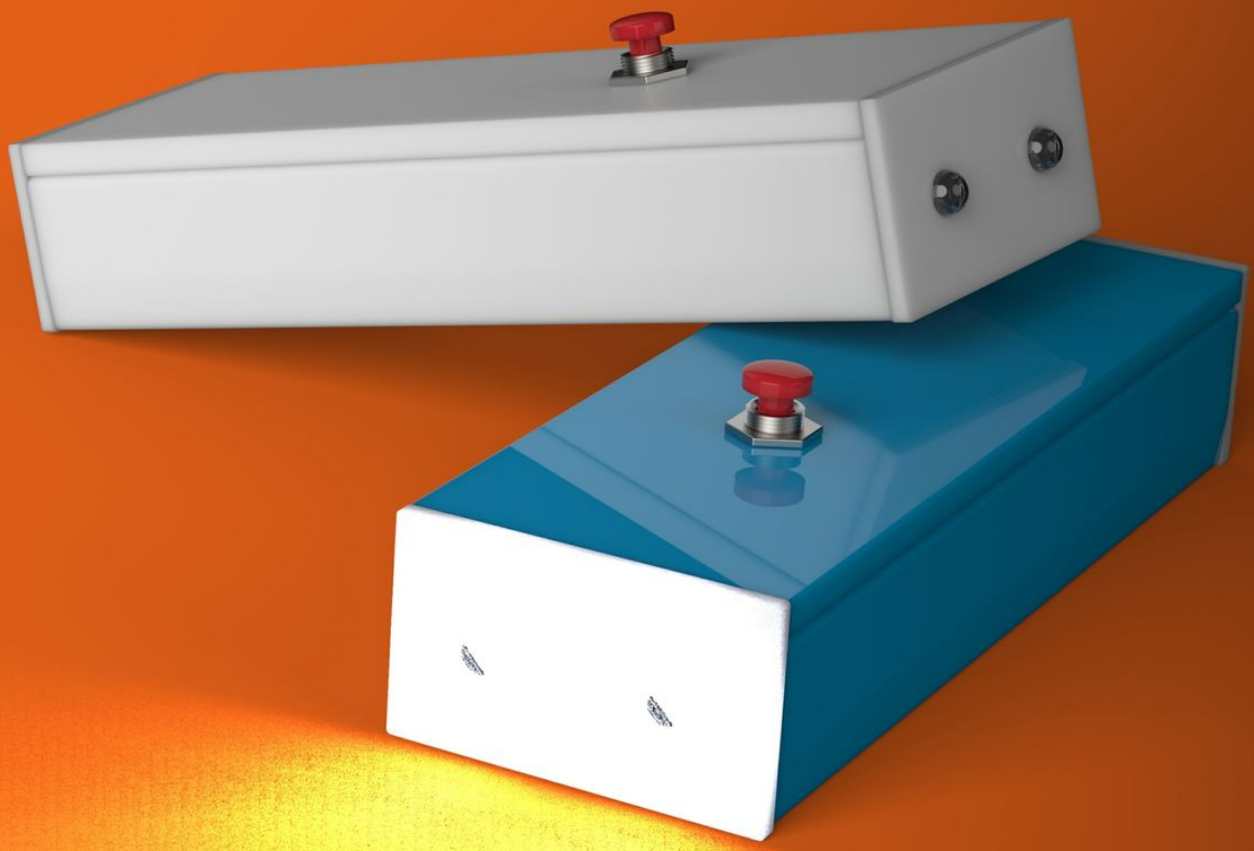
introduction to

ELECTRONIC +ELECTRICAL ENGINEERING



NAME _____ CLASS _____

WHAT IS ENERGY?

Energy is a term we hear frequently and often incorrectly. The term 'energy' has a specific meaning in science and engineering. It means something has the ability to do 'work'.

Energy cannot be created or destroyed. It can only be converted from one type to another.

There are several different forms of energy and you will learn about them all in the future.

Four forms of energy are named below.

Describe each type of energy and sketch a scenario to help explain your description.

