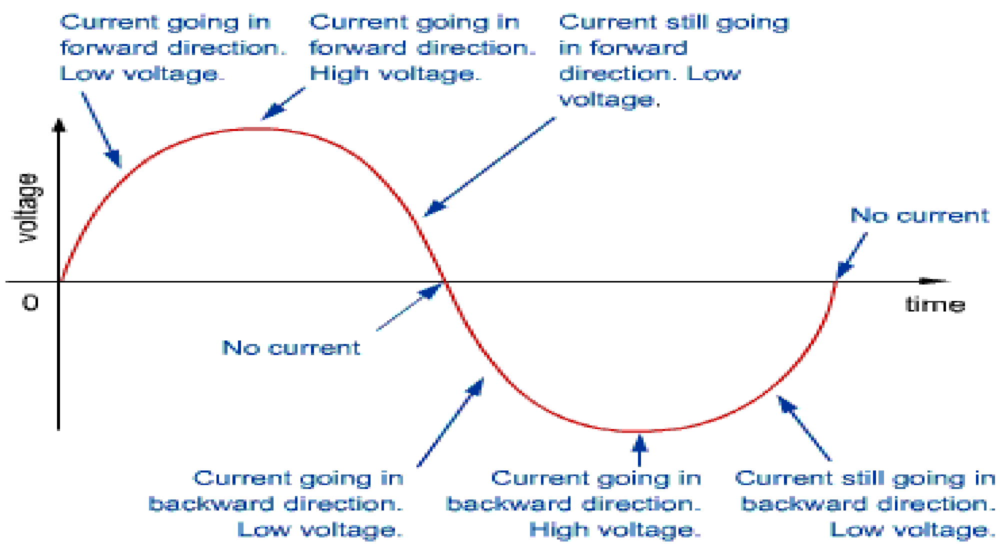
<u>Alternating Current (AC) Electricity</u>

Alternating current or AC electricity is the type of electricity commonly used in homes and businesses throughout the world. While the flow of electrons through a wire in direct current (DC) electricity is continuous in one direction, the current in AC electricity alternates in direction. The back-and-forth motion occurs between 50 and 60 times per second, depending on the electrical system of the country.

What is special about AC electricity is that the voltage in can be readily changed, thus making it more suitable for long-distance transmission than DC electricity.

With an AC generator, electricity in the wire moves in one direction for a while and then reverses its direction when the generator armature is in a different position.The charge at the ends of the wire alternates between negative (-) and positive (+).



Electrical Power

The electrical power used in operate an electrical device is defined as the potential energy or voltage times the current passing through the device. **This is compared to the mechanical definition of power as the work done over a period of time.** The electric company uses the power used over a period of time to calculate the energy used and thus your electric bill.

It is compared with the power required to do some work over a period of time.

Determining electric power

The electrical power required to operate a device is the input voltage times the current required.

$$P = V * I$$

where **P** = power, **V** = voltage and **I** = current in amperes.

Electrical power is measured in **watts**. If the amount of watts is large, **kilowatts** are used. 1 kilowatt = 1000 watts. The abbreviation for kilowatt is usually kW.

Equation 2:	Equation 3:
$P = V \bullet I$	$P = V \bullet I$
$P = (I \bullet R) \bullet I$	$P = V \bullet (V / R)$
$P = I^2 \bullet R$	$P = V^2 / R$

Calculating your electric bill

The electric company sends you a bill determined by the amount of work the electricity has done or amount of energy expended in kilowatt-hours. Most homes have an electric meter outside that measures the amount of electrical energy used by the house over a period of time.

Many electric companies charges about 10 c per kilowatt-hour. For example, if you used a 1500-watt hair dryer for 1 hours in a month at a cost of 10 c per kilowatt-hour, the electric company would bill you for:

1500 w/1000 = 1.5 kw

1.5 kw * 1 hours = 1.5 kw hours

Thus your bill would amount to:

1.5 kilowatt-hours * 10 c = 15c

Alternating Current (AC) Home Wiring

Home wiring

Typically, homes receive 240 volts of AC electricity. Certain high-power devices, such as an electric heater, use the full 240 volts.

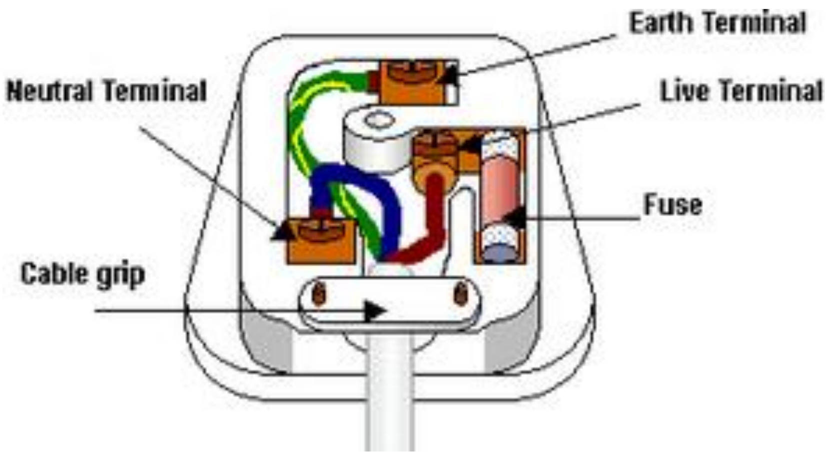
Wires into home - the Flex

A length of flex will usually consist of three insulated conductors, encased in an insulating sheath. Each of the conductors will have a different colour insulation, according to the terminal it should be connected to:

- **Brown** - Live
- **Blue** - Neutral
- **Yellow and green** - Earth

If you have any old style appliances, they may well have different colours:

- **Red** - Live
- **Black** - Neutral
- **Green** – Earth



Note that appliances which are double-insulated may not have an Earth wire, and some appliances (such as doorbells or fairy lights) may have flex consisting of two uncoloured wires.

