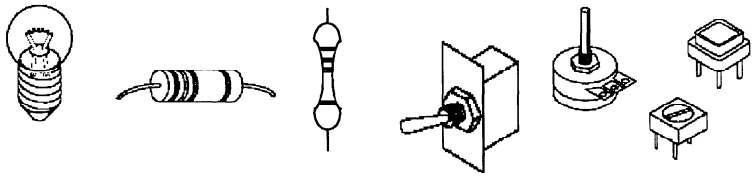
PHYSICS
Intermediate 1
Practical Electricity

ACTIVITY 1

Title: Components

Aim: To identify a variety of electrical components

Apparatus: A selection of components - each component will have a tag with a number



Instructions

- Study the selection of components you have been given.
- Write down the number of each component.
- Beside the number of the component;

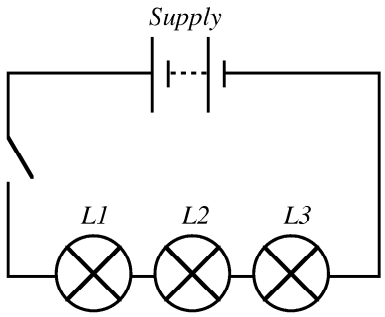
  (a) name the component
  (b) draw the circuit symbol.

ACTIVITY 2

Title: Current in a Series Circuit

Aim: To construct a series circuit and measure current

Apparatus: Power supply or battery, switch, 3 identical lamps, ammeter



Instructions

- Connect the battery, switch and three lamps in series as shown.
- Demonstrate to your teacher that the circuit is working.
- Measure the current through each lamp. Use a table like the one shown here to record your measurements.

Current in L1	Current in L2	Current in L3	Supply Current

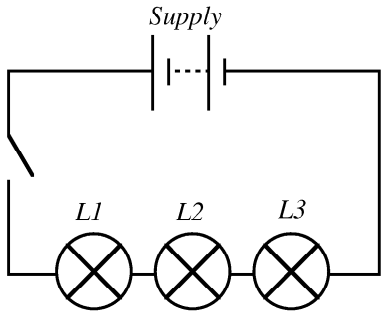
- Measure the current from the supply.
- Compare the currents measured.
- Write a conclusion about the current in a series circuit.

ACTIVITY 3

Title: Voltage in a Series Circuit

Aim: To construct a series circuit and measure voltage

Apparatus: Power supply or battery, switch, 3 identical lamps, voltmeter



Instructions

- Connect the battery, switch and three lamps in series as shown.
- Demonstrate to your teacher that the circuit is working.
- Measure the voltage across each lamp. Use a table like the one shown here to record your measurements.

Voltage across L1	Voltage across L2	Voltage across L3	Total Voltage	Supply Voltage

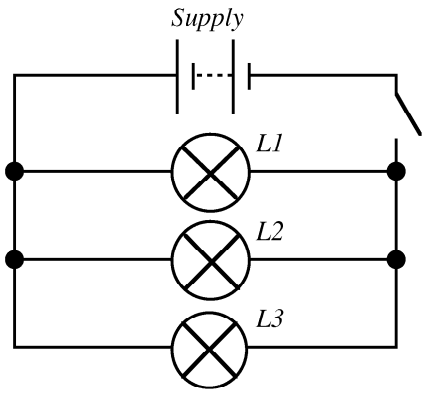
- Measure the voltage across the supply.
- Find the total voltage across the three lamps (L1 + L2 + L3).
- Write a conclusion about the supply voltage and the total voltage across the three lamps.

ACTIVITY 4

Title: Voltage in a Parallel Circuit

Aim: To construct a parallel circuit and measure voltage

Apparatus: Power supply or battery, switch, 3 identical lamps, voltmeter



Instructions

- Connect the battery and switch in series and three lamps in parallel as shown.
- Demonstrate to your teacher that the circuit is working.
- Measure the voltage across each lamp. Use a table like the one shown here to record your measurements.

Voltage across L1	Voltage across L2	Voltage across L3	Supply Voltage

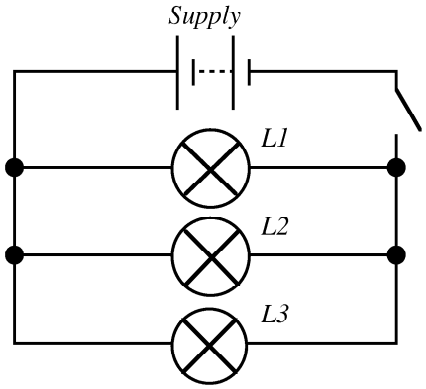
- Measure the voltage across the supply.
- Compare the voltages measured.
- Write a conclusion about the voltage in a parallel circuit.

ACTIVITY 5

Title: Current in a Parallel Circuit

Aim: To construct a parallel circuit and measure current

Apparatus: Power supply or battery, switch, 3 identical lamps, ammeter



Instructions

- Connect the battery and switch in series and three lamps in parallel as shown.
- Demonstrate to your teacher that the circuit is working.
- Measure the current through each lamp. Use a table like the one shown here to record your measurements.

Current in L1	Current in L2	Current in L3	Total Current	Supply Current

- Measure the current through the supply.
- Find the total current through the three lamps (L1 + L2 + L3).
- Write a conclusion about the supply current and the total current through the three lamps.

ACTIVITY 6

Title: The ohmmeter

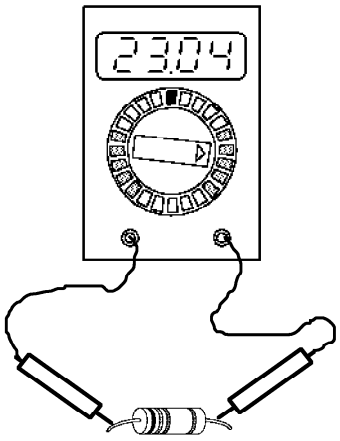
Aim: To measure resistance using an ohmmeter

Apparatus: Resistors of different values (each resistor is numbered), ohmmeter, data sheet (giving the manufacturer's value of each resistor)

Instructions

- Use the ohmmeter to measure the resistance of the resistors directly.
- Enter the value in the table.

Resistor number	Measured resistance (Ω)	Data sheet resistance (Ω)
1		
2		
3		
4		
5		



Using the ohmmeter to measure resistance directly.

Ensure the multimeter setting is correctly set at Ω.

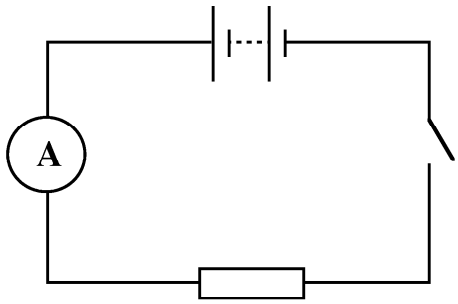
- Write a note comparing the measured resistance with the data sheet resistance.

ACTIVITY 7

Outcome 3 ✔

Title: Current and Resistance

Apparatus: Power supply or battery, switch, ammeter, resistors of known resistance



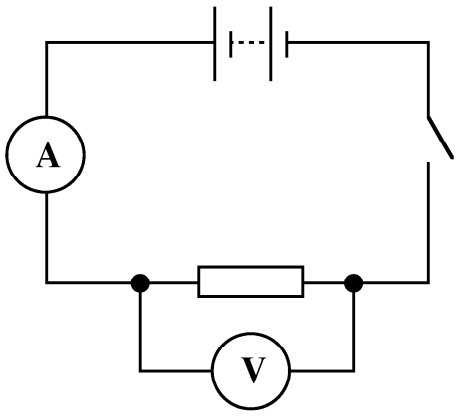
Instructions

- Set up the circuit shown.
- Use the resistor with the lowest resistance value first.
- Measure the current; record the value of the resistance and the current in a suitable table.
- Use the resistor with the next lowest resistance value.
- Measure the current; record the value of the resistance and the current.
- Repeat until you have current measurements for all resistors.
- Plot a graph of current against resistance.

