AQA GCSE Physics

Paper 1 Revision

Topic 2: Electricity

Name: ____

Form: 11___

AQA Electricity Topic Checklist (Double Content)		Do I have Notes?	What I need to improve:
Charge Flow	Draw and Use circuit symbols		
	State the conditions for charge to flow in a circuit		
	Know that electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge.		
	Calculate Charge Flow ($Q = It$)		
	Know that a current has the same value at any point in a single closed loop.		
Current, PD and Resistance	Describe how the greater the resistance of the component the smaller the current for a given potential difference (pd) across the component.		
	Calculate Potential Difference ($V = I R$)		
	Describe the resistance characteristic of an Ohmic Conductor		
	Describe and explain V-I graphs for resistor, bulb and diode		
	Draw and explain a circuit to measure current and potential difference		
	Describe the effect of adding resistances in series and parallel		
	Calculate the currents, potential differences and resistances in dc series circuits		
Mains	Mains electricity is an ac supply. In the United Kingdom the domestic electricity supply has a frequency of 50 Hz and is about 230 V.		
	Explain the difference between direct and alternating potential difference.		
	Know the name, colour and use of the three mains cables		
Appliances	Calculate Power ($P = I V$) ($P = I^2 R$)		
	Know amount of energy an appliance transfers depends on how long the appliance is switched on for and the power of the appliance.		
	State that work is done when charge flows in a circuit.		
	Calculate energy transferred by appliances ($E = P t$) ($E = Q V$)		
	Calculate Power of appliances ($P = I V$) ($P = E / t$)		
National Grid	Describe the National Grid as a system of cables and transformers linking power stations to consumers.		We covered most of this in the energy topic
	Explain the role of step-up and step-down transformers in the National Grid		

(Triple Content)		Do I have Notes?	What I need to improve:
Static	Describe how friction can cause insulators to become charged		
	Explain what happens when two charged objects are close to each other		
	Draw and describe the electric field round a charged object, and the effect it has on another charged object		

Would two charged polythene rods, when brought close together, attract or repel? Explain your answer.

Static electricity

(Separate students only)

Static Electricity

When two insulators are rubbed against each other (friction), electrons transfer from one object to the other, making both electrically charged.

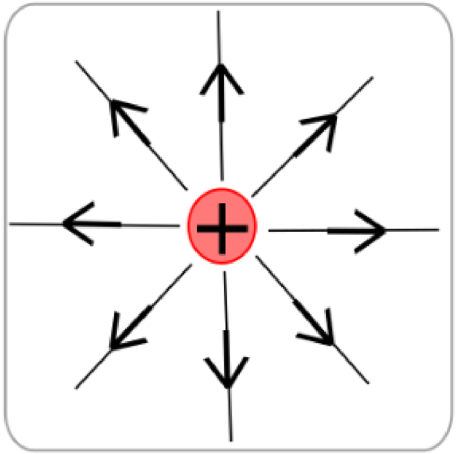
The material that gains electrons becomes negatively charged and the material that loses electrons become positively charged.

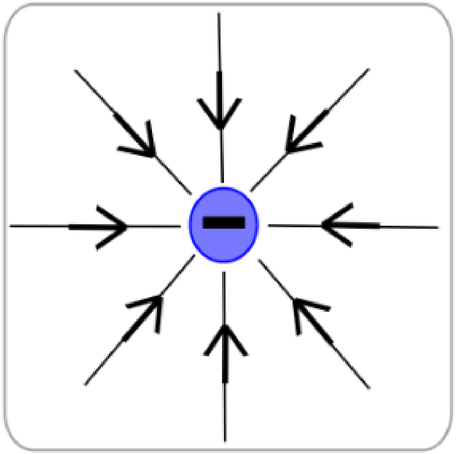
Like charges repel.
Opposite charges attract.

Sparks can be seen between objects when they are discharging – i.e. becoming neutral.

