THE DUSTON SCHOOL
Knowledge itself is power
TDS 4-19

Year 10 Science Knowledge Booklet

Term 1

Name:	Class:

Year 10 Mini Test Timetable and Workbook Deadlines	
21/9/2022	B1
5/10/2022	C1
19/10/2022	P2

Big questions: What causes disease?

What are communicable diseases?
Viral, Fungal and Bacterial diseases, what causes what?
Viral, Fungal and Bacterial diseases, how are they spread?
What is malaria?
How do microbes make us ill?
How does our immune system cure and protect us?
What are vaccinations?
Why won't antibiotics help if you have flu?
How do antibiotics effect microbial growth?
What do painkillers do?
Where do we get drugs from and how are they developed?
What causes plant diseases?

Key vocabulary

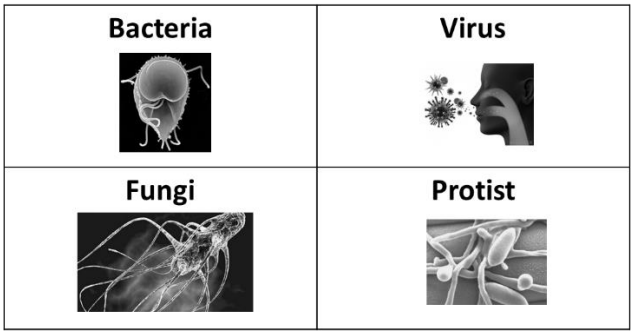
Antibiotic	Substances that slow down or stop the growth of bacteria.
Antibody	A protein produced by white blood cells in the response to the presence of an antigen.
Antigen	A molecule on the surface of a cell. A foreign antigen will trigger an immune response.
Bacteria	A microorganism (prokaryote) some of which cause diseases e.g. salmonella.
Bacterial resistance	Bacteria that have mutations in their DNA which mean an antibiotic no longer effects them is said to be resistant e.g. MRSA.
Communicable disease	A disease that can spread between individuals.
Double Blind Trial	The volunteers do not know which group they are in, and neither do the researchers, until the end of the trial.
Fungi	A microorganism, some of which cause disease e.g., Ring worm.
Gonorrhoea	A sexually transmitted bacterial disease.
HIV	A virus that attacks the immune system cells so that eventually it cannot cope with other infections or cancers. It causes AIDS.
Measles	A viral disease that causes a red skin rash and a fever.
Malaria	A disease caused by a protist and spread by mosquito, which causes repeating episodes of fever.
Pathogen	A disease causing microorganism.
Painkiller	Painkillers are chemicals that relieve the symptoms but do not kill the pathogens. Common examples include paracetamol and aspirin, and they can relieve a headache or a sore throat.
Phagocytosis	The process by which white blood cells engulf foreign cell and digest them.
Protist	A microscopic animal some of which cause disease e.g. malaria.
Rose Black Spot	Fungal plant disease, causes the leaves to turn yellow and fall early.
Tobacco Mosaic Virus	Viral plant disease that causes the leaves to become mottled. Platelets Part of the blood that is involved in clotting – helps prevent the entry of pathogens.
White blood cells	Cells that carry out the immune response when pathogens enter the body.
Vaccination	Small amount of dead/inactive pathogen injected into the body to promote an immune response.

What are communicable diseases?

Communicable diseases are infectious diseases caused by pathogens.
A pathogen is a microbe that causes disease.

There are 4 types of pathogen:

1. Bacteria - Small single celled organisms with no membrane bound organelles
2. Viruses - Very tiny and simple, just a protein coat and string of genetic material
3. Fungi – Fungi (singular: fungus) are a kingdom of usually multicellular eukaryotic organisms that are heterotrophs (cannot make their own food
4. Protists - Eukaryotes that are not plant, animal or fungus. They have a nucleus and membrane bound organelles. Some are multicellular but most are unicellular



Viral, Fungal and Bacterial diseases, what causes what?

Pathogen	**Example in animals**	**Example in plants**
Viruses	HIV potentially leading to AIDS	Tobacco mosaic virus
Bacteria	Salmonella and Gonorrhoea	Agrobacterium
Fungi	Athlete's foot	Rose black spot
Protists	Malaria	Downy mildew

Viral, Fungal and Bacterial diseases, how are they spread?

Transmission – how disease are spread.
Transmission can occur in a number of important ways.