ACTIVITY 8

Title: Voltage, Current and Resistance

Apparatus: Power supply or battery, switch, ammeter, voltmeter, resistors of known resistance



Instructions

- Set up the circuit shown.
- Use the resistor with the lowest resistance value first.
- Measure the current and voltage; record the value of the resistance, current and the voltage in a suitable table.
- Use the resistor with the next lowest resistance value.
- Measure the current and voltage; record the value of the resistance, current and the voltage.
- Repeat until you have measurements for all resistors.
- Calculate $\frac{voltage}{current}$ for each resistor and enter this result in your table.
- Compare $\frac{voltage}{current}$ with the resistance value for each resistor.

ACTIVITY 9

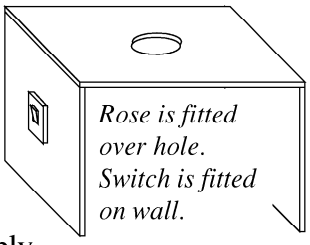
Safety note:

Do not connect to the Mains

Title: The Lighting Circuit

Aim: To wire a ceiling rose, lamp and switch circuit

Apparatus: Ceiling rose, 12 V lamp, bayonet lampholder, wall mounting switch, 1 mm^2 twin and earth cable, two core flex for lamp, model room, power supply, cable strippers, screwdriver

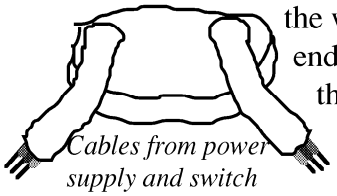


Model Room

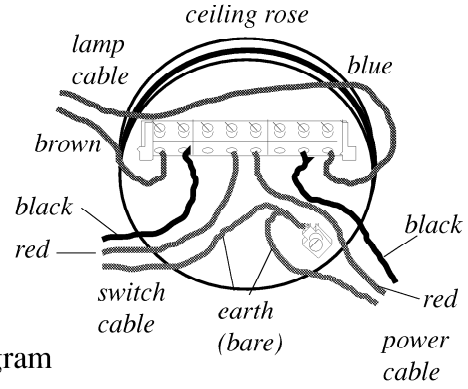
Instructions

- Run a length of 1 mm^2 cable from the power supply to the hole in the "ceiling" of the model room where the rose will be attached - use the conduit if fitted. (Note that 1 mm^2 cable has internal wires coloured red, black and bare.)

- Run a length of 1 mm^2 cable from the switch to the same point on the "ceiling" - use the conduit if fitted.

- 
Cables from power supply and switch
outer sheathing of the cable and the inner insulation from the wires to expose about 1 cm of copper. Push the cable ends through the holes in the "ceiling". Mark each cable so that you know which is from the switch and which is from the power supply.

- Remove the outer sheathing from both ends of the two core lamp flex and strip the inner brown and blue wires to expose about 1 cm of copper. Connect the flex to the bayonet lampholder.



- Wire the ceiling rose using the diagram shown. Screw on the rose cover.

- Wire the other end of the switch cable to the switch terminals.

- Connect the power cable to the supply and switch on to test. (Red and black to supply terminals, bare to earth - if no earth, leave unconnected.)

ACTIVITY 10

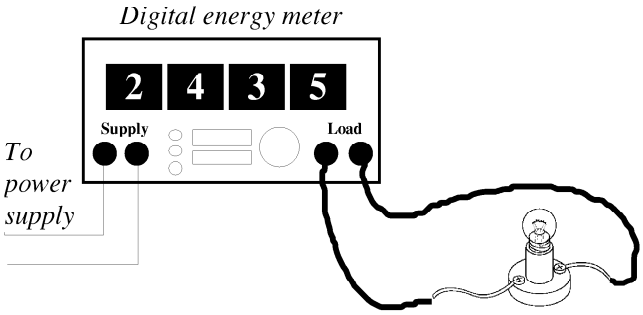
Outcome 3 ✔

Title: Energy and Power rating of an appliance

Apparatus: 12 V power supply, lamps of various powers, lampholder, digital energy meter, stopclock

Instructions

- Set up the apparatus as shown. Reset the energy meter.



The power supply is connected to the terminals "Supply". The lamp is connected to the terminals marked "Load".

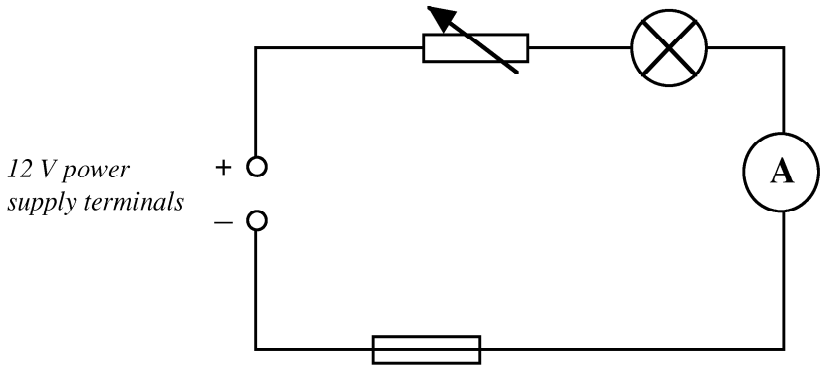
- Connect the lowest rated lamp to the holder.
- Switch on the power supply and stopwatch at the same instant.
- After 100 seconds, switch off the power supply.
- Record the power rating of the lamp and the energy used.
- Repeat until you have measured the energy used by each lamp in 100 seconds.
- Plot a graph of energy used against power of appliance.

ACTIVITY 11

Title: The Fuse

Aim: To demonstrate the action of a fuse

Apparatus: 12 V, 24 W raylamp, rheostat (value 100 Ω upwards), 12 V d.c. power supply, ammeter, fuse (500 mA) in fuse holder.



Instructions

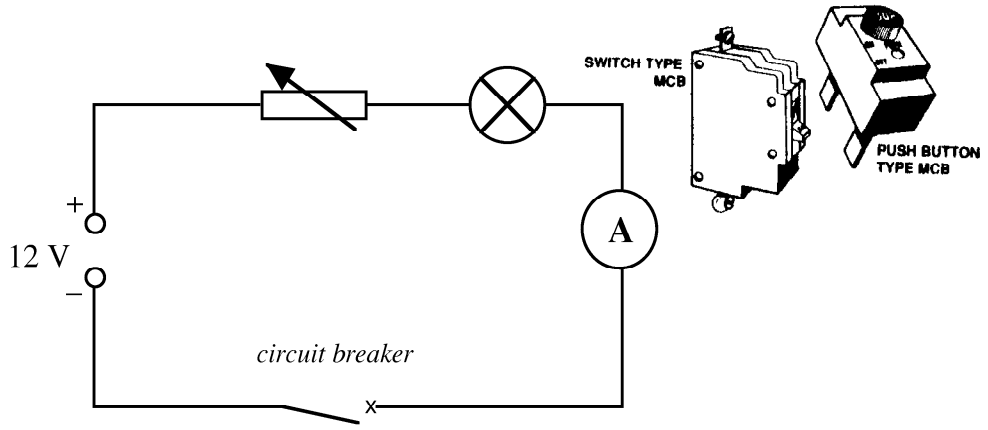
- Before you set up the circuit, move the sliding contact of the rheostat into the middle position.
- Set the power supply to the correct voltage.
- Set up the circuit shown and switch on.
- By moving the sliding contact on the rheostat, gradually increase the current until the fuse melts. Make a note of the current when this happens.

ACTIVITY 12

Title: The Circuit Breaker

Aim: To demonstrate the action of a circuit breaker

Apparatus: 12 V, 24 W raylamp, rheostat, 12 V d.c. power supply, ammeter, miniature circuit breaker (MCB).