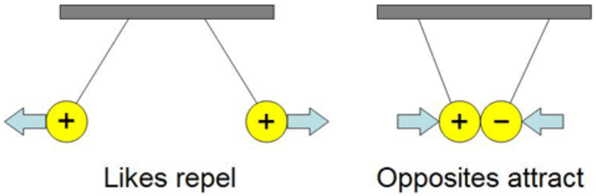
Electric field lines

Electric field lines should be equally spaced, leave the surface at 90°, arrows directed into a negative charge and away from a positive charge.





A charged object feels a force if placed into another charged objects electric field. The closer the two objects are to each other, the stronger the force.



Current, p.d. & resistance

Current
In metals, there are free electrons that are not attached to the positive ions. When the electrons flow, a current is produced.
Current is defined as the rate of flow of electric charge.

Charge	=	Current	x	Time
(C)		(A)		(s)

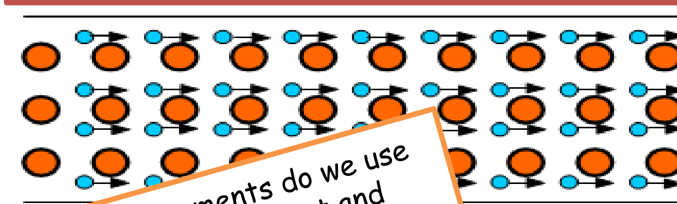
Potential difference (the posh term for voltage)
P.d is defined as the work done between two points per coulomb of charge that passes the points.

P.d	=	Work done	/	Charge
(V)		(J)		(C)

Other factors that affect resistance
The length of a wire was a **required practical** that you carried out. As the length of the wire increases the resistance increases because there are more ions so the rate of collisions increases. You could also investigate the thickness of a wire.

Resistance
Electrons need to push themselves past vibrating ions. The faster these ions vibrate (they vibrate faster when the temperature increases leading to an increase in their kinetic energy), the harder it is for electrons to do this. This means there is a higher resistance.

Resistance	=	P.d	/	Current
(Ω)		(V)		(A)



What instruments do we use to measure current and potential difference?

Practice rearranging the equations for each quantity.

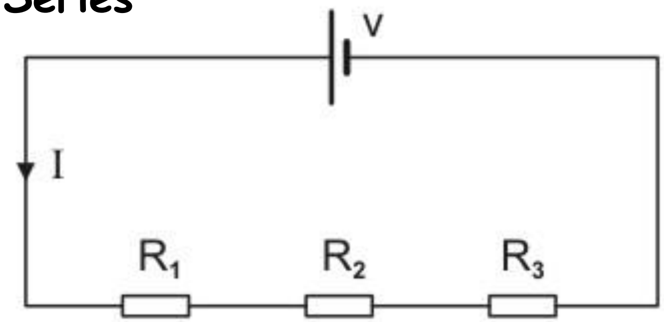
How do you think the thickness of a wire would affect the resistance?

If The cell has a p.d. of 6V, $R_1 = 2\Omega$, $R_2 = 4\Omega$ and $R_3 = 8\Omega$. What is the current flowing through the circuit? [0.43 A]

Required practicals

Resistors in series and parallel

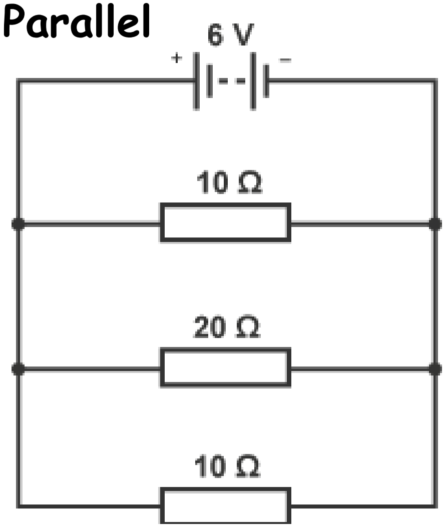
Series



As you add more resistors in series, the total resistance increases.