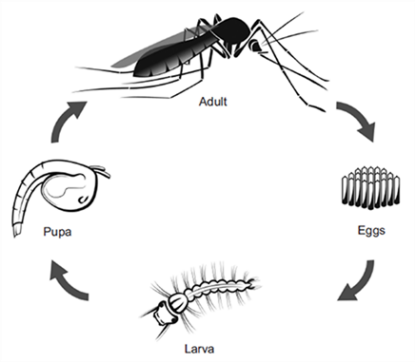
Type	Examples
Direct contact	This can be sexual contact during intercourse or non-sexual contact, like shaking hands.
Water	Dirty water can transmit many diseases, such as the cholera bacterium.
Air	When a person who is infected by the common cold sneezes, they can spray thousands of tiny droplets containing virus particles to infect others.
Unhygienic food preparation	Undercooked or reheated food can cause bacterial diseases like Escherichia coli which is a cause of food poisoning.
Vector	Any organism that can spread a disease is called a vector. Many farmers think tuberculosis in their cattle can be spread by badgers.

How to prevent the spread of diseases

Method	Example	How it works
Sterilising water	Cholera	Chemicals or UV light kill pathogens in unclean water.
Suitable hygiene - food	Salmonella	Cooking foods thoroughly and preparing them in hygienic conditions kills pathogens.
Suitable hygiene - personal	Athlete's foot	Washing surfaces with disinfectants kills pathogens. Treating existing cases of infection kills pathogens.
Vaccination	Measles	Vaccinations introduce a small or weakened version of a pathogen into your body, and the immune system learns how to defend itself.
Contraception	HIV/AIDs	Using barrier contraception, like condoms, stops the transfer of bodily fluids and sexually transmitted diseases

What is malaria?

- Malaria is a protist disease
- Malaria is a disease caused by a microorganism carried by mosquitoes
- Part of the protist's life cycle takes place inside the mosquito
- The microorganism is transferred to humans when adult female mosquitoes feed on human blood
- Mosquitos are vectors
- Causes, fever (can cause death)
- Prevention: stop the mosquitos breeding and use mosquito nets



How do microbes make us ill?

- Infectious (communicable) diseases are caused by microbes called pathogens
- These may reproduce rapidly inside the body and may produce poisons (toxins) that make us feel ill
- Viruses damage cells in which they reproduce

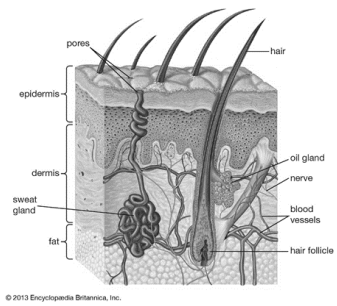
How does our immune system cure and protect us?

Non-specific human defence systems against disease

The first line of defence against infection stops the pathogens from entering your body. These first lines are general defences, and are not specific to fight against certain types of pathogen. They are called non-specific, and they can be physical or chemical barriers.

The skin

The skin covers almost all parts of your body to prevent infection from pathogens. If it is cut or grazed it immediately begins to heal itself, often by forming a scab, which prevents infection as the skin acts as a physical barrier.



The immune system of the body is highly complex, with white blood cells being the main component

Once a pathogen has entered the body the role of the immune system is to prevent the infectious organism from reproducing and to destroy it

White blood cells help to defend against pathogens by:

Phagocytosis

Phagocytes engulf and digest pathogens.

The phagocyte surrounds the pathogen and releases enzymes to digest and break it down to destroy it.

Production of antibodies

Lymphocytes (a type of white blood cell) produce antibodies.

Antibodies are Y-shaped proteins. The aim of antibody production is to produce the antibody that is specific (complementary) to the antigens on the surface of the pathogen.

Production of antitoxins

Some pathogens (usually bacteria) can produce substances which act as toxins which make you feel unwell

Lymphocytes can produce antibodies against these substances – in this case, they are called antitoxins

The antitoxins neutralise the effects of the toxin.

What are vaccinations?

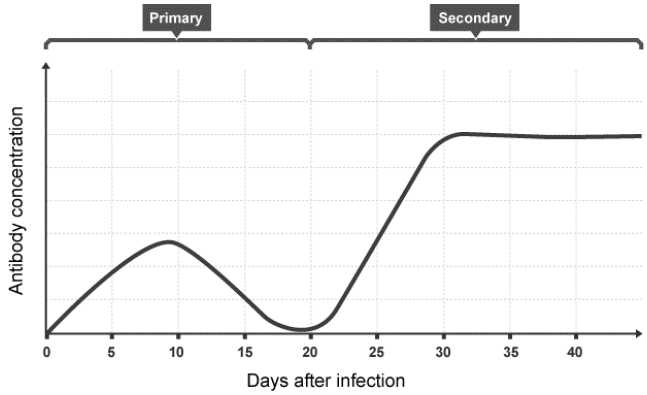
A vaccine contains a small amount of dead or inactive (attenuated) pathogens.