Instructions

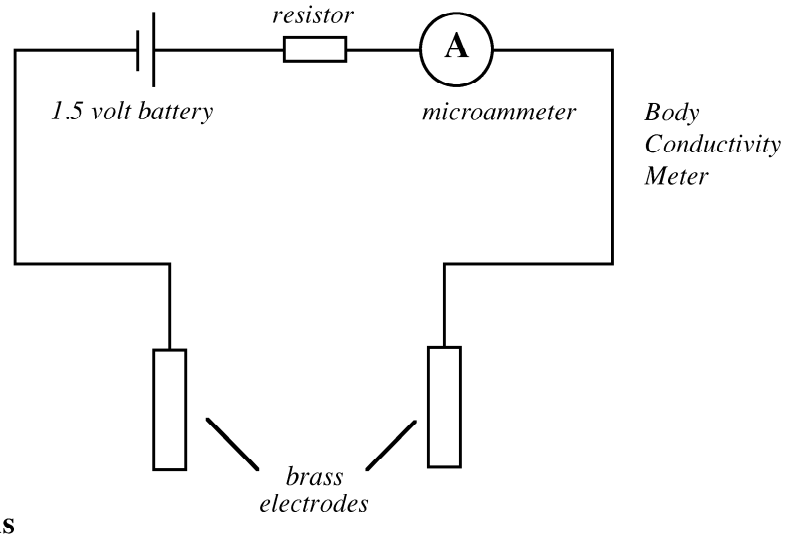
- Before you set up the circuit, move the sliding contact of the rheostat into the middle position.
- Set the power supply to the correct voltage.
- Set up the circuit shown and switch on.
- By moving the sliding contact on the rheostat, gradually increase the current until the MCB trips. Make a note of the current when this happens.
- Compare the measured value of current with the current rating of the MCB and write a description of how the MCB operates.
- Compare the operation of the MCB with the operation of a fuse and list two benefits of using an MCB in place of a fuse.

ACTIVITY 13

Title: Human Conductivity

Aim: To investigate how the conductivity of the human body changes when dry or wet.

Apparatus: Body conductivity meter.



Instructions

- Hold one brass electrode in each hand.
- The microammeter measures the current passing through your body.
- The meter indicates your conductivity - the greater the current, the higher your conductivity. Make a note of this current.
- Now wet your hands and repeat the experiment. Make a note of the new current.
- Compare the currents when dry and wet. Write a conclusion about how the conductivity of the human body changes when it is dry or wet.
- Extend your conclusion to say why it is dangerous to operate mains appliances in a bathroom.

ACTIVITY 14

Title: The Earth Wire

Aim: To demonstrate how the earth wire acts as a safety device

Apparatus: Earth wire wiring model

Instructions

- Your teacher will demonstrate the importance of the earth wire as a safety device
- Write a brief description of the function of the earth wire

ACTIVITY 15

Title: Double Insulation

Aim: To determine the meaning of double insulation by examination of appliances

Apparatus: Various electrical appliances; some with double insulation symbol - plugs removed

Instructions

- Examine the flexes of each appliance. Note the number and type of wires in each flex.
- Write a conclusion about the meaning of double insulation.

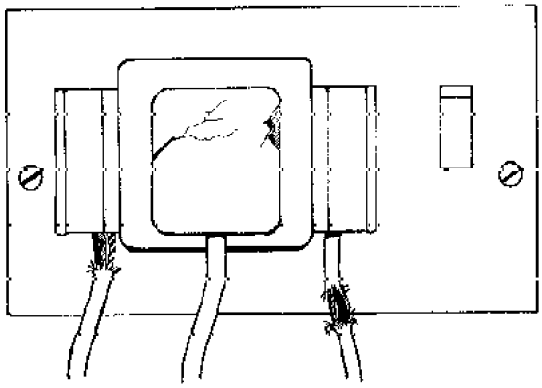
ACTIVITY 16

Title: Electrical Hazards

Aim: To identify hazards from pictures/diagrams

Instructions

- Study the drawing.
- List 3 faults apparent in the picture and explain how each is dangerous.



ACTIVITY 17

Safety Point:

Never use a continuity tester on an appliance when it is connected to any Power Supply - or the Mains.

Title: Continuity Check

Aim: To use an ohmmeter to check for continuity

Apparatus: Ohmmeter, sample circuits, components and appliances for testing

Instructions

- Use the ohmmeter to determine whether or not there are any faults.
- Identify the faults to your teacher.

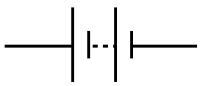
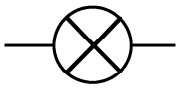
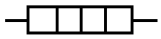
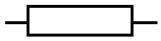
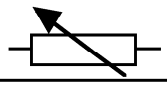
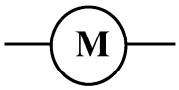
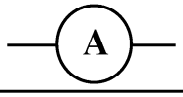
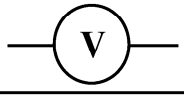
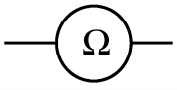
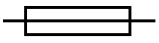
ELECTRICAL CIRCUITS

A circuit will always have a source of electrical energy, an electrical component and wires forming a complete path out from one end of the source and back to the other end. If the circuit is complete, there will be current. If the circuit is incomplete, there will be no current.

Each electrical component has a symbol - called a "circuit symbol". When we draw circuit diagrams, we draw the circuit symbol instead of trying to draw the component itself.

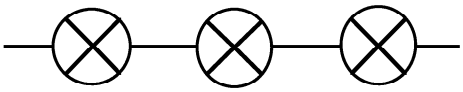
Circuit Symbols

The following table is a list of the circuit symbols for all the electrical components needed for this course as well as a brief description of the function of the component.

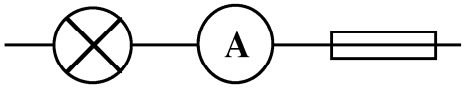
Component	Circuit Symbol	Description
Battery		Supplies electrical energy.
Lamp		Converts electrical energy to light energy.
Switch		Open: breaks a circuit. Closed: completes a circuit.
Heater		Converts electrical energy into heat energy.
Resistor		Opposes current, it converts electrical energy into heat energy.
Variable resistor		A resistor whose resistance can be changed.
Motor		Converts electrical energy into kinetic energy.
Ammeter		Used to measure electric current - always connected in series.
Voltmeter		Used to measure voltage - always connected in parallel.
Ohmmeter		Measures resistance directly - use when component is not connected.
Fuse		A protection device. It melts when the current gets too high.

Series Circuits

When components are connected to allow only one path for the current, we say that the components are connected in series.

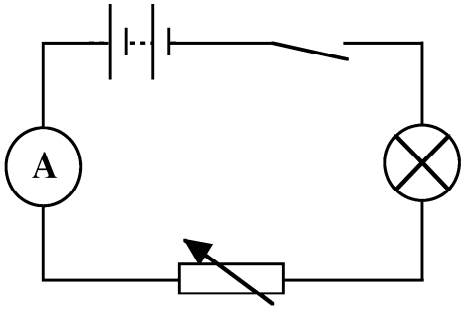


three lamps in series



lamp, ammeter and fuse connected in series

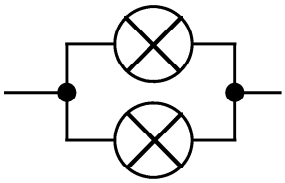
If the components form a circuit, the circuit is called a series circuit.



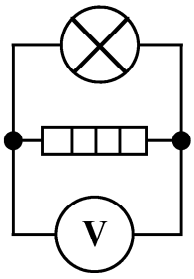
A series circuit. The battery, switch, lamp, variable resistor and ammeter are all connected in series. There is only one path for the current from one end of the battery, through each component in turn to the other end of the battery.

Parallel Circuits

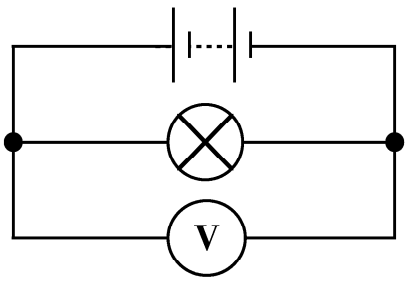
When components are connected to allow more than one path for the current, we say that the components are connected in parallel.



two lamps in parallel



lamp, heater and voltmeter connected in parallel



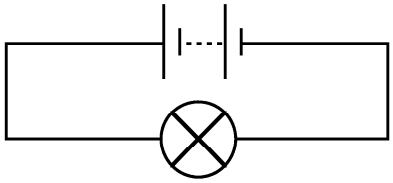
A parallel circuit. The battery, lamp and voltmeter are all connected in parallel. There is more than one separate path for the current. You can trace a separate path from the battery through either component back to the other end of the battery.

Measuring Current

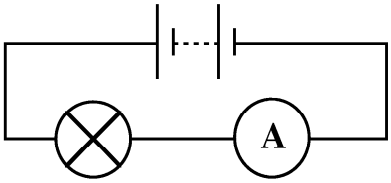
- Current is measured using an ammeter
- Current is measured in amperes. (Shorthand for amperes is "A")
- To measure the current through a component, always connect the ammeter in series with the component.

