BA SANGAM COLLEGE

YEAR 13

APPLIED TECHNOLOGY

WORKSHEET 2

Subject: Applied Technology		**Year/Level:** 13	
Week: 2	**Lesson 1**	**Date:**	
Topic: **BASIC HOME IMPROVEMENT**			

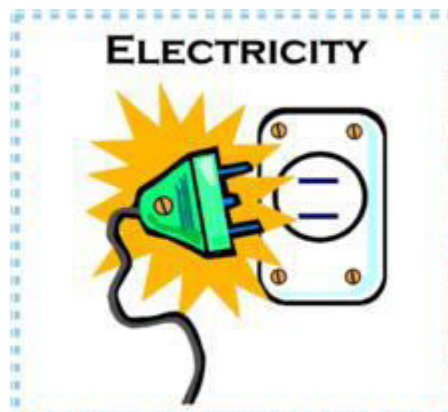
Previous Knowledge
Students have some prior knowledge on topic which was done last year in Year/Level 12/ 2019.

Learning Outcomes

By the end of this topic, students will: know what electricity is.

Electricity

Introduction



Electricity is the most versatile energy source that we have; it is also one of the newest: homes and businesses have been using it for not much more than a hundred years. Electricity has played a vital part of our past. But it could play a different role in our future, with many more buildings generating their own renewable electric power using solar cells and wind turbines. Let's take a closer look at electricity and find out how it works.

Current

Current is the movement or flow of electrons along a conductor.

The diagram shows an example of current flow around a circuit.

When a battery is connected to a lamp with copper wires, the lamp illuminates. This is because as current flows through the filament of the globe (which has resistance), the filament becomes hot. The heating of the filament radiates light.

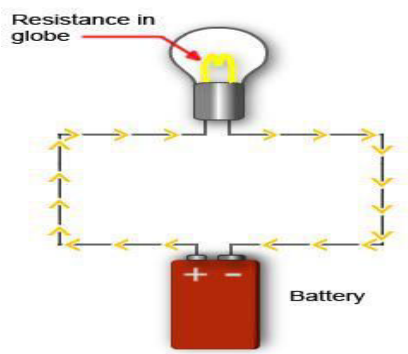
The unit of measurement of current is the **ampere** (or amp).

Voltage

Voltage in the battery
Voltage is the term used to describe electrical pressure or electromotive force (EMF).
A battery can create and store voltage or electrical pressure.
A battery has a buildup of negative charge at one terminal and positive charge at the other. These charges want to balance out, so there is an electrical force, or strain, between them.
When a circuit is connected between the terminals of a battery, the electrical pressure (voltage) from the battery forces electrons to flow from the negative terminal to the positive terminal.
The unit of measurement for voltage is the **volt**.

Resistance

The filament of the globe contains resistance.



In an electrical circuit, resistance means opposition to current flow.

The amount of resistance is directly related to how easily atoms of specific materials give up electrons. Conductors have low resistance and insulators have high resistance.

In an electrical circuit, components such as globes or appliances such as toasters provide resistance to current flow. All electrical components and circuits, including the wire, have resistance that will cause opposition to current flow.

The unit for measurement of resistance is the **ohm**.

Review questions

1 Define electricity?

2 Discuss the following terms
- Current
- Voltage
- Resistance

LESSON PLAN

Subject: Applied Technology		**Year/Level:** 13
Week: 4	**Lesson 2**	**Date:**
Topic: **BASIC HOME IMPROVEMENT**		

Previous Knowledge

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Learning Outcomes

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Electrical basics

One way to help understand how current, voltage and resistance work is to use an analogy. This means using something you already know and understand to help explain something new.

The diagrams show how water can be a useful analogy to help understand electricity.

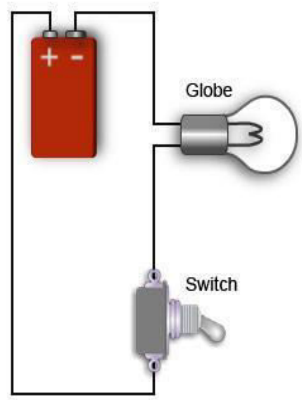

Figure 1: Electrical

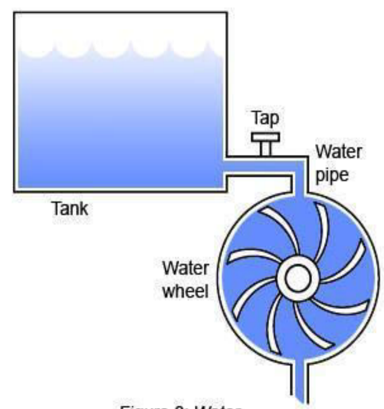

Figure 2: Water

Pressure –voltage

Figure 2 shows a full water tank. This is where the water pressure is stored. The greater the amount of water in the tank, the greater the water pressure. The water tank in Figure 2 can be compared to the battery in Figure 1, where a battery in an electrical circuit stores the electrical pressure (voltage).

An empty tank of water with no pressure is similar to a flat battery with no electrical pressure.

Flow –current

Turning on the tap in Figure 2 allows water, pushed out of the tank by pressure, to flow through the pipe and water wheel. This causes the wheel to rotate. Similarly, in Figure 1, turning on the switch allows current flow, pushed out of the battery due to electrical pressure, through the wire and globe.

The flow of water is similar to the flow of current (amps).

Restriction –resistance

The pipe size and wheel construction cause a restriction to the water flow. The restriction of water flow is similar to resistance in an electrical circuit. In Figure 1 the wire and globe offer a resistance to current flow. The size of the wire and the globe affect the amount of current flowing.