- These are introduced into the body, often by injection.
- These cause the white blood cells to produce antibodies.
- Immunity allows white blood cells to quickly produce specific antibodies, preventing the disease developing.

Infections and vaccinations produce primary and secondary responses-

Primary - the antibodies slowly increase, peak at around ten days and then gradually decrease.

Secondary - exposure to the same pathogen causes the white blood cells to respond quickly, producing lots of the relevant antibodies, which prevents infection.



Why won't antibiotics help if you have flu?

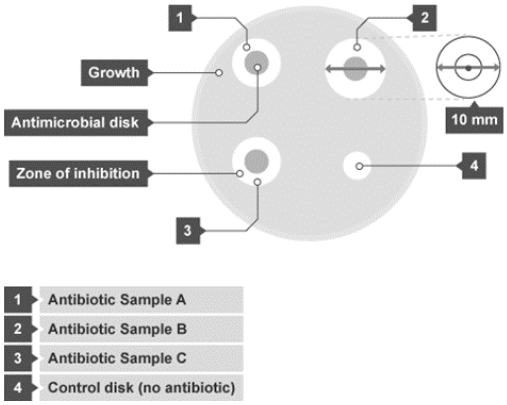
Antibiotic – Antibiotics, also known as antibacterials, are medications that destroy or slow down the growth of bacteria.

Antibiotics do not work on viruses.
So there is no point taking antibiotics for a cold or flu – as these are caused by a virus.

How do antibiotics effect microbial growth?

Antibiotics can work in a number of different ways –

1. By targeting the cell wall or membranes that surrounds the bacterial cell.
2. By targeting the machineries that make the nucleic acids DNA and RNA.
3. By targeting the machinery that produce proteins (the ribosome and associated proteins).



BBC Bitesize

What do painkillers do?

- Painkillers are drugs that relive pain
- E.g. throat sweets, painkillers (aspirin, ibuprofen, paracetamol)
- Painkillers relieve symptoms but do not kill pathogens, they stop you feeling the pain
- Paracetamol, aspirin and morphine block nerve impulses from the painful part of the body, or block nerve impulses travelling to the part of the brain responsible for perceiving pain

In larger doses they can be harmful or even fatal.
Some painkillers are addictive.

Where do we get drugs from and how are they developed?

Plants: plants are also attacked by pathogens and have evolved chemicals to defend themselves against pests and pathogens. We can adapt some of these to make new drugs.

- Aspirin was developed from a chemical found in the bark of willow trees. It is used to lower pain and reduce inflammation.
- Digitalis is used to treat heart conditions. It was developed from a chemical found in poisonous foxgloves.

Microorganisms: As with plants, microorganisms have chemical defences which we can copy.

- Penicillin was our first antibiotic, discovered by Alexander Fleming. He was throwing away old bacteria petri dishes when he noticed one had mould on it. The area around the mould was free of bacteria. He discovered that the mould (Penicillium notatum) produced a substance which kills bacteria.

How does a new drug get tested?
Producing new drugs is a lengthy and very expensive process. Drug development goes through the following stages:

- Discovery
- Pre-clinical Testing
- Clinical Trials

To work out how well a drug works, patients are put random groups. One group is given the real drug, the other group a placebo which looks like the real drug but doesn't do anything.

Where possible, clinical trials are blind to allow for the placebo effect (when a patient expects to feel better, they often believe that they do, even if nothing physical has changed.)

Double-blind means that neither the patient nor the doctor knows whether they are getting the placebo or the real drug.
This is because even doctors are not immune to the placebo effect, and can be subconsciously influenced by their knowledge when reporting the results.

What causes plant diseases?

Tobacco mosaic virus (TMV)

This is a disease caused by a virus, it can infect tobacco and crops like potatoes, peppers and tomatoes.

It spreads through contact or through animals spreading it from one plant to another.

It reduces the leaf's ability to photosynthesise and so reduces the size of the crop.

Rose black-spot

Rose black spot fungus is a fungus that causes black spots on leaves, it infects roses.

Again this reduces the plants ability to photosynthesise, so plants do not grow as well.

