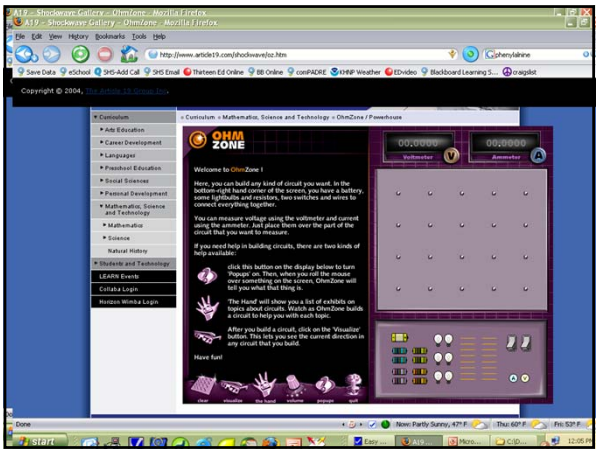
Demonstration:
½ wave rectification
and
Full wave rectification

Edison vs. Westinghouse

- US “House Current”
- 115 Volts
- 15 Amperes (Max)
- 60 Hertz AC
- Load is the resistance - what is in use at the time.

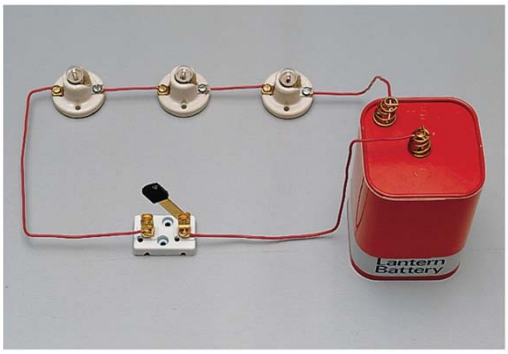
Electric circuits

Chapter 35

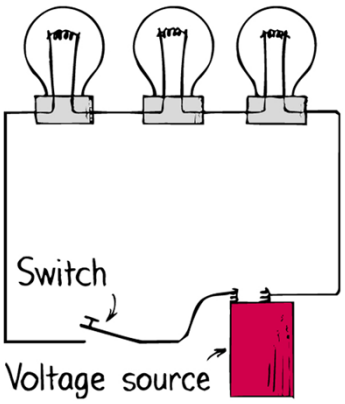


Series circuit summary

Series circuit



Cartoon diagram of series circuit.



Important characteristics of a series circuit.

- Electric current has a single path though the circuit.
- The current is resisted by each of the components in sequence, so
  - Rt = R1 + R2 + R3 + …
- total current = total voltage / total resistance (Ohm's Law)

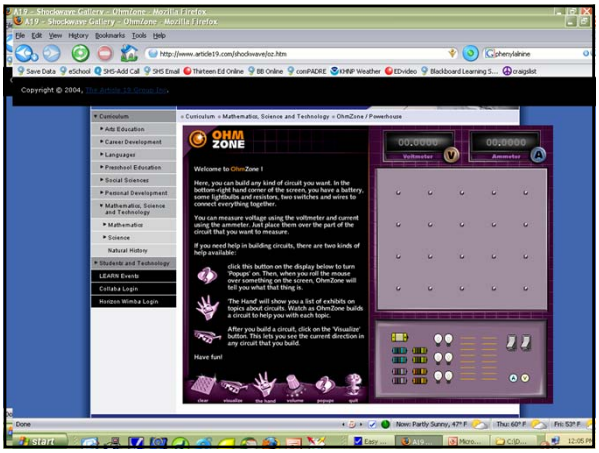
- Ohm's law applies to each of the components. This is called the "Voltage drop" or "IR drop"
- The total voltage impressed across the circuit is divided among each of the components, not always equally!

Summary of Series Circuit

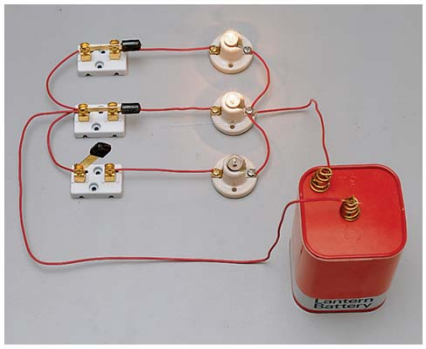
- Voltage
- $V_t = V_1 + V_2 + V_3 + \ldots$
- Resistance
- $R_t = R_1 + R_2 + R_3 + \ldots$
- Current
- $I_t = I_1 = I_2 = I_3 = \ldots$

Concept- Development Practice page **35 – 1**

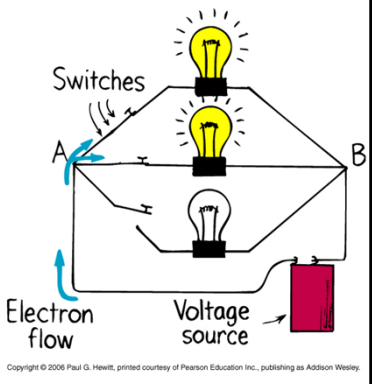
Side 1 Series Circuits



Parallel circuit



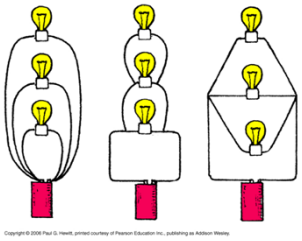
Cartoon diagram of parallel circuit.



Important characteristics of a parallel circuit.

- Each component connects to the same two points in the circuit.
- The total current in the circuit divides among the branches. Current passes more readily through branches with less resistance.
- The total current in the circuit equals the sum of the current in each of the branches.

- As the number of branches increases the total current decreases. This means that the overall resistance is less than the resistance in any one of the branches.



Each of these circuits is identical to the other.

Summary of parallel circuit

- Voltage
- $V_t = V_1 = V_2 = V_3 = \ldots$
- Resistance

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

- Current

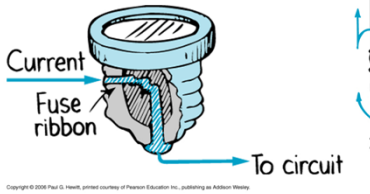
  $I_t = I_1 + I_2 + I_3 + \ldots$

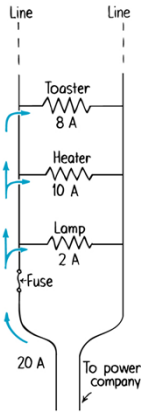
Concept- Development Practice page **35 – 1**

Side 2 Parallel Circuits

Parallel circuits and overloading

Safety in the home





Concept- Development Practice page **35 – 2**

Compound Circuits

One last Thing...

Revisions

- 12-Mar-07 Created
- 18-Mar-08 added Hewitt images, swf's and worksheets.
- 25-Feb-09 Reviewed Hewitt and Physics views videos – chose not to include.
- 4-Mar-09 Added School power naturally activity slides.
- 16-Feb-12 Added Energy formula slide, replaced Hewitt CDPP worksheets with Physics Classroom worksheets