  This means breaking the circuit to insert the ammeter.

Connecting the ammeter



Before
How to measure the current through the lamp.



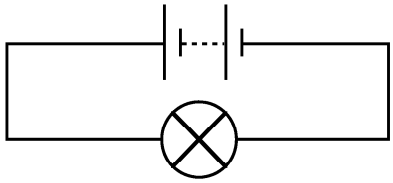
After
The circuit is altered to include the ammeter in series with the lamp. The reading on the ammeter is the current through the lamp.

Measuring Voltage

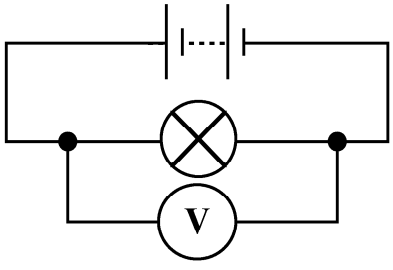
- Voltage is measured using a voltmeter
- Voltage is measured in volts. (Shorthand for volts is "V")
- To measure the voltage across a component, always connect the voltmeter in parallel with the component.

  This can be done without breaking the circuit. The voltmeter forms another parallel branch across the component.

Connecting the voltmeter



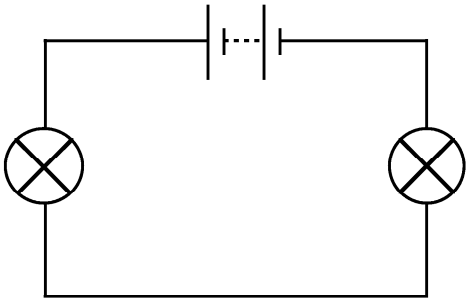
Before
How to measure the voltage across the lamp.



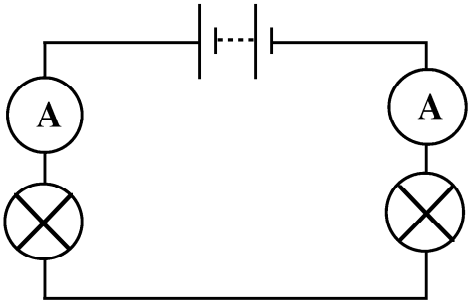
After
The voltmeter is added to make another branch in parallel with the lamp. The reading on the voltmeter is the voltage across the lamp.

Current and Voltage in Series Circuits

The current through every component in a series circuit is identical and is the same as the supply current.



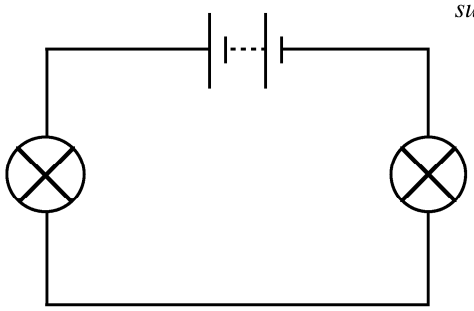
The current through each lamp can be measured directly.



To measure the current in each lamp, connect an ammeter in series with each lamp.

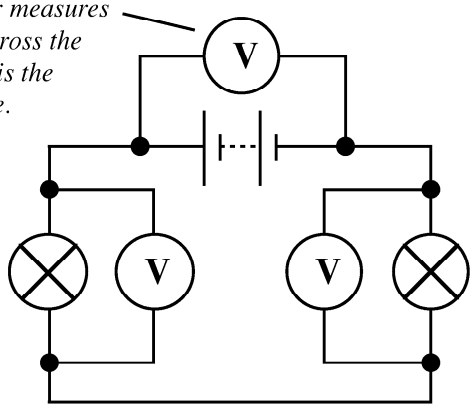
Each ammeter will have the same reading.

The sum of the voltages across each component in a series circuit adds up to the supply voltage.



The voltage across each lamp can be measured directly.

This voltmeter measures the voltage across the battery. This is the supply voltage.

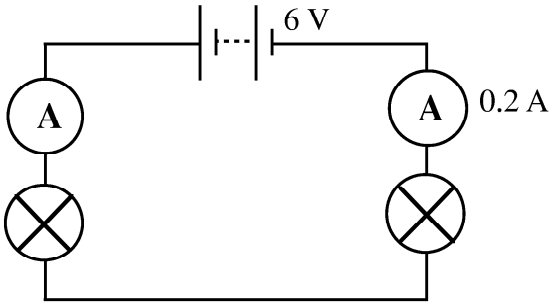


To measure the voltage across each lamp, connect a voltmeter in parallel with each lamp.

The voltmeter readings across the lamps add up to the supply voltage.

Examples

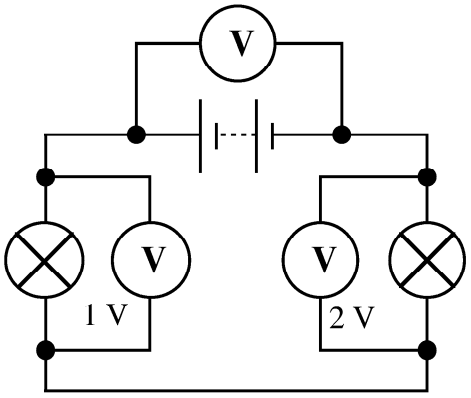
1. In the circuit shown, the current reading on one of the ammeters is 0.2 amperes. Find the current reading on the other ammeter and the current through each lamp.



In a series circuit, the current is the same at all points.

The current reading on the other ammeter = 0.2 A
also the current through each lamp = 0.2 A

2. Find the supply voltage in the circuit shown below.

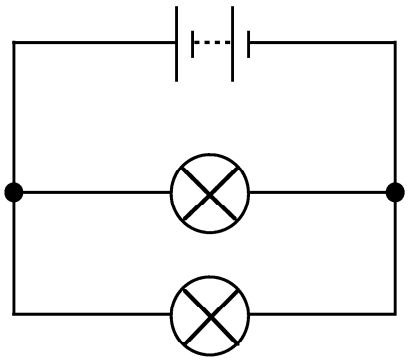


In a series circuit, the voltage across each component adds up to the supply voltage.

The supply voltage = 2 + 1
= 3 V

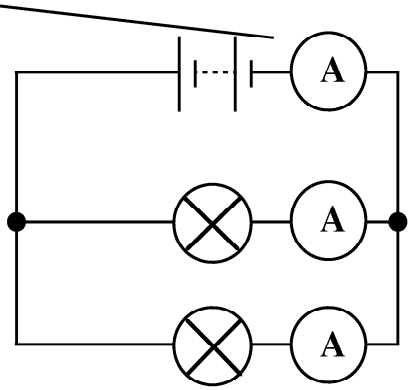
Current and Voltage in Parallel Circuits

The sum of the currents through each component in a parallel circuit adds up to the supply current.



The current through each lamp and the battery can be measured directly.

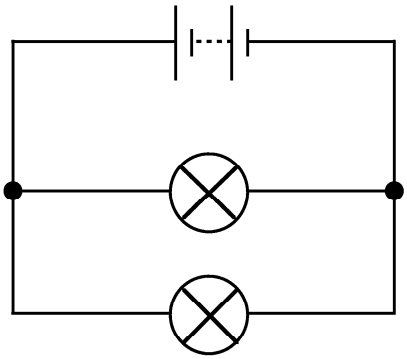
This ammeter measures the current through the battery. This is the supply current.



To measure the current in each lamp, connect an ammeter in series with each lamp. To measure the current through the battery, connect an ammeter in series with the battery

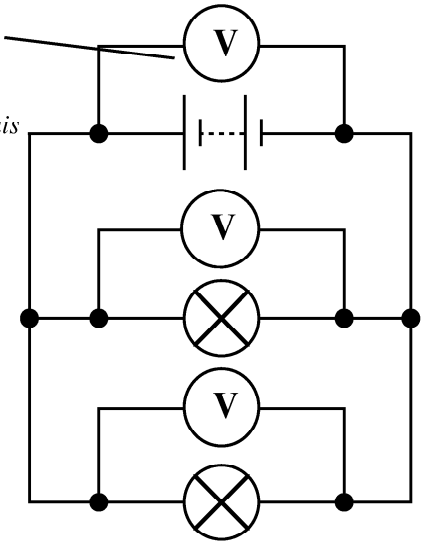
The ammeter readings add up to the ammeter reading through the supply.