Key knowledge question	**Answer**
Define withdrawal symptoms.	Caused when a person tries to stop taking the drug. Symptoms - anxiety, headaches and pain.
Give the definition for drug addiction.	The body becomes used to the changes caused by a drug.
How are antibodies specific to one pathogen?	Each pathogen has a specific antigen on its surface.
How does our body protect itself from invading microbes?	Skin barrier. Hydrochloric acid in the stomach. Platelets seal cuts. Mucus to cover the lining of lungs and trap microbes. White blood cells.
Name 3 ways a vaccine can be introduced to the body.	Injection, orally or nasal spray.
Name 3 ways that pathogens are spread.	Food, water, airborne droplets, insect bites, direct and indirect contact.
Name 4 types of drugs.	Depressants, pain killers, stimulants and hallucinogens.
Name the 3 things that white blood cells do to invading microbes.	Engulf, produce antibodies, produce antitoxins.
Name the 4 types of pathogen.	Virus, fungi, bacteria, protozoa.
What are toxins?	Harmful substances produced by a pathogen.
What do protists do to red blood cells?	Bursts them.
What is a bacteriophage?	A virus that affects bacteria.
What is a pathogen?	An organism which causes diseases.
What is a vaccine and what do they do?	Dead or weakened pathogens. They stimulate the production of antibodies and memory cells making person immune.
What is an overdose?	When someone takes too much of drug.
What is a drug?	Chemical substance that causes chemical reactions in the body to change.
What is herd immunity?	Majority of the population is vaccinated, reduce the chances of people coming into contact with the pathogen.
What is the difference between medicinal and recreational drugs?	Medicinal drugs are used to treat a condition. Recreational drugs are taken for enjoyment.

Big questions: What is electricity?

What are electric circuits and how do we draw them?
What is electric current and how do we measure it?
What is potential difference and how is it measured?
What do we mean by electrical resistance?
RP15 What factors affect the resistance of a wire?
What are the rules that help us analyse series and parallel circuits?
What happens to the resistance if we arrange resistors in combination?
What is Ohms law and what does it tell us?
What does the potential difference - current graph look like for a bulb.
What affects the resistance of a thermistor?
How can we use resistors to switch a circuit on and off?
What is alternating current?
Why do plugs have three wires?
How do we calculate the power transferred by an appliance?
How does resistance affect the power transferred?
Why are transformers needed in the national Grid?

Key vocabulary

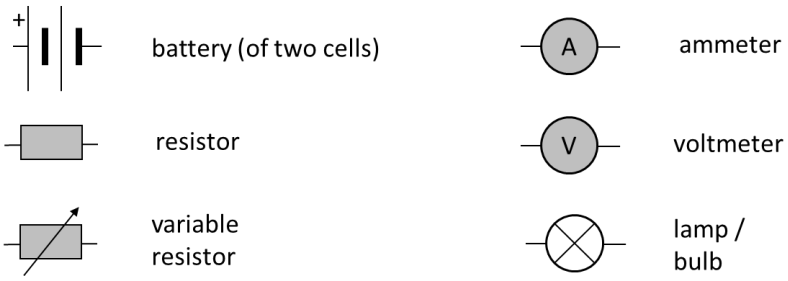
Electric current	The flow of electric charge around a circuit. Electric current carries energy transferred from the cells. Measured in amps, A.
Series circuit	A single loop of a circuit with the components following one after another. The current is the same all around the loop.
Voltmeter	A meter to measure potential difference. Voltmeters are connected in parallel with the component they are measuring in their own loop.
Light dependent resistor	A device whose resistance goes down when the amount of light goes up. They are useful in light sensing circuits such as automatic street lights.
Potential difference	The energy per coulomb transferred between two points in a circuit. Measured in volts, V
Parallel circuit	A circuit with more than one loop. The current from the cells divides at the junction.
Variable resistor	A resistor whose value can be changed (varied). They can control the current in a circuit to make it bigger or smaller.
Alternating current	Electric current that rapidly changes direction. Mains electricity is 50Hz ac – it changes direction 50 times a second.
Resistance	How much a component in a circuit slows down the current. It is found by dividing the potential difference by the current. Measured in ohms, Ω
Ammeter	A meter to measure electric current. Ammeters are connected in **series** in the loop they are measuring.
Thermistor	A device whose resistance goes down when the temperature goes up. They are useful in temperature sensing circuits like thermostats.
National grid	The network of overhead cables and transformers that connects power stations and our homes to provide us with electricity.

What are electric circuits and how do we draw them?