To work out the total resistance of a series circuit you add the resistances of each component together. $R_T = R_1 + R_2 + R_3$

Parallel



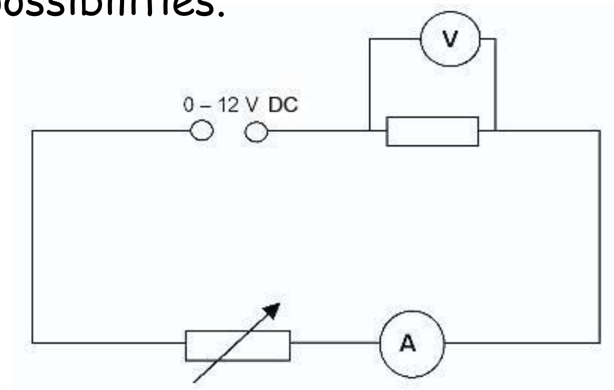
You do not need to know how to calculate the total resistance in parallel but just know that the resistance of the circuit decreases when more resistors are added in parallel – a bit counter intuitive.

What would happen to the brightness of bulbs in a circuit if you added more in parallel with each other?

I-V Graphs

You need to be aware of the following circuit that would need to be setup to find the I-V characteristic of a resistor, bulb and a diode.

The resistor is the component being tested in the circuit below, check you know what the symbols are for the other two possibilities.

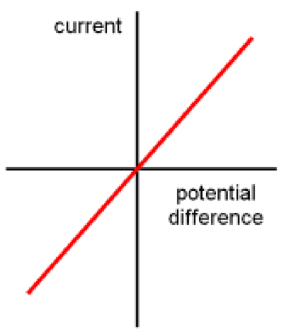


The variable resistor is used to change the p.d. around the component.

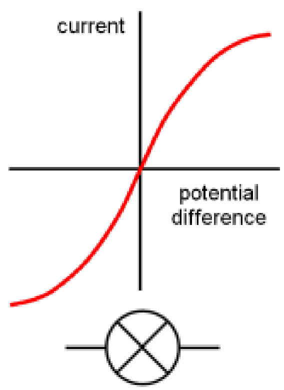
What feature of the graphs enable you to describe what is happening to the resistance in each I-V graph?

Current and potential difference graphs

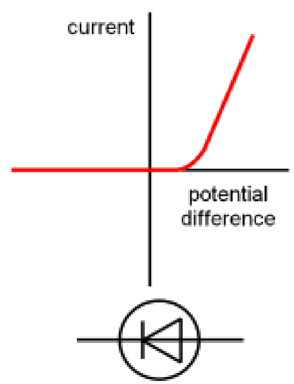
Resistor/Wire



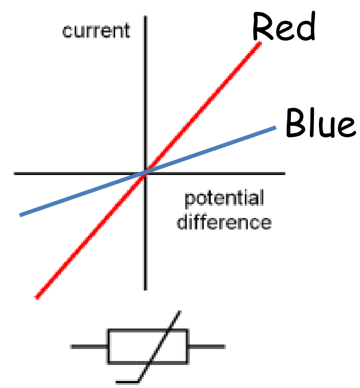
Filament Lamp



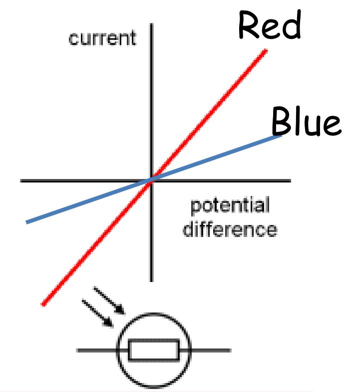
Diode



Thermistor



LDR



Ohm's law states that, for a resistor, the current that flows through it is directly proportional to the potential difference across the resistor, providing it is at constant temperature.

A diode only allows current to flow in one direction. LED's are replacing filament lamps as they can operate at lower currents.

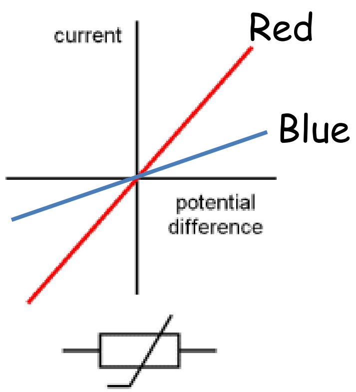
The resistance in a thermistor increases as the temperature decreases. (High temp = red line low temp = blue line).