Copper wire is used because it is a good conductor of electricity. Materials that do not conduct electricity as good usually have a higher resistance. This results in wasted energy and the tendency to get hot, which could be a safety hazard.

Wall outlets

Power outlets incorporate shutters on line and neutral contacts to prevent someone from pushing a foreign object into the socket.

The domestic electrical system uses a ring circuit in the building which is rated for 32 amps (6 amps for lighting circuits). Moreover, there is also a fusing in the plug; a cartridge fuse, usually of 3 amps for small appliances like radios etc. and 13 amps for heavy duty appliances such as heaters.

Safety

Proper grounding and the use of fuses are important for protection against shock, as well as to prevent electrical overheating and fire hazards. Correct grounding is very important. Often ground wires are connected to earth electrodes that normally go into the ground .

Fuses

Fuses and circuit breakers are used as a safety measure in case of short circuits. A fuse or circuit breaker will break the connection if more current is passing through the wire than is considered safe. This will prevent the house wiring to overheat and start a fire.

Most homes now use circuit breakers instead of fuses.

<u>Measurement of Voltage, Current, and Resistance</u>.

You will be familiar with the use of voltmeters and ammeters in circuits, in that <u>the ammeter is wired in **series** with the component, while the voltmeter is wired in **parallel**.</u> We have always treated ammeters and voltmeters as **perfect**.

☐ **A perfect voltmeter has an infinite resistance so takes no current.**

☐ **A perfect ammeter has zero resistance. Therefore there is no voltage drop across it.**

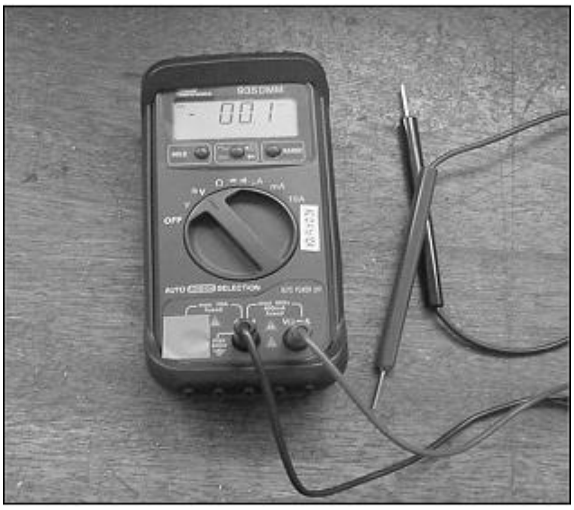
However, real voltmeters and ammeters are not perfect by any means.

<u>Multimeters</u>

Electrical and electronic engineers carry a **multimeter** which is a combined instrument that can:

- Measure voltage
- Measure current
- Measure resistance

A typical digital multimeter looks like this.



Resistivity

The resistance of a wire depends on three factors:

- **the length**; double the length, the resistance doubles.
- **the area**; double the area, the resistance halves.
- the **material** that the wire is made of.

Resistivity is a property of the material. It is defined as the **resistance of a wire of the material of unit area and unit length.**

1. The longer the wire, the more resistance that there will be. There is a direct relationship between the amount of resistance encountered by charge and the length of wire it must traverse. After all, if resistance occurs as the result of collisions between charge carriers and the atoms of the wire, then there is likely to be more collisions in a longer wire. More collisions means more resistance.
2. Wider wires have a greater cross-sectional area. In the same manner, the wider the wire, the less resistance that there will be to the flow of electric charge. When all other variables are the same, charge will flow at higher rates through wider wires with greater cross-sectional areas than through thinner wires.
3. Some materials are better conductors than others and offer less resistance to the flow of charge. Silver is one of the best conductors, but is never used in wires of household circuits due to its cost. Copper and aluminum are among the least expensive materials with suitable conducting ability to permit their use in wires of household circuits. The resistivity of a material is dependent upon the material's electronic structure and its temperature. For most (but not all) materials, resistivity increases with increasing temperature.

A way to remember 4 electrical formula

PIVIR and EVQIT

pronounce phonetically as 'piver' and 'evquit'!

$P = I \times V$ and $V = I \times R$

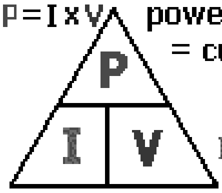
$E = V \times Q$ and $Q = I \times t$

NOTE 1
p.d. = potential difference in V

NOTE 2
1W = 1J/s

the = and x signs in the same place AND end of one formula is start of the other

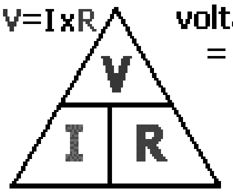
$P = I \times V$



power (watts, W) = current (amperes, A) x voltage (p.d. in V)

$I = P/V$ and $V = P/I$

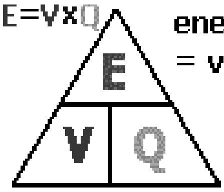
$V = I \times R$



voltage (p.d. in V) = current (amperes, A) x resistance (ohms, Ω)

$I = V/R$ and $R = V/I$

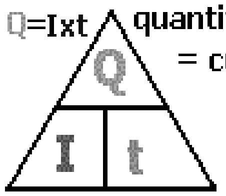
$E = V \times Q$



energy (joules, J) = voltage (p.d. in V) x quantity of electric charge (coulomb, C)

$V = E/Q$ and $Q = E/V$

$Q = I \times t$



quantity of electric charge (C) = current (amperes, A) x time (seconds, s)

$I = Q/t$ and $t = Q/I$