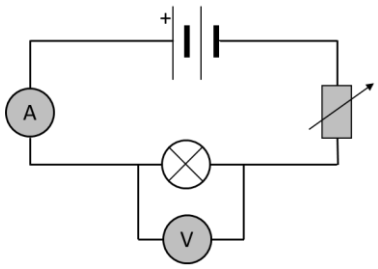
Electric circuits transfer energy.

- Energy is transferred from a power supply or battery to a device like a bulb, a heater or motor.
- Energy is transferred by the electric current.
- The current must flow from the power supply to the device and then back to the power supply. This is called an electrical circuit.

Symbols are used to represent the components in an electrical circuit.

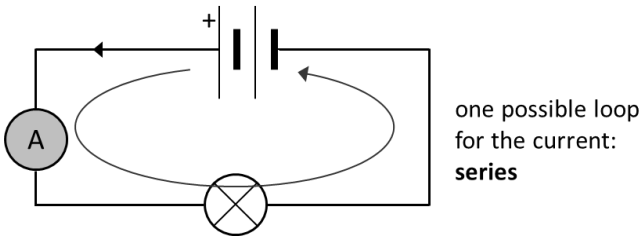


Circuits are drawn neatly with a ruler and pencil.



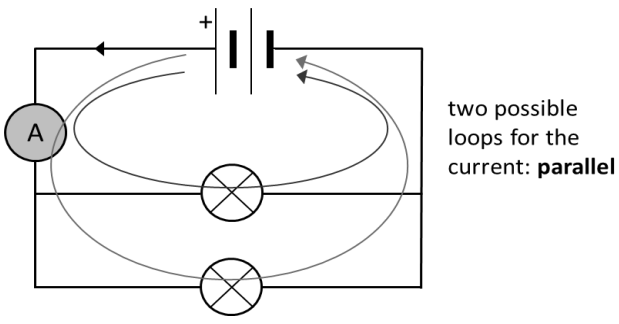
Series circuits

A circuit with only one loop for the current is called a series circuit**.**



Parallel circuits

A circuit with more than one loop for the current is called a parallel circuit. Each loop must include a cell or power source.

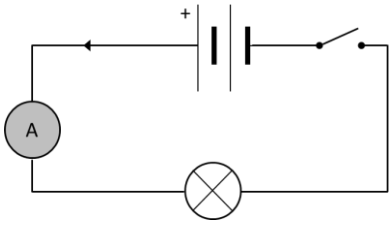


What is electric current and how do we measure it?

- Electric current is a flow of charged particles called electrons.
- Electric current flows around complete loops of a circuit.
- The symbol for electric current is I.
- The amount of current depends on the potential difference of the battery and the resistance of components in the circuit. **(V=IR)**
- Electric current is not used up by circuit components.
- The amount of current is the same at all points in the loop.
- The current leaving the battery is the same as the current returning.

An ammeter is a meter that measures the electric current.

- The unit for electric current is ampere. This is usually shortened to amp or A.
- An ammeter must be connected in the loop whose current it is measuring. We say it is connected 'in series'.



What is potential difference and how is it measured?

The potential difference across a component measures the energy transferred per coulomb of charge that passes through it.

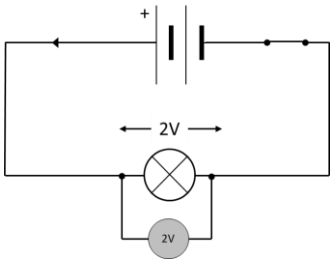
- The p.d across the battery is the energy transferred from the battery to the current for every coulomb of charge that passes through it.
- The p.d across a component is the energy transferred from the current to the component for every coulomb of charge that passes through it.

Energy is conserved so all of the energy transferred to the charge by the battery must be transferred out of the circuit by its components.

The p.d across the battery = The total p.d across the components

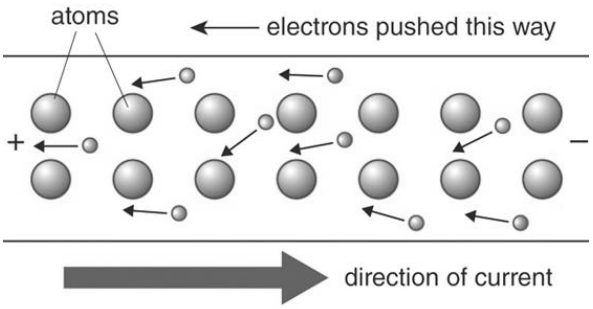
A voltmeter is a meter that measures the potential difference or voltage, between two points in an electric circuit.

- The unit for potential difference is **volt, V.**
- A voltmeter must be connected in its own loop across the component it is measuring. We say it is connected 'in parallel'.