The resistance in a LDR decreases as the light intensity increases. (Bright light = red line low temp = blue line). Resistors get hot as current flows through them.

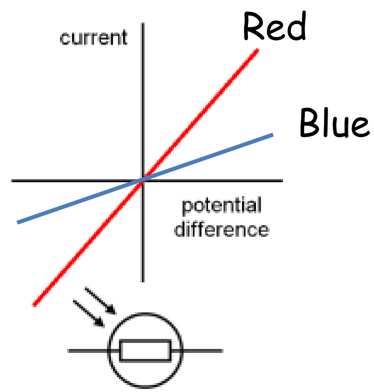
With the above in mind, explain why the resistance increases at higher potential differences for the filament lamp.

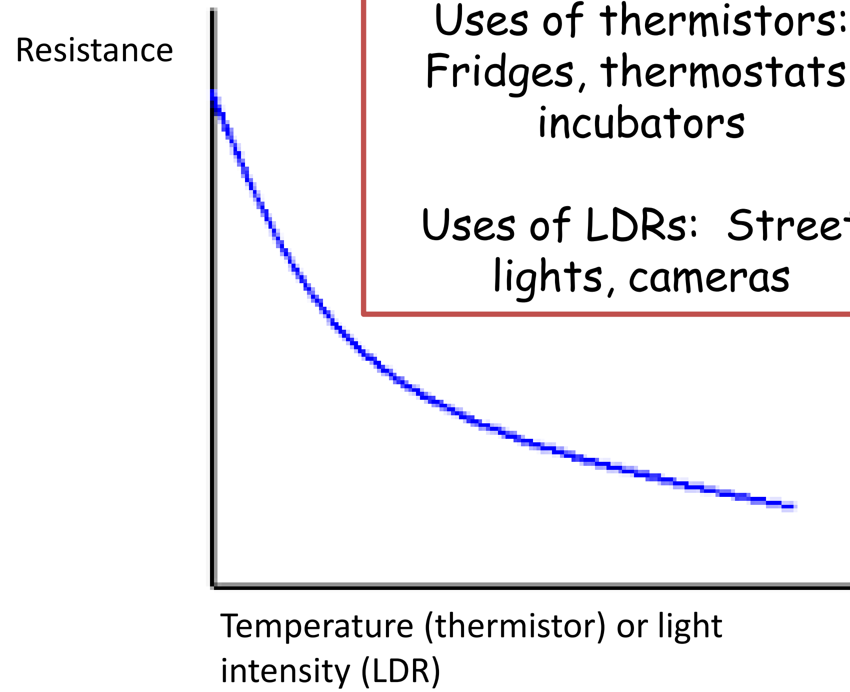
Thermistors and LDRs

Thermistor



LDR





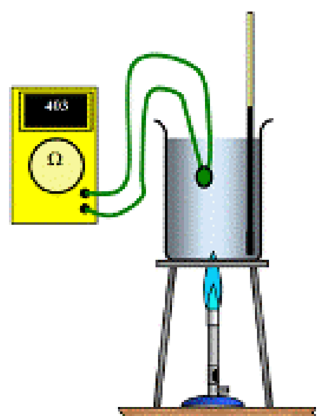
Uses of thermistors: Fridges, thermostats, incubators

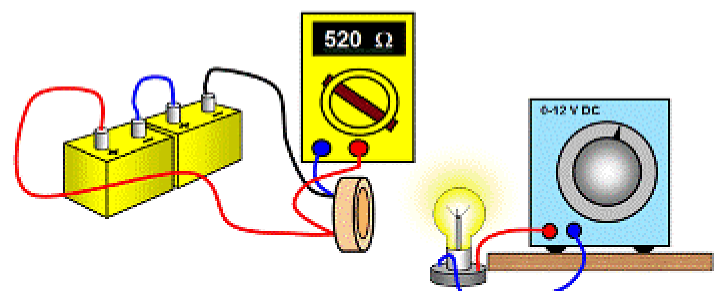
Uses of LDRs: Street lights, cameras

The resistance in a thermistor increases as the temperature decreases. (High temp = red line low temp = blue line).