Summary

- Water pressure stored in the tank is similar to **voltage** (electrical pressure) stored in a battery.
- The flow of water through a pipe is similar to the flow of **current** through a wire.
- The path the water flows along causes a restriction to flow.

- The path the current flows through has a certain amount of **resistance**

Units of measure

There are seven base units in the International System (SI) for measuring physical quantities.

The units are:

- **ampere** –unit of electric current (symbol for ampere is **A**, symbol for current is **I**)
- **newton** –unit of force (symbol **N**)
- **metre** –unit of length (symbol **m**)
- **kelvin** –unit of thermodynamic temperature (symbol **K**)
- **kilogram** –unit of mass (symbol **kg**)
- **pascal** –unit of pressure (symbol**Pa**)
- **second** –unit of time (symbol **s**).

Derived units

Derived units			
Unit	**Unit for**	**Symbol**	**Description**
coulomb	electrical charge	**C**	The quantity of electric charge transferred each second by a current of one ampere (nominally equal to 6.24 x 1018 electrons)
farad	capacitance	**F**	The capacity that exists between two plates of a capacitor if the transfer of one coulomb from one plate to the other creates a potential difference of one volt
henry	inductance	**H**	If the rate of change of current in a circuit is one ampere per second, and the resulting electromotive force is one volt, then the inductance of the circuit is one henry
hertz	frequency	**Hz**	The number of periodic oscillations per second
joule	energy and work	**J**	One joule of work is required to move one coulomb through an electrical potential difference of one volt
ohm	resistance	**Ω**	If a device dissipates one watt of power with one ampere of current flowing through, it has a resistance of one ohm ($R = P/I^2$)
volt	potential difference or voltage	**V**	The potential difference existing between two points on a conductor carrying a current of one ampere when the power dissipated is one watt
watt	power	**W**	The power used when energy is expended at the rate of one joule per second

Submultiple and multiple units

There are times when we need to measure very large or very small amounts of an electrical quantity. This can lead to a number made up of six or more digits, eg 1,000,000 or 0.000001.

In order to simplify these numbers, we use prefixes, eg 5 million ohms can be written as 5, simplified to 5MΩ**mega**., whichMisthe prefixthemeaningsymbol'million'. for

The following table lists the prefixes you are likely to use.

Prefixes				
Prefix	**Symbol**	**Meaning**	**Value**	**Factor**
nano	**n**	1,000,000,000th	0.000,000,001	10^{-9}
micro	**u**	1,000,000th	0.000,001	10^{-6}
milli	**m**	1,000th	0.001	10^{-3}
centi*	**c**	100th	0.01	10^{-2}
deci*	**d**	10th	0.1	10^{-1}
kilo	**k**	1,000 x	1,000	10^{3}
mega	**M**	1,000,000 x	1,000,000	10^{6}
giga	**G**	1,000,000,000 x	1,000,000,000	10^{9}

The first five prefixes are **submultiples**, ie they are smaller in value than the basic unit. The remaining prefixes are **multiples**,and they have larger values than the base unit.

*centi and deci are only used in relation to metre, the unit of measure.

Examples of submultiple and multiple:

- nano –33nV equals 0.000000033 of a volt
- micro –33uV equals 0.000033 of a volt
- milli –33mV equals 0.033 of a volt
- kilo –33KV equals 33,000 volts
- mega –33MV equals 33,000,000 volts
- giga –33GV equals 33,000,000,000 volts.

Calculations with submultiple and multiple units

When doing calculations with mixed quantities (any combination of base, multiple or submutliple), all of the quantities should be converted to the base unit.

The conversion is done by moving the decimal point either left or right, based on the factor, as shown in the table above.

To convert **33nV** to **volts**:

- 33 is multiplied by 0.000,000,001to get 0.000000033V (decimal point moved nine places to the left on the number 33.0).

To convert **33mV** to **volts**:

- 33 is multiplied by 0.001 to get 0.033V (decimal point moved three places to the left on the number 33.0).

To convert **33GV** to **volts**:

- 33 is multiplied by 1,000,000,000 to get 33,000,000,000V (decimal point moved nine places to the right on the number 33.0).

The conversion rule is:

- submultiple to a base –move the decimal point to the **left**
- Multiple to a base –move the decimal point to the **right**.

Review questions

1 Explain electrical basics with a help of a sketch?

2 Convert the following to volts

a. 44nV

b. 55nV

c. 73nV

d. 43nV

LESSON PLAN

Subject: Applied Technology		**Year/Level:** 13
Week: 4	**Lesson 3**	**Date:**
Topic: **BASIC HOME IMPROVEMENT**		

Previous Knowledge

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Learning Outcomes

By the end of this topic, students will: know what electricity is.