What do we mean by electrical resistance?

Electric current is a flow of charged particles called electrons.
When they move electrons collide with atoms or ions inside the metal wires. This slows them down and is called electrical resistance.



The amount of resistance a piece of material has can be measured. It is measured in **Ohms, Ω.**

- Every electrical component has some resistance.
- Components designed to have a fixed amount of resistance are useful and are called resistors.
- The more resistance the components in a circuit have the smaller the current becomes.
- A variable resistor has resistance that can be changed.
- Increasing the resistance of the variable resistor decreases the current in the circuit.

The relationship between potential difference, current and resistance is given by:

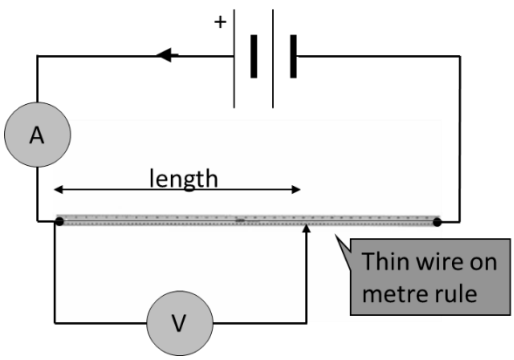
Potential difference = current X resistance

V = I x R

- V = potential difference, V
- I = current in amps, A
- R = resistance, Ω

What factors affect the resistance of a wire?

The resistance of a wire depends on its length, how thick it is, its temperature and what it is made of.
We can investigate exactly how resistance changes with length using an ammeter and voltmeter to find the resistance for different lengths of wire.

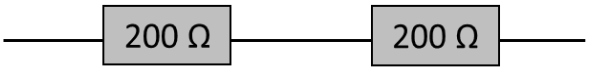


What happens to the resistance if we arrange resistors in combination?

When resistors are in series:

- The total resistance is more.
- The resistances add together.
- The total resistance is given by:

$$R_{total} = R_1 + R_2$$

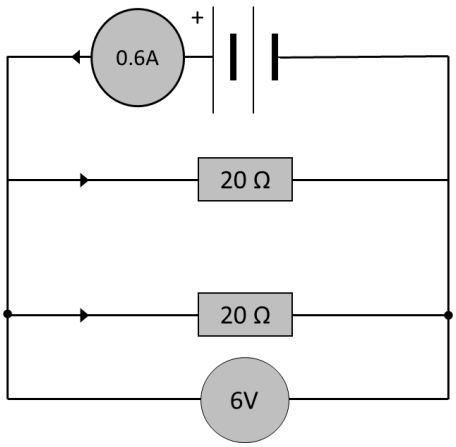


So the total resistance for this pair of resistors would be **400 Ω.**

When resistors are in parallel the circuit has less resistance:

- The total resistance is:

$$1/R_{total} = 1/R_1 + 1/R_2$$



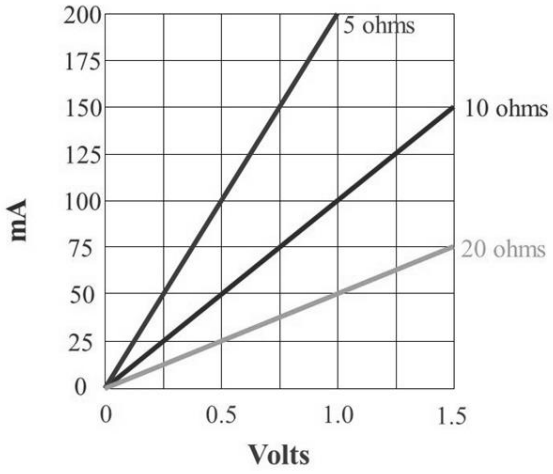
What are the rules that help us analyse series and parallel circuits?

- In a **series circuit** the current is the same at all points in the loop.
- In a **series circuit** the potential difference across the components adds up to the potential difference across the battery.
- Resistors in **series circuits** add up.

- In a **parallel circuit** the total potential difference is the same across both loops.
- In a **parallel circuit** the current divides at the junction.
- When resistors are in **parallel** the circuit has less resistance:

What is Ohms law and what does it tell us?

A graph can show how the current (I) changes when the potential difference (V) is increased across a particular device.



If the graph is a straight line through the origin we can say:

The potential difference is directly proportional to the current.