The voltage across every component in a parallel circuit is identical and is the same as the supply voltage.



The voltage across each lamp can be measured directly.

This voltmeter measures the voltage across the battery. This is the supply voltage.



To measure the voltage across each lamp, connect a voltmeter in parallel with each lamp.

Each voltmeter will have the same reading. The supply voltage is the same as the voltage across each lamp.

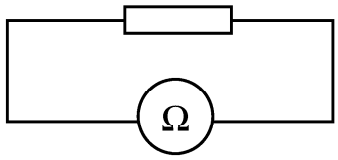
RESISTANCE

Materials oppose current and some materials oppose it more than others. The opposition to current is called resistance. An increase in resistance causes a decrease in current.

A resistor causes electrical energy to be converted into heat energy in the material. Sometimes this is a nuisance - when circuits heat up and get too hot. Sometimes it is useful - when heat is required, for example in kettles or cookers.

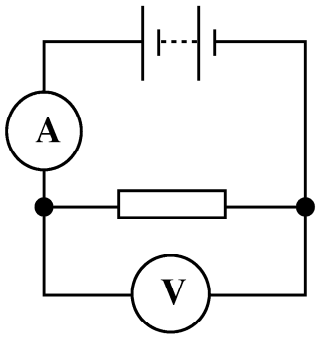
Measuring Resistance

- Resistance is measured in ohms. (Shorthand for ohms is "Ω" - the Greek letter omega)
- Resistance can be measured using an ohmmeter



- To measure resistance, connect the ohmmeter directly across the resistor or component whose resistance you want to measure.

Calculating resistance from ammeter and voltmeter values



Put the resistor or component into a circuit.

Measure the current through the resistor.

Measure the voltage across the resistor.

Calculate resistance using:

$$resistance = \frac{voltage}{current}$$

Example

The current through a resistor is 0.1 amperes when the voltage across it is 12 volts. Calculate the resistance.

$$resistance = \frac{voltage}{current} = \frac{12}{0.1} = 120\ \Omega$$

Variable resistors

It is often useful to be able to adjust the flow of current continuously. For example; controlling the loudness or brightness of a TV, the heat setting on a toaster, adjusting the speed of a model train. To do this we use a variable resistor. When the resistance is reduced, the current increases.

MAINS ELECTRICITY

Mains electricity is dangerous. Never experiment with mains electricity.

Electricity supplied to houses is called mains electricity. Mains electricity is dangerous because your body can conduct electricity and mains voltage can cause a current large enough to kill you. Your body conducts even more if it is wet or damp, this is the reason why there must be no sockets or switches in a bathroom.

The declared value of mains voltage is 230 volts.

All mains appliances in Britain are designed to operate with a voltage of 230 volts across them. This means that the household wiring must be such that all the appliances are connected **in parallel**. This ensures that each appliance receives the same (230 V) voltage.

The three pin plug

Household wiring consists of cables in which there are three wires. The cable is connected to the mains using a three pin plug - one pin for each of the wires.

1 The live wire (brown)

The live wire is the wire connected to the 230 volts supply from the power station. It is coloured brown. If you touch the brown wire of an appliance which is connected to the mains you will get a shock which can kill you. The switch in an appliance is always connected to the live wire so that when the switch is off, the appliance is disconnected from the 230 V supply from the mains.

2 The neutral wire (blue)

The neutral wire is used to complete the circuit from the appliance to the mains. If you touch the blue wire in an appliance you can still get a shock if the appliance is connected to the mains and working.

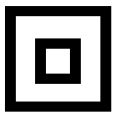
3 The earth wire (green and yellow)

The earth wire does not normally carry current. It is a safety device. It only carries current if there is a fault in the appliance. All appliances with metal parts which can be touched must have an earth wire.

Double Insulated appliances

Appliances are called "double insulated" if it is impossible to touch the live wire inside it. These appliances do not need an earth wire and only have a live and neutral wire.

Double insulated appliances have a symbol on them.



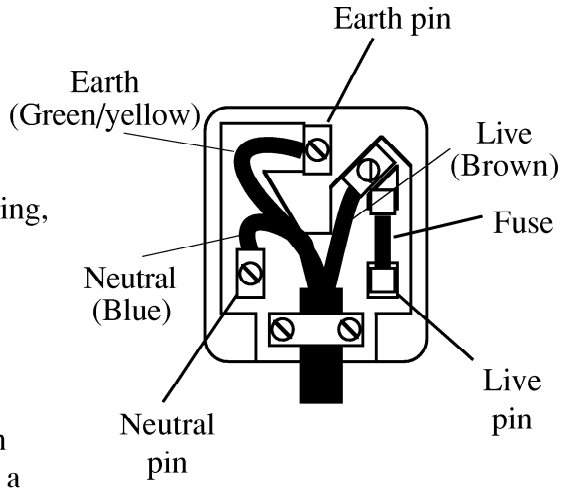
Double insulated symbol.

Appliances with this symbol do not have an earth wire since it impossible to touch any metal parts.

Wiring a plug

All appliances are connected to the mains power supply by a three pin plug. The plug which connects an appliance to the mains must be connected as shown here.

It is dangerous to operate an appliance if the wires are not connected as shown here. If you are unsure about a plug's wiring, do not use it!



Three pin plug used to connect appliances in Britain to the Mains supply

The fuse

The fuse in a plug is a safety device to protect the cable. It melts if the current in the cable gets too high. All plugs contain a fuse.

The fuse is always connected between the live pin of the plug and the live wire of the appliance. This is so that if something goes wrong, the fuse melts and disconnects the live wire of the appliance from the mains power supply.

Fuse values

Fuse values are usually 3 ampere or 13 ampere in domestic appliances.

It is important to use the correct fuse value to avoid too high a current. The fuse value can be calculated from the voltage and the power rating:

$$\text{current} = \frac{\text{power}}{\text{voltage}}$$

Example

Calculate the fuse value required for a mains appliance with a power of 1150 watts.

$$current = \frac{power}{voltage} = \frac{1150}{230} = 5A$$

Hence a 13 ampere fuse is required.

As a general rule if the power rating is 700 W or more, a 13 ampere (13 A) fuse must be used. If the power rating is less than 700 W, a 3 ampere (3 A) fuse must be used.

Electrical power

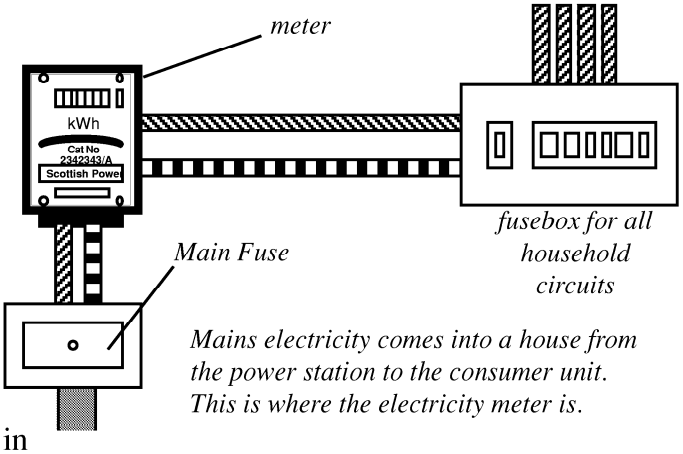
Electrical energy is not free! We have to pay for batteries to get electrical energy from them and we have to pay for the electrical energy supplied by the power station. The amount of energy used by a household is measured by the meter at the consumer unit.

Every appliance has a power rating marked on it (usually in kilowatts *kW*, or watts *W*). The greater the power of the appliance, the more energy it uses in one second (this is because it uses more current).

Also, the longer the time the appliance is used, the more energy it uses. So to save energy and money, always switch off appliances after use.

The Consumer Unit

Mains electricity comes from the power station into your house through a service cable which goes to the meter board.

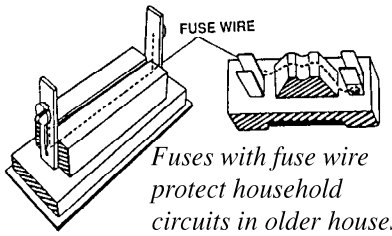


Mains electricity comes into a house from the power station to the consumer unit. This is where the electricity meter is.