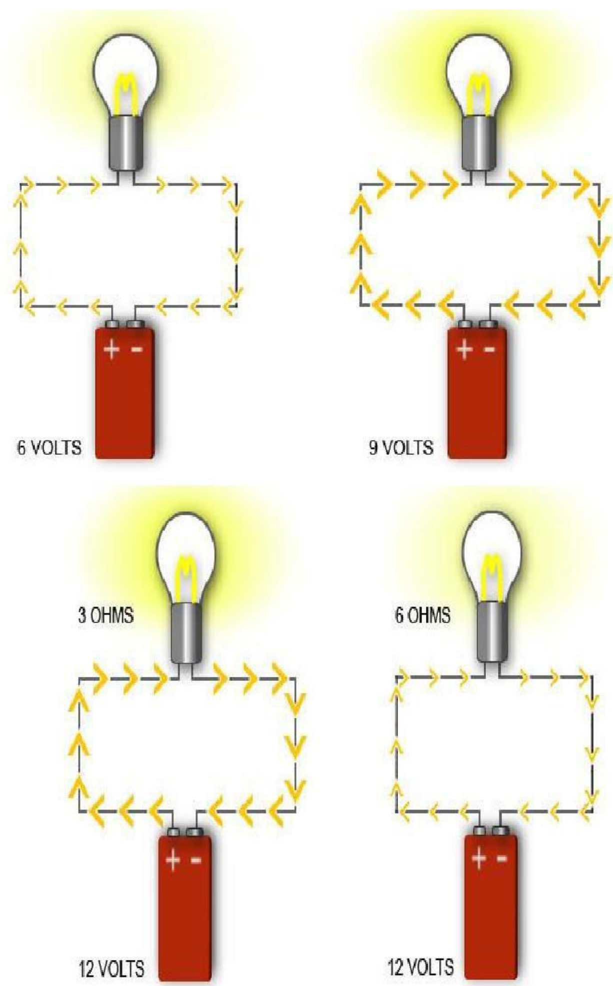
Ohm's law

Voltage, current and resistance are present in all operational circuits and a relationship exists between these three things. The relationship is named after the person who discovered it, George Ohm.

Ohm's law states, 'Current flow in a circuit is directly proportional to the voltage across the circuit and inversely proportional to the resistance contained in the circuit, providing

circuit conditions remain the same.
In other words:

- if you increase the voltage (or electrical pressure) in a circuit then the current (flow of electrons) will increase in direct proportion, eg if you double the voltage the current flow will double
- if you increase the resistance (the opposition to current flow) in a circuit then the current flow will decrease in direct proportion, eg if the resistance in a circuit doubles then current flow will halve.



V = **IR**

Voltage is equal to current multiplied by the resistance. If the current and resistance of a circuit is known, the voltage can be calculated.

Transposing the formula allows us to calculate current or resistance.

$I = {}^{V}/_{R}$

$R = {}^{V}/_{I}$

If any two values in a circuit are known, the third value can be calculated.

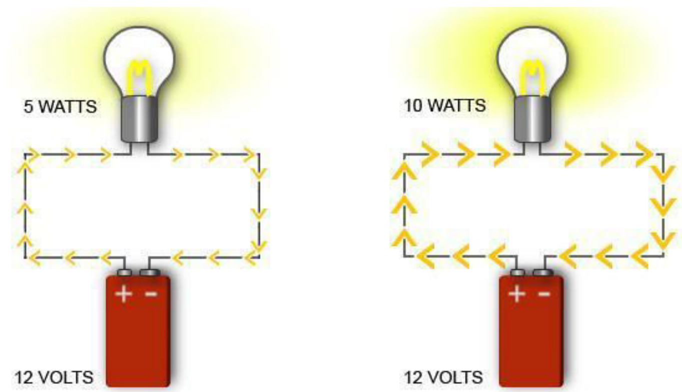
Use the following Ohm's law triangle animation to help you practise using the formula.

Power

Power in an electrical circuit refers to the rate at which electrical energy is converted to some other form, such as heat or magnetism. The power dissipated in a circuit is directly related to the applied voltage and to the amount of current flowing through the circuit.

The diagrams show that increasing the wattage of the globe in a circuit with the same voltage results in a higher current flow, therefore more power is dissipated, ie more heat and light. A higher current flow indicates that a high wattage globe has less resistance than the low wattage globe.

The unit of measurement for power is the **watt**.



Quantity	Symbol	Unit	Abbreviation	Meaning
power	**P**	watt	**W**	power dissipated

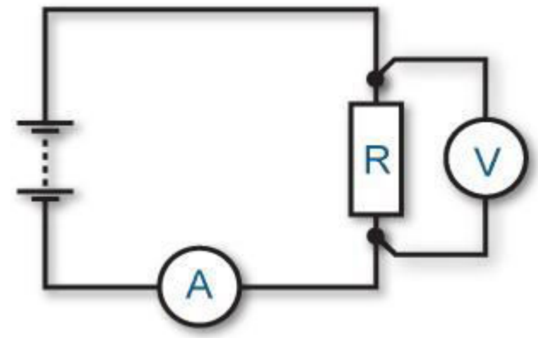
If there is an increase in voltage, the power will quadruple. If you increase the voltage (or electrical pressure) in a circuit, then the current (flow of electrons) will increase in direct proportion, eg if you double the voltage the current flow will double.

The formula for calculating power is:

P = VI

Therefore double the current multiplied by double the voltage will quadruple the power.

Ohm's law for calculating power dissipation



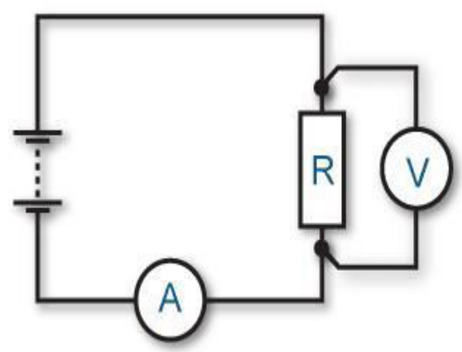
The worked examples are based on the circuit diagram shown.

1. What power would be dissipated by resistor (R) if the circuit has a current flow (A) of 2A with an applied voltage (V) of 24V?
   - o P = VI
   - o P = 24 x 2 o
   - P = **48W**
2. What power would be dissipated by resistor (R) if the circuit has a current flow (A) of 2uA with an applied voltage (V) of 10mV?
   - o P = VI
   - o A and V are both submultiples and must be converted to base units o
   - A = 2uA = 2 x 0.000,001 = 0.000,002A
   - o V = 10mV = 10 x 0.001 = 0.01V o
   - P = 0.01 x 0.000,002
   - o P = **0.000,000,02W** or **20nW**

Formula substitution

In keeping with Ohm's law, power dissipated is directly related to the applied voltage and the amount of current flowing. This directly relates to the amount of resistance. If any two values of a circuit are known, we can calculate the other two values by using substitution.