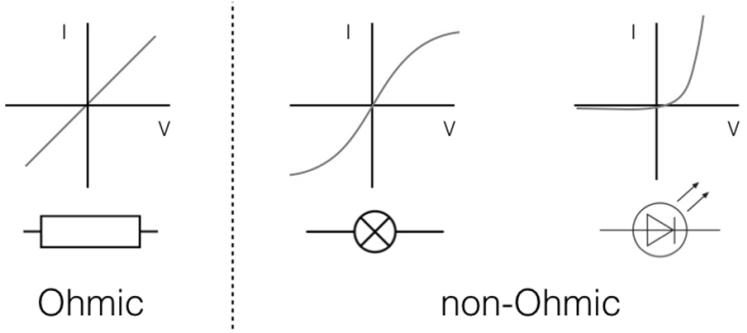
This result is known as **Ohm's law.**
Components that obey Ohm's law are called ohmic conductors.

What does the potential difference - current graph look like for a bulb?

All electric currents make wires hotter. This heat increases their resistance.

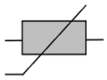
- Electrons are pushed through wires by a potential difference.
- Electrons collide with metal ions making them vibrate more.
- This makes the wire hotter and makes it harder for the electrons to move – increasing the resistance.

The I-V characteristics of a resistor, bulb and diode look like this.

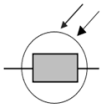


What affects the resistance of a thermistor?

Thermistors, and LDRs are components whose resistance is not constant. They are used as sensors in control circuits.



Thermistor — Resistance **goes down** when it gets hot — Can turn circuits on and off as the temperature changes. In a **fridge** say.



Light dependent resistor (LDR) — Resistance **goes down** when light shines on it. — Can turn circuits on and off as the light changes. In a **street lamp** say.

How can we use resistors to switch a circuit on and off?

Potential divider circuits

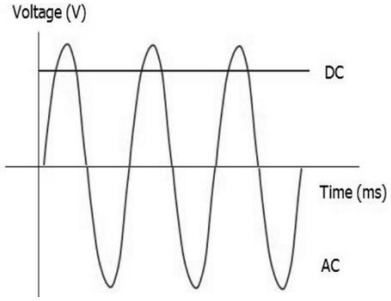
- When two resistors are in series the potential difference of the battery is shared between them.
- If the resistances are different then the bigger resistor takes a bigger share of the potential difference.
- In a control circuit one of the resistors is a sensor like an LDR or a thermistor.
- As the resistance of the sensor changes it takes a takes a bigger or smaller share of the potential difference.
- The changing potential difference across a resistor can be used to switch another circuit on or off. Examples are:
- Street lights use LDRs to turn on in the dark and go off in the morning.
- Thermostats use thermistors to switch heaters on when it gets cold and off again when it gets warmer.

What is alternating current?

- Energy is transferred to our homes by electric current. We call this mains electricity.
- Power stations and renewable energy resources generate electric current.
- Electric current is carried all over the country by a network of cables called the national grid.
- Mains electricity has a **higher potential difference,** UK mains = **230V**
- Mains electricity uses **alternating current,** UK mains = **50Hz ac**.

Mains sockets provide alternating current, **ac**.

- The potential difference is constantly changing from positive to negative.
- The current constantly changes direction.



Why do plugs have three wires?

Devices are connected to the mains with a three pin plug. The three pins connect to three wires; live, neutral and earth.

- The live wire carries the 230V ac potential difference from the mains.
- The neutral wire completes the circuit and carries current back to the supply.
- The earth wire is for safety and stops an appliance from becoming live if there is a fault.

For easy identification the three wires are colour coded:

- The live wire is coloured brown.
- The neutral wire is coloured blue.
- The earth wire is coloured green and yellow.

The earth wire connects to the metal parts of an appliance.

- If the appliance becomes live then there is a potential difference of 230V between the metal parts and the earth wire.
- Electric current will flow through the earth wire and not through you.
- The large current will blow the fuse and turn off the appliance to make it safe.

How do we calculate the power transferred by an appliance?

The power of a device

The power of a device is the Energy that it transfers per second. A more powerful device is brighter, louder, faster or hotter than a less powerful one.
Power is measure in watts, W or kilowatts, kW.