The resistance in a LDR decreases as the light intensity increases. (Bright light = red line low temp = blue line).

Resistors get hot as current flows through them.

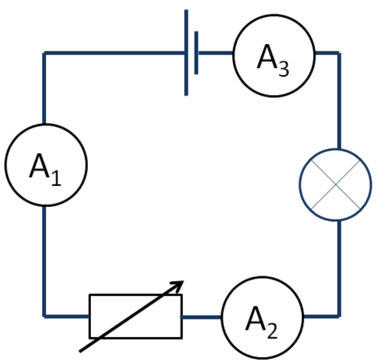


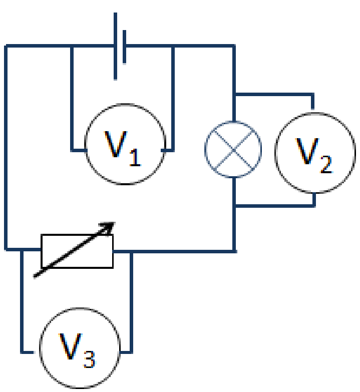


Series and Parallel Circuits

A series circuit is one in which current only has one path to flow through.

What would happen to the current as more bulbs are added? Why?





There is the same current through each component. $A_1=A_2=A_3$

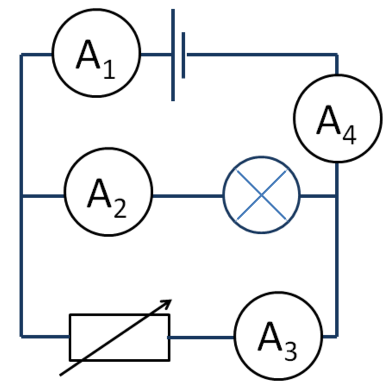
The total resistance of the circuit is the sum of the resistance of each component.

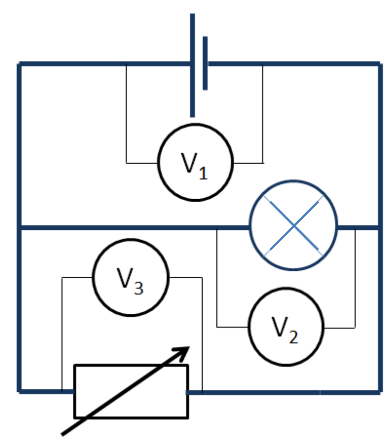
The potential difference is shared by each components. E.g. A 12V power supply could supply 8V to the resistor and 4V to the bulb.

A parallel circuit is one in which there is more than one path/junction, current can flow through.

When the current reaches a junction is 'splits'. However the total current is the sum of the current through the components. $A_1=A_2+A_3=A_4$

The potential difference across each branch is the same. It would then be shared by the components in that branch. $V_1=V_2=V_3$



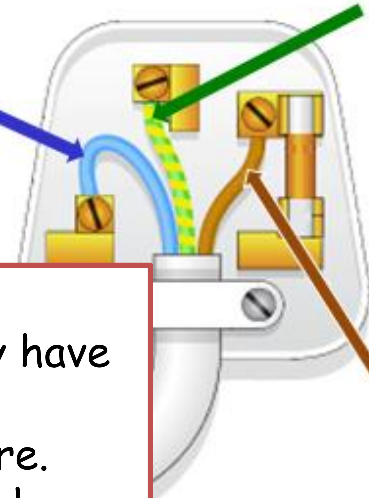


Mains Electricity

AC/DC
Cells and batteries supply current that always passes in the same direction. This is known as a **direct current** (d.c).
An **alternating current** is one that is constantly changing direction. Mains electricity has a frequency of 50Hz and is about 230V

Neutral (N)
This is the second wire to complete the circuit.