Example



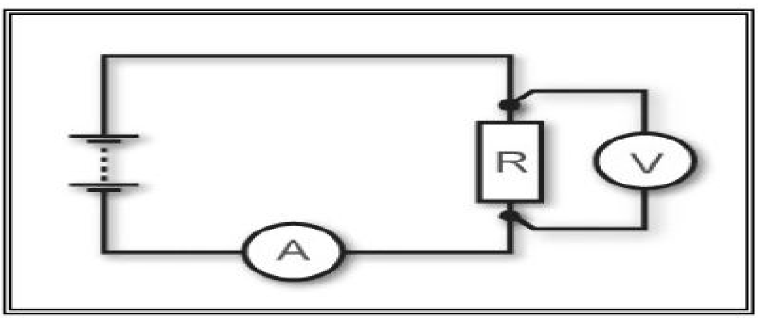
1. In this example if the battery voltage is 20V and the resistance (R) has then would the power dissipated be?
   - Formula for calculating power is:
   - P = VI
   - We don't know the current flow (I). We could use Ohm's law I = $^{V}/_{R}$ to calculate the current flow, then use the calculated value in the power formula above.
   - The answer can be found with one formula:
   - P = VI replace the I with $^{V}/_{R}$
   - This will give you a formula:
   - P = $^{V \times V}/_{R}$ volts multiplied by volts divided by resistance)
   - Volts multiplied by volts is expressed as V^2 (volts squared). So the final formula would be:
   - **P = V^2/R**
   - P = 20^2/100 which is the same as (20 x 20 / 100)
   - P = 400/100

- **P = 4W**

2. If the circuit has a total resistance of 80Ω
   - P = VI we don't know the voltage, but using Ohm's law V = IR. Therefore the formula is:
   - P = **I x R** x I which is the same as I x I x R which is the same as I^2R so the formula is:
   - **P = I^2R**
   - P = $2^2/80$
   - P = 4/80
   - **P = 0.05W** or **7071mW**
3. If the power dissipated in the circuit is 500W and the current flow is 2A, what is the total resistance?
   - R = V/I is the formula for calculating resistance, but voltage is unknown.
   - The power formula V = P/I could be used to find voltage, but this can be substituted into the first formula as follows:
   - R = (P/I)/I (Resistance equals watts divided by amps and then divided by amps again.)
   - This equation can however be simplified as P/(I x I) and so therefore can be expressed as:
   - **R = P/I^2**
   - R = $500/2^2$
   - **R = 125Ω**
4. If the power dissipated in the circuit is 10
   - V = IR is the formula for calculating voltage, but the current value is unknown.
   - The power formula V = P/I can't be used to find voltage because current is also unknown. However, because of the direct relationship of these values, formula substitution can be used.
   - We know that the voltage would be equal to V = P/I and current would be I = V/R therefore
   - V = P/(V/R) which is the same as V = PR/V and after transposing this would be V^2 = PR
   - We want to know the voltage, not the square of the voltage, so the square root (√) of **PR** will give the answer.
   - Therefore, the formula is:
   - **V = √PR**
   - V = √(10 x 5)
   - V = √50

Review questions

Use the circuit diagram shown below to answer the given question.



Source: *Year 13 Applied Technology*, Ministry of Education, 2017.

Calculate the power dissipated by resistor (R) if the circuit has a current flow (A) of 2A with an applied voltage (V) of 24V. **(3 marks)**

<u>LESSON PLAN</u>

Subject: Applied Technology		**Year/Level:** 13
Week: <u>4</u>	**Lesson 4**	**Date:**

Topic: **BASIC HOME IMPROVEMENT**

Previous Knowledge
Students have some prior knowledge on topic which was done last year in Year/Level 12/ 2019.

Learning Outcomes

By the end of this topic, students will: know what electricity is.

Electrical Properties

Conductors

The outermost orbit path for electrons is known as the valence shell, or conduction band. An atom with only a small number of electrons in the valence shell allows the electrons to move freely. Materials that are made up of atoms with these 'free electrons' are known as conductors.

Most metals are good conductors. Examples of good conductors include gold, silver and copper because each of these metals has only one electron in its valence shell.

The application of some kind of force, eg a magnetic field or voltage, will cause electrons in a conductor to freely interchange between atoms.

Electrical Properties

Conductance is defined as the ability to conduct current, which is the opposite of resistance. If a wire has a high conductance, it will have a low resistance. There is no perfect conductor. All conducting materials offer some resistance to electron flow.

Insulators

Atoms with a valance shell that is completely full of electrons will not readily transfer them. Materials that are made up of atoms with these 'firmly bound' electrons are known as insulators.

Insulator material can be a solid, liquid or gas. Insulators are generally organic materials, but a number of inorganic materials are also good insulators. Examples of insulator materials used with electrical circuits include mica, glass, rubber and plastic.

Insulators have high resistance to electron flow.

Semiconductors

Semiconductors are insulators that conduct under certain conditions.

Some materials that are good insulators can, under different conditions, become good conductors. The conditions that can produce this change include high temperatures or a very high applied voltage.

Common semiconductor materials include germanium and silicon.

Semiconductors are used in electronic components such as diodes and transistors

Resistance

Resistance is the opposition to current flow. In an electrical circuit everything has some resistance, including conductors.

Some factors that determine the amount of resistance in a conductor are explained below.