The energy transferred by a device is given by:

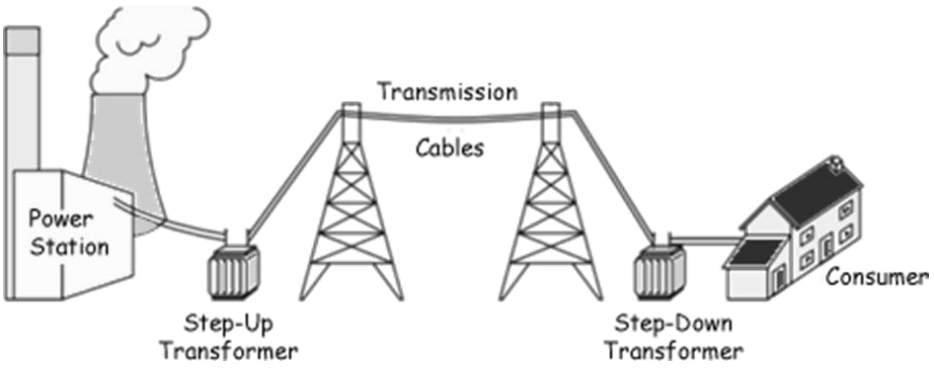
Energy = power X time
E = P x t

Why are transformers needed in the national Grid?

Power is delivered from power stations to our homes by the National Grid.

The National Grid is the network of cables, pylons and transformers that distribute electricity around the country.

Transformers step-up (increase) and step-down (decrease) the potential difference so that power is not lost in the transmission cables. This makes transmission **more efficient**.



How to get the most out of your knowledge organiser:

- To get the most use out of the knowledge organisers you should be learning sections and then self-testing.

- There are several different things you can do
  - Look, cover, write, check, correct
  - Read through the organisers
  - Mind maps
  - Key spellings
  - Make a glossary
  - Missing out key words
  - Questions/answers answers/questions
  - Flash cards
  - Revision clock learning
  - Mnemonics

Science Learning Tools and wider study:

The Oak Academy – Online Science lessons
BBC Bitesize
<u>You tube channels:</u>
Fuse school
Ted talks
Free science lessons
Primrose Kitten
<u>Shows on Netfilx</u>
Our planet
Tiny creatures
A life on our planet

Some useful equations

power = energy transferred/time
$P = E/t$

power = work done/time
$P = W/t$

efficiency = useful output energy transfer/total input energy transfer

efficiency = useful power output/total power input

charge flow = current × time
$Q = I\,t$

potential difference = current × resistance
$V = I\,R$

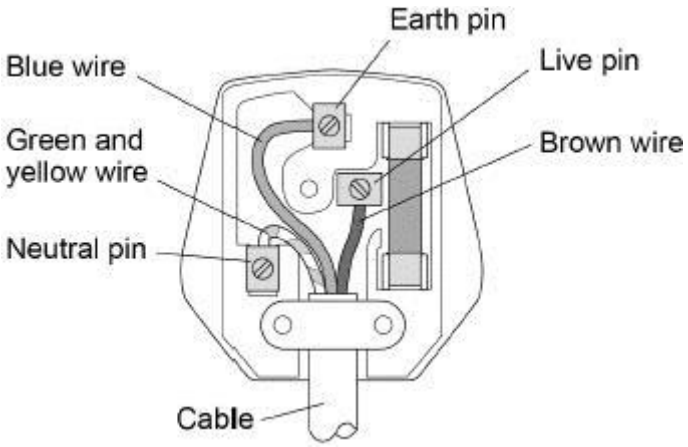
power = potential difference × current
$P = V\,I$

power = $(\text{current})^2$ × resistance
$P = I^2\,R$

energy transferred = power × time
$E = P\,t$

This is an example of the sort of question you might be asked about electricity.

The diagram below shows the inside of a plug.



(a) The plug is **not** wired correctly.

What should be done to connect the wires in the plug correctly?

_____

_____

(1)

The correctly wired plug and cable connects a washing machine to the mains electricity supply.

(b) Give the potential difference and frequency of the mains electricity supply in the UK.

The potential difference is _____ V

The frequency is _____ Hz

(2)

(c) The washing machine is switched on.

What is the potential difference between the neutral wire and the earth wire?

Potential difference = _____ V

(1)

Key knowledge question	**Answer**
How is resistance defined?	The opposition to the flow of current
If resistance in a circuit increases what happens to the current?	It decreases
In a circuit, potential difference is 12volts; resistance is 6 ohms, what is the current?	2 Amps
Voltage is the unit of?	Potential difference
What formula links potential difference, current and resistance?	V = IR, potential difference = current x resistance
What is current?	The rate of flow of charge
What is the potential difference of a UK plug socket?	220 – 240 volts
What is the unit of current?	Amps (A)
What is the unit of potential difference?	Volts (v)
What is the unit of resistance?	Ohms (Ω)
What meter is used to measure potential difference?	A voltmeter