From here the mains supply is split into various domestic circuits. The lights, power sockets and cooker each have separate circuits which are wired in parallel. The parallel wiring ensures each circuit has the same 230 V voltage needed to operate appliances.

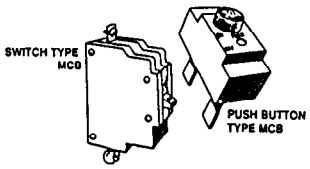
Mains Protection

Although the fuse in the three pin plug protects the cable of the appliance, it does not protect any wiring in the house which comes from the mains supply (wires behind wall, etc.). Household wiring is protected at the point where it comes into the house - at the consumer unit.



Fuses with fuse wire protect household circuits in older houses

Every circuit in the house is protected in the mains consumer unit. In older houses, a fuse is used to protect each circuit but in newer houses and houses which have been recently rewired, a circuit breaker is used.

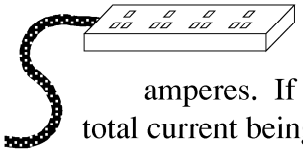


Circuit breakers protect household circuits in modern houses

The Circuit Breaker

A circuit breaker is a very fast switch which opens and disconnects the circuit when the current gets too large. It disconnects the circuit by switching faster than a fuse can by melting. This means that circuit breakers are much safer and are gradually replacing fuses altogether.

Using Extensions



When appliances are plugged into an extension block, the total current increases. A kettle carries a current of about 10 amperes. If four kettles were to be plugged into an extension block, the total current being carried would be about 40 amperes.

This very high current causes the cables behind the wall or under the floor, to heat up and become a fire risk. Unfortunately, this is the cause of many house fires.

Safety Rules

1. Never use worn or damaged flexes: you could get a shock from an exposed live wire.

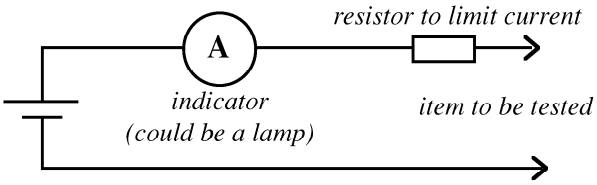
2. Avoid the use of extensions if possible: too many appliances connected to an extension could produce overheating at the socket.

3. Always use the correct flex: a flex which is too thin could overheat.

4. Always use the correct plug fuse: if the fuse rating is too high and a fault develops, the flex could overheat.

Testing for Continuity

Simple conductors can be tested for continuity by trying to pass a current through them in series with some indicator device (e.g. a bulb or ammeter). If there is a current, the series circuit is complete. If there is no current, there is a break in the circuit.

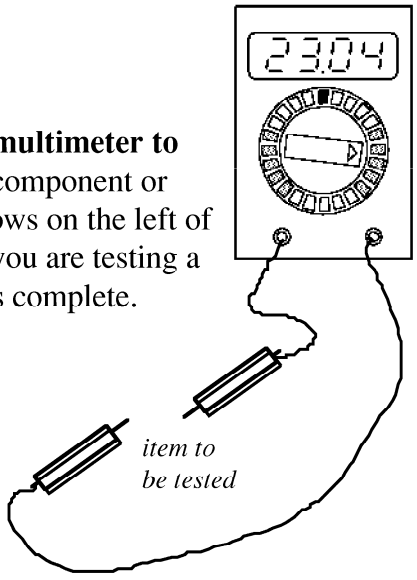


Switches can be tested, after removing them from their circuit, by using this simple continuity tester. There should be a current with the switch in the ON position. There should be no current when the switch is changed to the OFF position.

The continuity tester must **never** be used with equipment connected to the mains!

This simple continuity tester should not be used for components which are still connected in their circuits.

Using the multimeter



When using the multimeter to test for faults, **set the multimeter to measure resistance** and place the probes across the component or circuit element. **If the reading is infinity** (a "1" shows on the left of the display) **there is an open circuit** (this is O.K. if you are testing a switch set to OFF). If there is a reading, the circuit is complete.

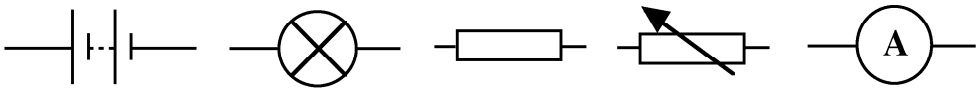
Safety Point

You must only test a component if there is no chance of there being any current in it.

PRACTICAL ELECTRICITY

1. Draw the circuit symbols for a; voltmeter, electric motor, switch and fuse.

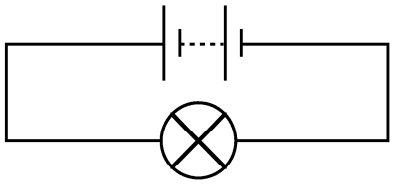
2. Copy the circuit symbols shown here and beside each symbol write the name of the component and what is does.



3. Draw a circuit diagram showing:

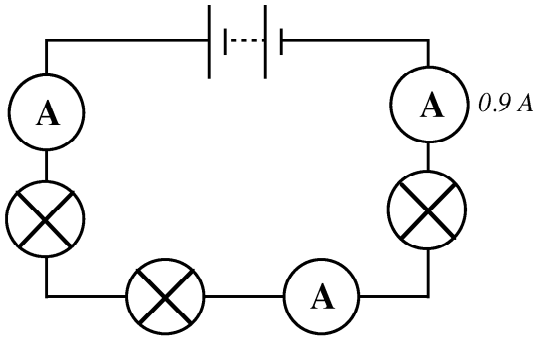
   (a) a battery, a lamp and two resistors all in series
   (b) a battery, two lamps, a switch and an ammeter all in series
   (c) a battery and three lamps in parallel
   (d) a battery and switch in series and these are in parallel with three resistors.

4. Redraw the circuit below showing how to measure the current through the lamp.



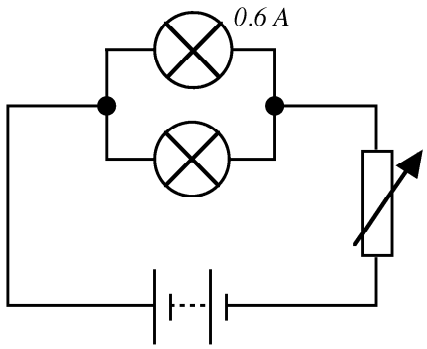
5. Redraw the circuit of question 4 showing how to measure the voltage across the lamp.

6. Redraw the circuit below and write the reading of the ammeters beside each ammeter symbol.

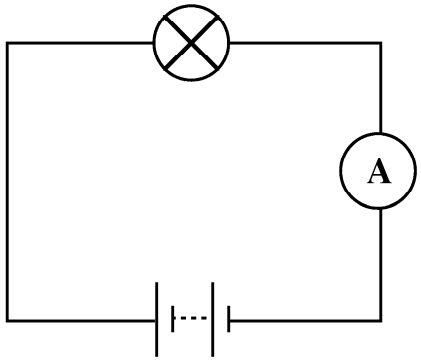


7. Redraw the circuit of question 6 without the ammeters and show how you would connect a voltmeter to measure the supply voltage.

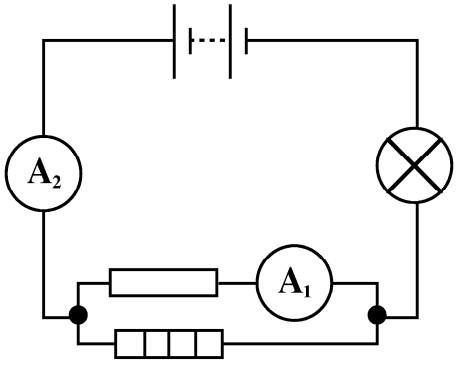
8. In the circuit below, the lamps are identical and the current through each lamp is 0.6 amperes. Redraw the circuit and mark beside each component the value of the current through it.