Conductor material

The amount of resistance of a conductor will depend on the atomic structure of the conductor material. The amount of resistance offered by a material is termed its 'resistivity'.

The symbol for the resistivity of a material is ρ (rho).

Quantity	Symbol	Unit	Abbreviation	Meaning
resistivity	ρ	**ohm/metre**	**Ω/m**	**resistance of material**

The following table shows the resistivity of a number of conductors.

Metal	Resistivity-metre)
Silver	1.65×10^{-8}
Copper	1.72×10^{-8}
Aluminium	3.2×10^{-8}

(Ω

Nickel	8.7 x 10^{-8}
Iron	11 x 10^{-8}
Nichrome	112 x 10^{-8}
Metal Resistivity Table (@ 20.5°C)	

As temperature increases or decreases, its resistance value changes.

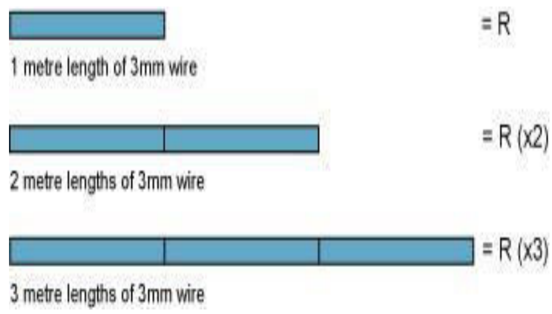
A material that has a Positive Temperature Coefficient (PTC) will increase in resistance with an increase in temperature.

A material with a Negative Temperature Coefficient (NTC) will decrease in resistance with an increase in temperature.

Conductor length

This is how the resistance of a conductor changes, depending on the conductor's length.

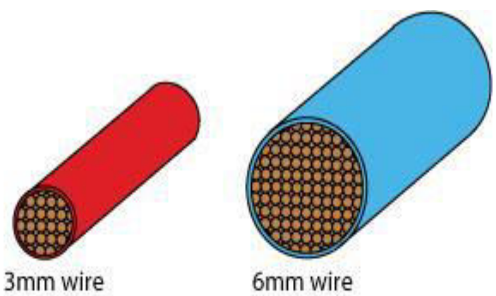
Increased conductor length equals increased resistance in direct proportion.



Conductor cross sectional area

The thinner or smaller the diameter (cross sectional area), the greater the resistance.

A wire with a 3mm diameter would have four times the resistance of a 6mm diameter wire.



Calculating resistance of a conductor

The following formula can be used to calculate the resistance of a length of conductor (at 20 degrees Celsius).

R = *ρ* / A*l*

where

R = resistance in ohms

ρ = resistivity in ohmmetres

l = length in metres

A = cross-sectional area in square metres (m2)

Resistors

Resistors are devices which are manufactured to a predetermined resistance value. They are made in many shapes and sizes and from a range of materials including:

- carbon
- metal film
- nichrome.

A resistor can be used in a circuit to restrict the amount of current flow or decrease the voltage.

Colour codes

The colour bands on carbon and metal film resistors are used to identify the resistance value (in ohms) and tolerance (accuracy in percentage) of the resistor. The resistance value colour bands are crowded towards one end of the resistor and the last band is for the tolerance.

- Four colour bands have three value colour bands and then a fourth for the tolerance. Some have no fourth tolerance band, therefore the resistor has a tolerance of plus or minus 20.
- Five colour bands have four value colour bands and then the fifth band for tolerance.

The following table can be used to identify the value of a resistor. Read the table:

- from the top down for a four band resistor
- from the bottom up for a five band resistor.

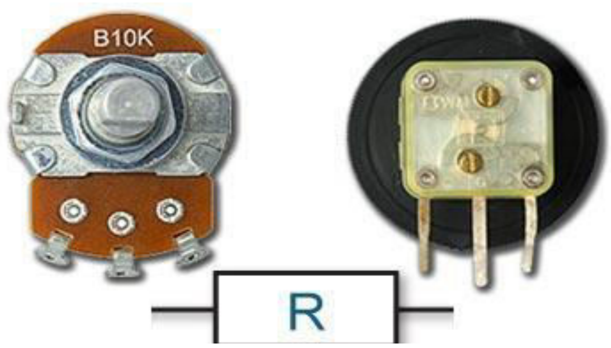
Example

The resistor shown has four bands. Using the table allows us to work out the value.

1. The first band is brown so the first digit is one.
2. The second band is black, so the second digit is zero. Putting the two and the zero together gives a value of ten.
3. The third band, which is the multiplier, is brown so it has a value of one. This means that one extra zero will be added to the value.
   The resistor is rated at one hundred ohms.
4. The fourth band is gold which indicates that the resistor has a tolerance of plus or minus five percent.