Earth (E)
A safety wire to stop a large current flowing through the device.



Live (L)
This wire carries the high voltage and is connected to the **fuse**.

Why do some appliances have no earth wire?

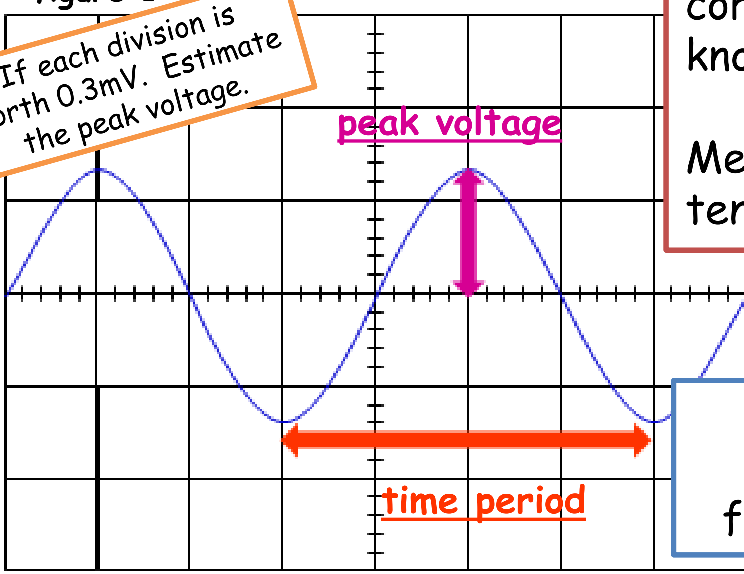
Cables
Some appliances only have two wires, they are missing the earth wire. This is because they have a plastic casing. The cables are said to be two-core cables. This is also known as double insulation.

Metal cased appliances tend to be earthed.

The fuse
A fuse contains a thin wire which heats up and melts if too much current is passed through it. The fuse is always placed in series with the live wire.

figure 1

If each division is worth 0.3mV. Estimate the peak voltage.



The frequency is given by the number of cycles per second
frequency = 1/time for one cycle

Mains Electricity

The rate at which energy is transferred by an appliance is called the power.

Power (W) = $\frac{\text{Energy (J)}}{\text{Time (s)}}$

Power, potential different and current are related by the following equation:

Power (W) = Current (A) x Potential difference (V)

Energy, transferred, potential difference and charge are related by the equation:

Energy (J) = Potential difference (V) x Charge (C)

Prefixes

Remember to always check the units of the numbers given. If there is a prefix, you will need to convert the number into standard form first:

M = 1×10^{6} k = 1×10^{3} m = 1×10^{-3} μ = 1×10^{-6}

Power, current and resistance are related by the following equation:

Power = Current^2 x Resistance

Check you can rearrange each of the equations for each component.

What is the p.d of a bulb where 30J or energy is transferred per coulomb of charge?

Current flowing through a resistor is 5A, a p.d of 10V is applied across it. What is its resistance?

What is the resistance of a diode when 3V is applied across it which enables 50mA to flow through it?

What is the resistance of a 60 W lightbulb that has a current of 0.3 mA flowing through it?

Key equations

Equation	Symbols	Units
$Q = It$	Q = Charge I = Current t = Time	Q = C (coulombs) I = A (amps) t = s (seconds)
$V = IR$	V = Potential difference I = Current R = Resistance	V = V (volts) I = A (amps) R = Ω (ohms)
$P = VI$	P = Power V = Potential difference I = Current	P = W (watts) V = V (volts) I = A (amps)
$P = I^2R$	P = Power I = Current R = Resistance	P = W (watts) I = A (amps) R = Ω (ohms)
$E = Pt$	E = Energy P = Power t = Time	E = J (joules) P = W (watts) t = s (seconds)
$E = QV$	E = Energy Q = Charge V = Potential difference	E = J (joules) Q = C (coulombs) V = V (volts)

YOU HAVE TO MEMORISE THEM ALL!