9. In the circuit below the ammeter reads 0.6 amperes. What is the current through the lamp?

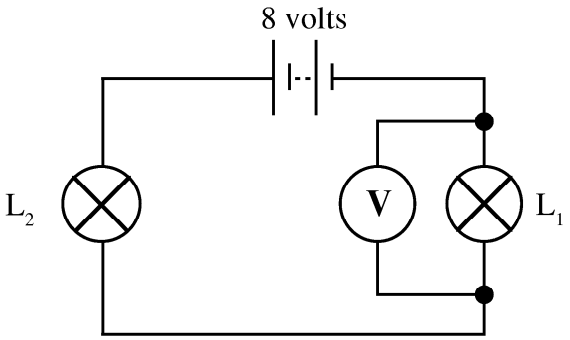


10. In the circuit below, ammeter A_1 reads 0.2 amperes and ammeter A_2 reads 0.5 amperes. Draw the circuit symbol for each component used and beside it write the component name and the value of the current through it.

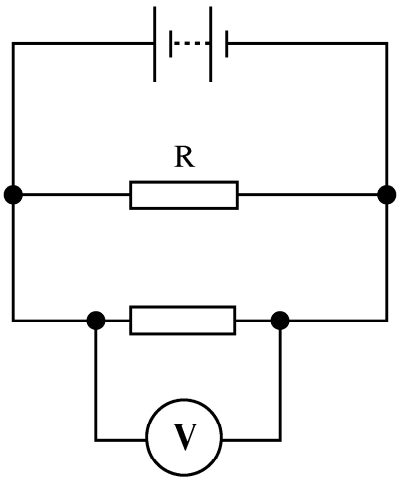


11. Redraw the circuit of question 10 and show how the voltage across the lamp can be measured.

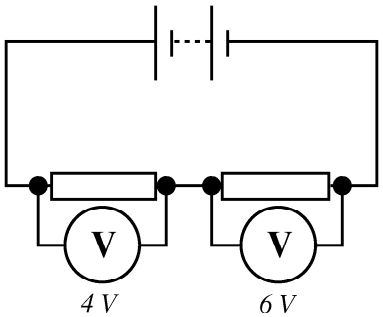
12. In the circuit below, the lamps are different. The voltmeter reads 3 volts. What is the voltage across the other lamp L_2?



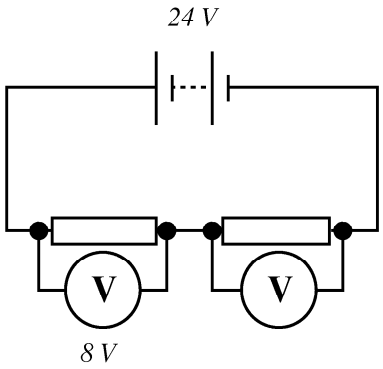
13. In the circuit below, the voltmeter reads 4 volts. What is the voltage across the resistor R?



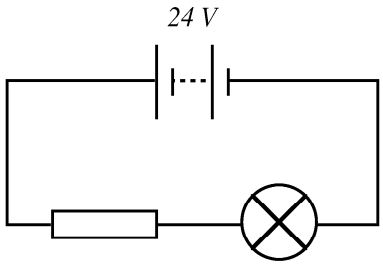
14. In the circuit below, the voltages are as shown. What is the voltage of the supply?



15. In the circuit below, the voltages are shown. What is the voltage across the second resistor?

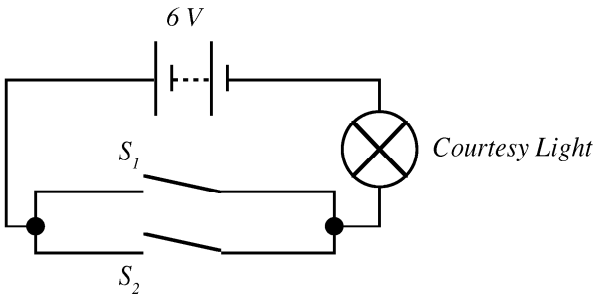


16. This diagram shows a 6 V bulb working correctly off a 24 V supply. What must be the voltage across the resistor?



17. The diagram shows the circuit of the courtesy light in a two-door car.

A car Courtesy Light operates when either door of the car is opened.



(a) What happens to a switch when a door is opened?

(b) Explain why the switches are in parallel rather than in series.

18. A resistor has a voltage across it of 12 volts and a current through it of 2 amperes. Calculate the resistance of the resistor.

19. A voltage of 6 volts is across a resistor where the current is 0.5 amperes. What is the value of the resistor?

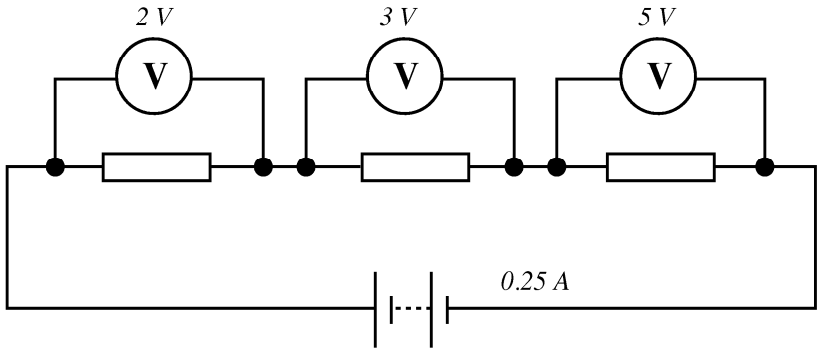
20. Calculate the resistance of a component when a voltage of 24 V causes a current of 0.1 amperes.

21. If a current of 2 amperes exists through a lamp when 12 volts across it, what is the resistance of the lamp?

22. A torch bulb is marked "6 V, 0.25 A". Calculate the resistance of the bulb.

23. A resistor is placed in a circuit. The voltage across it and current through it are measured as 12 volts and 0.02 amperes. The resistor is now removed from the circuit and an ohmmeter connected across it. What is the reading on the ohmmeter?

24. (a) Find the values of the resistors in the circuit below.
    (b) Calculate the value of the supply voltage.



25. Explain why it is dangerous to operate mains switches with wet hands.

26. Describe an experiment to show the change in conductivity of the human body when it is dry or wet.

27. Draw a sketch of a domestic three-pin plug.
    Label the wires; live, neutral and earth and state the colours of their insulation.
    Label the fuse and describe how it works.

28. Draw the symbol for a double insulated appliance.
    Describe what is meant by "double insulated".

29. What are the advantages of using a circuit breaker instead of a fuse?

30. Which fuse value is required for an appliance with a power of 1150 watts?

31. A mains appliance has a power rating of 820 watts. How much current does it require?

32. How much current will a 2 kilowatt mains heater require?

33. Mains plugs can have a choice of two values; 3 A and 13 A. Which fuse should be inserted in a plug attached to a 750 watt appliance?

34. A lighting circuit in a house serves 6 rooms. If each room can have a maximum of 150 watts per ceiling lamp, what value of fuse should be used to protect the circuit?

35. Complete the following sentences to make 4 important safety rules for mains electricity.

    (a) Never use worn or damaged ------: you could get a shock from an exposed ---- wire.

    (b) Avoid the use of -------- if possible: too many appliances connected to an adaptor could produce ---------- at the socket.

    (c) Always use the correct flex: a flex which is too ---- could overheat.

    (d) Always use the correct plug ----: if the fuse rating is too ---- and a fault develops, the flex could overheat.

36. Describe how to use a multimeter to detect an open circuit. Make sure you include how to set the multimeter to the correct setting and what you would expect to see for this fault.

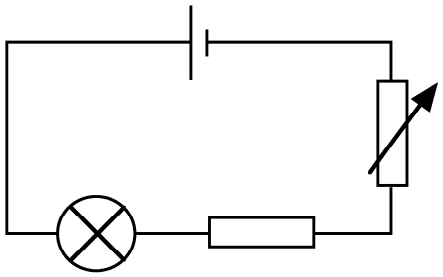
37. The circuit shown below contains a battery, lamp, 1 A fuse and a variable resistor.

    (a) Is this a series or a parallel circuit?