Variable resistors

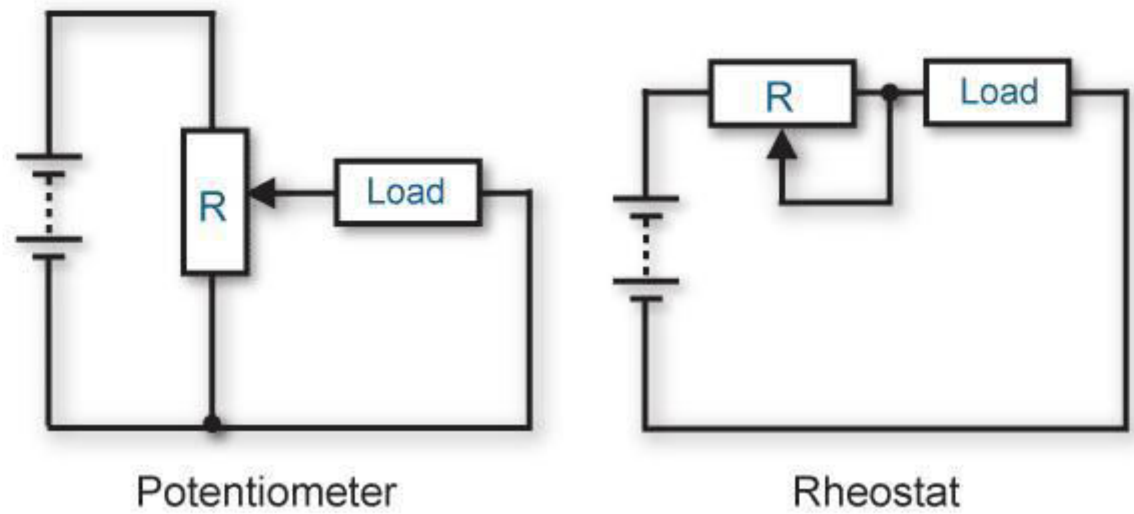
As the name suggests, a variable resistor is a device that allows a user to vary the amount of resistance. An example of this is the volume control on a radio. Variable resistors come in a variety of shapes, sizes and current carrying capacities. They have three terminals and one is joined to a wiper that can be moved along the resistance material.



Variable resistors are either:

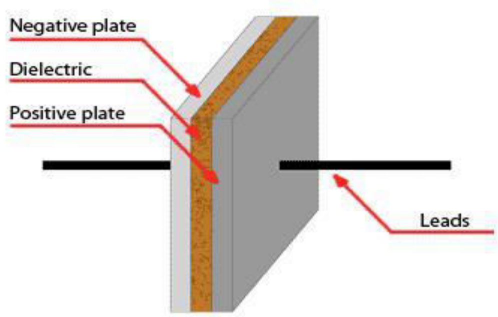
- potentiometer –used for voltage adjustment
- rheostat –used to vary current flow.

They are shown in the following circuit diagrams.



Potentiometer and rheostat circuits

Capacitance



Capacitance is the ability of a device to store an electrical charge.

The unit of capacitance is the farad.

Quantity	Symbol	Unit	Abbreviation	Meaning
capacitance	**C**	farad	**F**	ability to store a charge

The capacitor

A capacitor ia a device capable of storing an electrical charge. This is done by separating conductive plates with an insulating

material. The insulator material is called a dielectric.

Factors affecting the capacitance value of a capacitor:

- area of the plates (bigger plates, more capacitance)
- distance between the plates (bigger distance, lower capacitance)
- material used as dielectric (higher insulative qualities, more capacitance).

Types of capacitors

Various capacitor types are used for specific purposes.

Electrolytic capacitor

These capacitors have aluminums or tantalum and the dielectric rolled together then enclosed. They are polarity sensitive and if connected incorrectly will explode.

Ceramic capacitor

A ceramic disc is silver plated on both sides. They are often used where a capacitor of high values is required. Ceramic capacitors are not polarity sensitive.

Variable capacitor

A variable capacitor is made up so that one plate can be moved in or out to change the capacitance.

Stacked plate capacitor

Stacked plate capacitors have the plates and dielectric stacked alternately. Each alternate plate is connected together to form one plate. These are often used where it is important not to have any self-inductance.

Dangers of capacitors

Capacitors will hold their charge until they are discharged. If a capacitor is not discharged before it is touched, it can cause electric shock.

Polarity sensitive capacitors can explode if they are not connected correctly.

Connection of capacitors

Series

Capacitors, when connected in a series, work the opposite to resistors and the overall value of the capacitance will reduce.

Here is the formula to calculate total capacitance in a series circuit.

Parallel

When capacitors are connected in parallel, the result is the sum of all the capacitors.

Here is the formula to calculate total capacitance in a parallel circuit.

Time constants

When voltage is applied to a capacitor it does not charge instantly. The capacitor is charged up over five time periods. These periods are called time constants. In the first time constant, a capacitor will always achieve 63.2% of total charge. The actual time that it will take can range from milliseconds to hours.

Select the switch to see the capacitor charge.

The time it takes to charge up, depends on the size of the capacitor and the resistance in the circuit.

Now select the switch to see the capacitor discharge.

Calculations

The time constant depends on the resistance and capacitance (RC) in a circuit. The time constant can be calculated using the equation:

$t = RC$

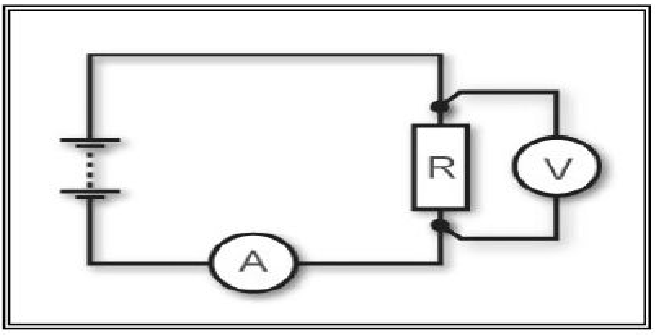
Where:

t = time in seconds
R = resistance in ohms
C = capacitance in farads.

REVIEW QUESTIONS

(d) Convert 40nV into Volts. **(2 marks)**

(e) Use the circuit diagram shown below to answer the given question.



Source: *Year 13 Applied Technology*, Ministry of Education, 2017.

Calculate the power dissipated by resistor (R) if the circuit has a current flow (A) of 2A with an applied voltage (V) of 24V. **(3 marks)**

(2) A power dissipated of 7V is applied to two resistors (5Ω and 3Ω) connected to the series.

Calculate the following:

1. The combine resistance. **(1 mark)**

2. The current flow. **(1 mark)**

3. Power dissipated across the 5Ω resistor. **(1 mark**

LESSON PLAN

Subject: Applied Technology		**Year/Level:** 13
Week: 4	**Lesson 5**	**Date:**
Topic: **BASIC HOME IMPROVEMENT**		

Previous Knowledge
Students have some prior knowledge on topic which was done last year in Year/Level 12/ 2019.

Learning Outcomes

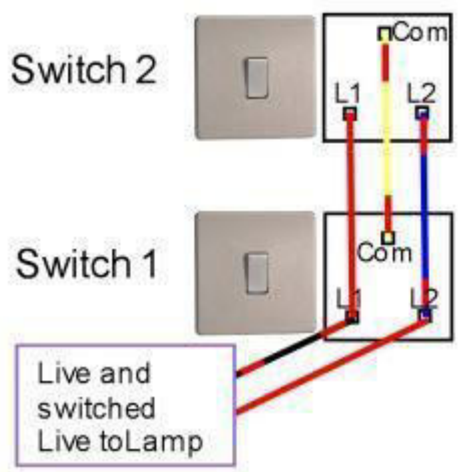
By the end of this topic, students will: know what electricity is.

Two Way Switch.

Two way switching is not as difficult as it first seems and should be pretty straight forwards if you follow the diagrams below.

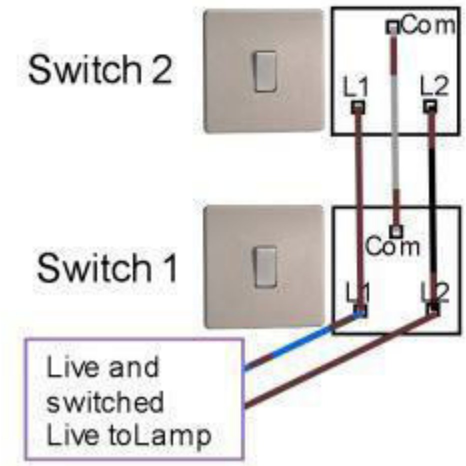
Earth wires have been omitted from all photo's and diagrams for clarity, but must be connected at all earth terminals. Two-way light switches are required for two way switching, these can be identified by looking at the terminals on the back of the switch . There will be a Com (common) terminal a L1 terminal and a L2 terminal.

Two way switching with the old wiring colours-



This diagram represents a two way switching arrangement. There are other ways of wiring a two way lighting circuit, but this is by far the most common and easiest method. The old wiring colours that are present in the majority of homes in the uk have been used for this diagram. Three core and earth cable is required to install two or three way switching and this should be run from the first light switch to the second and then wired as shown in this diagram. Switch one is the switch that contains the live wire and switched live wire. The diagram shows single colours only. In real life these wires would be covered by an outer protective sheath and would include a bare earth wire and would be called a cable. Red sleeving or tape would of been placed on the wires as shown to show that they would be live at some point. Now this sleeving would be brown. The connections are very simple and there is another guide further down this page.

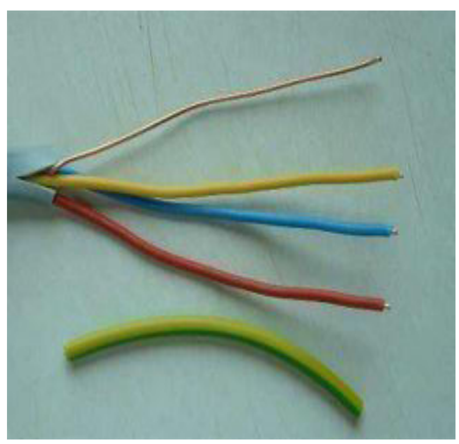
Two way switching with the new harmonised colours-



This is the same diagram as above, but using the new harmonised colours. Three core and earth cable is required to install two or three way switching and this should be run from the first light switch to the second and then wired as shown in this diagram. Switch one is the switch that contains the live wire and switched live wire. The diagram shows single colours only. In real life these wires would be covered by an outer protective sheath and would include a bare earth wire and would be called a cable. Brown sleeving or tape would of been placed on the wires as shown to show that they would be live at some point.

How to convert a single switch to a two way system

Here you can see the back of a light switch, in this instance it is a two way switch being used for a one way light. A one way switch has only a common and L1 terminal and a two way switch has a common, L1 and L2 terminal, like this one in the picture.



Note that new harmonised cable is being used (Brown and Blue) and note that Brown sleeving has been placed over the Blue wire, This signifies that it will be live at some point! The earth wire should always be connected to the earthing terminals, it has been removed for clarity here but must be connected, even on plastic light switches, unless there is no earthing terminal. The back box will need earthing unless it is plastic and there is no earthing point.

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For two way switching you need a length of three core and earth cable long enough to reach from the existing light switch to the place where you intend placing the second light switch.

This cable needs routing via the easiest route, here are the guidelines and permissible zones permitted wiring zones

This is not the new harmonised cable so the colours may need changing, the earth sleeving still needs using before connection as with all cable.

There are no set rules for which wire does what in three way lighting, but I am going to use the most sensible option.

Remove the wire which is in the common terminal and place it in the L2 terminal.

These two wires are the permanent live and switched live wires.

There are no fixed regulations for which wire goes where but if you follow the colours that I have used here, they seem to make sense!