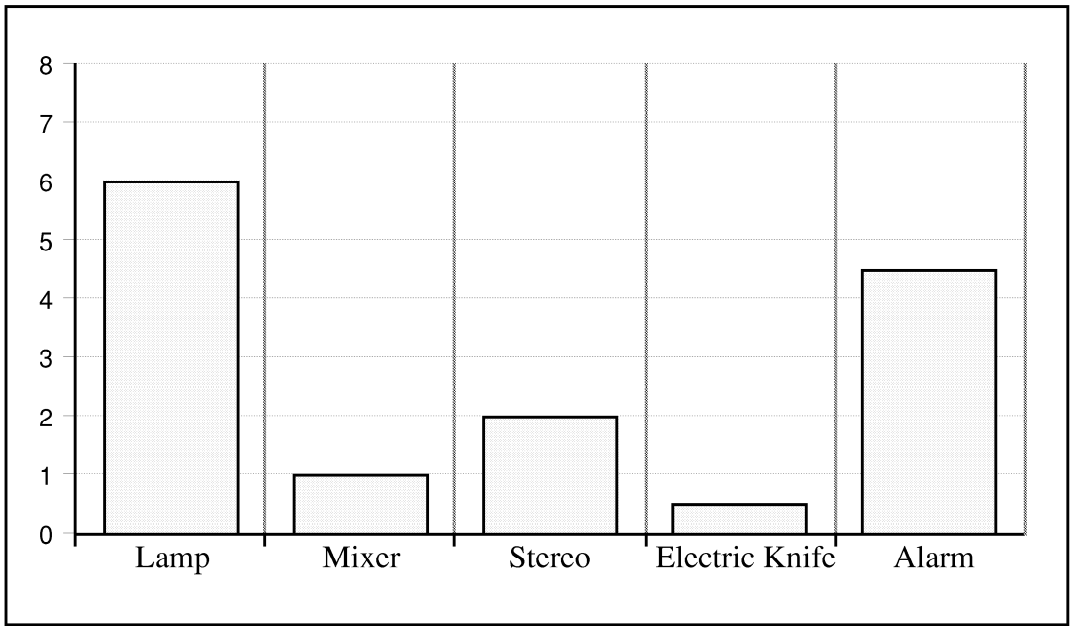
    (b) The variable resistor is set so that a current of 2 A flows.

        (i) What happens to the fuse when there is a current of 2 A?

        (ii) What happens to the lamp when there is a current of 2 A in the fuse? Explain your answer.



38. A group of pupils investigate the time various appliances are switched on for during a day. The appliances are all rated at 100 W. Their results are presented in the bar chart below.



(a) Which of the appliances is switched on for the longest time?

(b) All of the appliances have a power rating of 100 W.
Explain which of the appliances is most costly to use in one day.

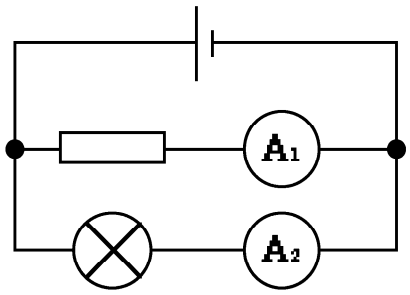
39. The following table gives details about various household appliances.

Name of Appliance	Table Lamp	Kettle	Washing Machine	Curling Tongs
Power	60 W	2 kW	1.8 kW	300 W
Voltage	230 V	230 V	230 V	230 V
Current				

(a) Copy and complete the table shown above.

(b) List all the appliances which should have a 3 A fuse fitted in their plug.

40. Shown below is a parallel circuit containing a battery, resistor, lamp and two ammeters.



The following readings are taken from the ammeters:

Reading on ammeter A_1 = 0.05 A
Reading on ammeter A_2 = 0.42 A

(a) State the current through the lamp.

(b) Which component, the resistor or the lamp has the larger resistance? Explain your answer.

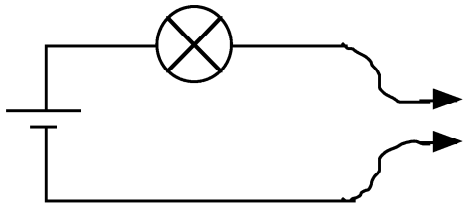
41. The adverts shown below give information on two music systems.

(a) Explain which music system is the more expensive to operate.

(b) Both of these systems need to be connected to the mains supply. State the voltage across these systems when connected to the mains.

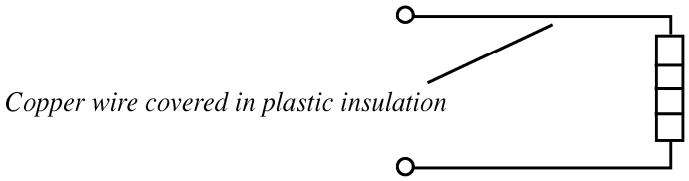
(c) Calculate the current in the Pony music system.

42. A continuity tester is shown below.



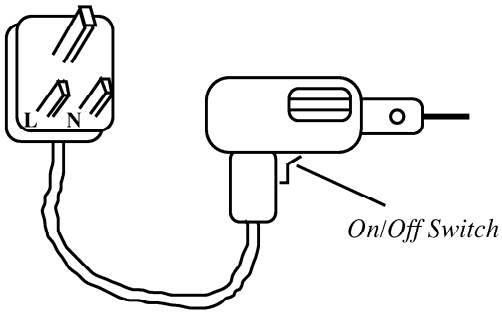
(a) A piece of bare copper wire is connected to both metal probes.
Will the lamp light?

(b) The circuit below contains 2 copper wires covered in plastic and a heater.
A test engineer suspects that there is an open circuit fault..



Copy the diagram with the copper wires and the heater. Describe how the continuity tester can be used to test if there is an open circuit.

(c) The continuity tester is connected to the L and N pins of the plug of the appliance shown below. The lamp does **not** light.



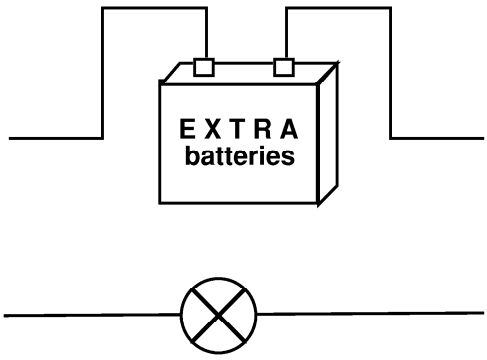
Copy and complete the following sentences.

Since the lamp does not light this must be an ____ circuit.

This could be because there is a _____ wire of the on/off switch is in the ___ position.

43. A car accessory shop sells a hand held search lamp which works with a car battery. A motorist buys the hand held search lamp and decides to check its resistance.

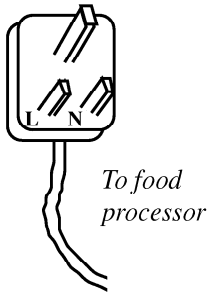
(a) Copy and complete the diagram below to show how this could be done using an ammeter and voltmeter.



(b) How would the motorist use the readings to find the resistance of the search lamp?

(SEB 1990)

44. The diagram below shows the wire of a food processor correctly connected to a three pin plug.



(a) Complete the table below naming the colour of the insulation on the wires connected to pins L and N.

Pin	*Colour of insulation*
L	
N	

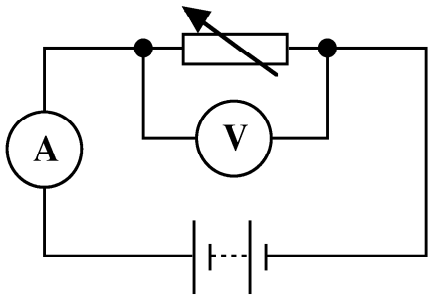
(b) One pin of the plug has not been used because the food processor is double insulated.

(i) What name is given to the pin which has not been used?

(ii) Draw the double insulation symbol.

(SEB 1990)

45. The circuit shown is used to investigate the effect of a variable resistor in a circuit.



The variable resistor setting is gradually changed.
The readings taken from the meters are shown in the table below.

	Set 1	Set 2	Set 3	Set 4
Voltage (volts)	6	6	6	6
Current (amperes)	0.1	0.2	0.3	0.4

Set 1 was the first set of readings, set 2 the second, etc. The readings were taken in the order shown.

(a) Was the resistance of the variable resistor increased or decreased during the experiment? Explain your answer.

(b) Calculate the resistance at the lowest setting of the variable resistor in this experiment.

46. Various appliances and the value of the fuse they need are listed below.

Computer: 3 A, Toaster: 13 A, Hair dryer: 13 A, CD player: 3 A, Coffee percolator: 3 A, Vacuum cleaner: 13 A.

Construct a table, with suitable headings, which lists the appliances in two groups.
One group should contain those appliances requiring a 3 A fuse.
The second group should contain those appliances requiring a 13 A fuse.