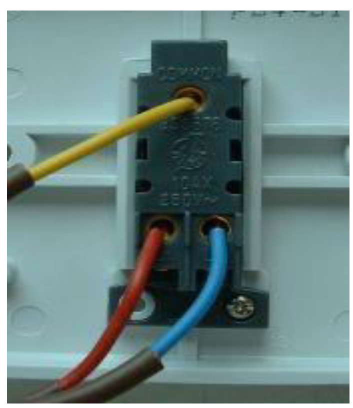
Note how all of the wires have brown sleeving on them! I have slid this back a little then you can see the actual colours of the wires. The brown wire and the blue wire that is sheathed brown are already in terminals L1 and L2, this is described above. These two wires are the Permanent live and switched live.

Old colours-

The Yellow wire goes in the common terminal, Red in the L1 terminal and Blue goes in the L2 terminal.

New colours-

The Grey wire goes in the common terminal, Brown in the L1 terminal and Black goes in the L2 terminal. When ever you fasten a wire into a terminal, always give it a gentle pull to ensure it is fastened correctly. This can save hours of work later on when the wire pops out and stops working!



This is the back of the second switch that will make the circuit 2 way, once again the brown sleeving has been slid back for clarity. The wires in this switch should mimic exactly the three wires that you have put in the other switch.

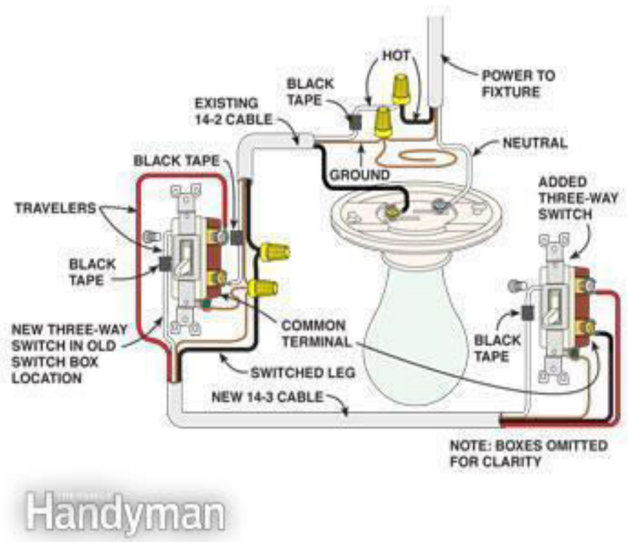
Old colours-
The Yellow wire goes in the common terminal, Red in the L1 terminal and Blue goes in the L2 terminal.

New colours-

The Grey wire goes in the common terminal, Brown in the L1 terminal and Black goes in the L2 terminal. You now have a light that can be switched on or off from 2 different locations.

Wiring a three-way switch

The wiring of three-way switches is certainly more complicated than that of the more common single-pole switch, but you can figure it out if you follow our diagrams. With a pair of three-way switches, either switch can make or break the connection that completes the circuit to the light. The whole project can be completed in a few hours if you don't have to do any re



To add the switch, you'll
depending on whether the power comes to your light switch first (the most common situation) or to the light fixture first. Either way, complete these five steps:

1. Turn off the correct circuit at your electrical panel.
2. Add an electrical box for the second three-way switch in the basement. It's likely you'll als accommodate the extra wires for the three-way switch.
3. Feed a length of 14-3 type NM cable (or 12-3, if you're-gaugeconnectingwire)betweenthetwo to boxes. The 14-3 cable has three insulated conductors: white, black and red (plus a bare ground wire).
4. Connect the wires to the new three-way switches with ground screws using one of the two wiring diagrams (Fig. A or B). On the switches, the common terminal will be identified by a label and/or the terminal screw will be a different color than the other two.
5. Make sure to wrap black electrical tape around the ends of all white wires that are used as travelers between the three-way switches. If you have the setup shown in Fig. A, also wrap black tape around the white wire from the switch to the light. This way, both you and others will know these no neutral like most white wires.

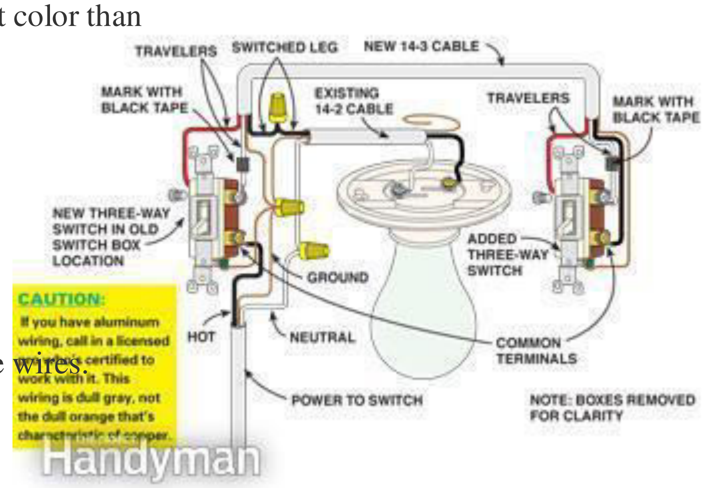


Figure A: Power to Light Fixture

This diagram shows how to wire the switches and the light when the power is coming to the light fixture.

The power comes to the light fixture, then to the light switches.

Figure B: Power to Light Switch

This diagram shows how to wire the switches and the light when the power is coming to the light switch.

The power comes to the light switch, then to the light fixture and the other light switch.

Review questions

3 Define electricity?

4 Discuss the following terms
   a. Current
   b. Voltage
   c. Resistance

5 Explain electrical basics with a help of a sketch?

6 Convert the following to volts
   a. 44nV
   b. 55nV
   c. 73nV
   d. 43nV

7 Discuss law Ohm's with the help of a sketch?

8 Describe two electrical properties?

9 Explain the following terms?
   Electrolytic capacitor
   a. Ceramic capacitor

10 List down the five steps