KINETIC

POTENTIAL

HEAT

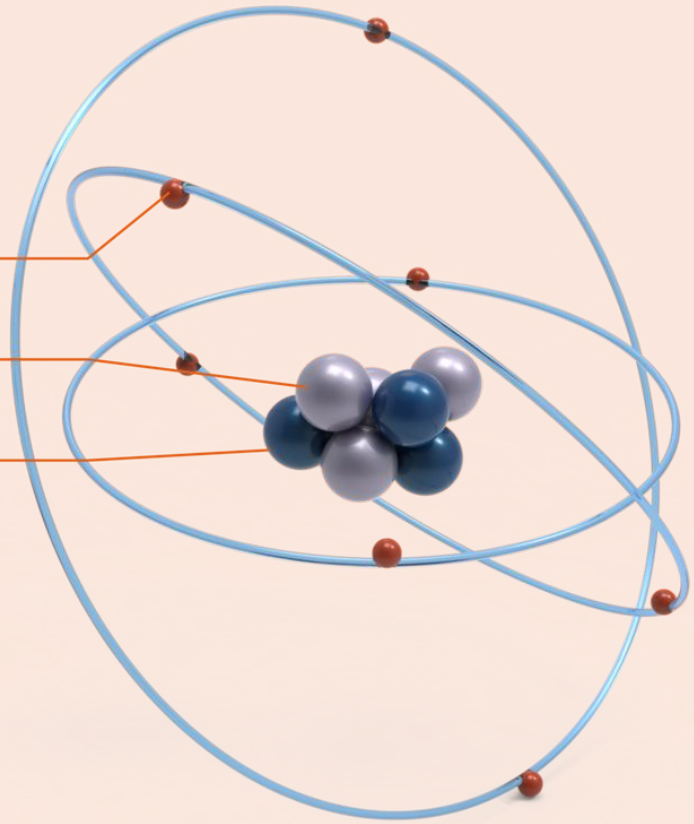
ELECTRICAL

WHAT IS ELECTRICITY?

Electricity can appear a complex topic, but is actually quite simple. Electricity is name used to describe a type of energy, based on the movement of 'electrons'. Electrons are a type of 'sub-atomic particle'.

Each electron has a small negative (-) charge. Atoms are made from three sub-atomic particles called the 'Proton', the 'Electron' and the 'Neutron'.

State the name of three atomic particles.



There are may different terms used when describing the properties of electricity.

Two of the most important are the terms 'voltage' and 'current'

Research what each of the terms mean and write a short description below. Ensure your teacher checks your work and understanding of these two important terms.

Describe what is meant by the term 'Voltage'

Describe what is meant by the term 'Current'

ENERGY AND THE ENVIRONMENT

Humans use energy just to live - food is a form of energy - and also use energy to make our lives more comfortable. We typically call this energy 'fuel'.

Harvesting this energy has an impact on the planet we live. Many types of fuel will release a gas called Carbon Dioxide when used and this gas has an impact on the atmosphere of the planet.

Sun, 94 million miles away from Earth...

Earth, without atmosphere, shown.



Sketch the atmosphere and diagram what happens to the heat energy from the Sun.

Describe what is meant by the term 'Fossil Fuel'

Describe what is meant by the term 'Renewable Energy'

HOW IS ELECTRICITY GENERATED?

Electrical energy is generated in a lots of different ways, each with their own benefits and problems.

Research each of the electrical energy generating technologies below. Describe the advantages and disadvantages of each technology.

WIND TURBINES



NUCLEAR



SOLAR



COAL FIRED



HYDRO-ELECTRIC



OIL & GAS



TEACHER MARK

HOW IS ELECTRICAL ENERGY TRANSMITTED?

Generating electrical energy is only part of the challenge. Electricity must be be transmitted from where it is generated to where it will be used.

What materials transmit electrical energy?

Are some designs better than others?

Describe what is meant by the term 'Conductor'

Describe what is meant by the term 'Insulator'

'Transmission tower' is the name given to the metal structures that support overhead cables.

These structures cross the country transferring electrical energy from generators to consumers.

Research what influences the design of transmission tower.



Transmission towers crisscross the country. What do designers and engineers have to consider when making them?

Write a 'Design Specification' for engineers designing a transmission tower.

HOW CAN ELECTRICAL ENERGY BE STORED?

Electrical energy is sometimes not needed immediately, or it needs to be used in portable devices. Storing electrical energy is important.

We store electrical energy in 'cells'. Groups of cells are called 'batteries'.

Describe devices that require batteries.

Describe any environmental impacts caused by batteries?

Batteries come in shapes, sizes and specifications.

Do you recognise those shown in the photograph below?

Describe the technical details (such as name, size, volate) of the batteries shown in this photograph. Label the space below.

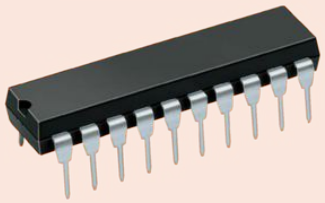


HOW IS ELECTRICITY USED?

Electrical energy can be used in lots of different ways and we use it to run much of our technologies.

Electrical energy can be transformed to another form of energy using different devices.

PROCESSING



LIGHTING



MOVING



HEATING



Describe where each of the devices above could be used.

Describe four ways in which you can save electrical energy in your home.

ENERGY & SOCIETY

Electrical energy is valuable and power companies charge people for using it. Different household appliances use more electrical energy than others. People can check how much energy is being used, or 'consumed' by checking their 'consumer unit'.

A consumer unit states how many 'units' of energy have been used by the customer.



Can you find your home consumer unit? Can you see any lights flashing, dials moving or numbers changing? This is the device monitoring how much electrical energy you are using.

Describe which household items use a lot of electrical energy? Which use little?

NEVER TOUCH OR OPEN A CONSUMER UNIT!

Consumer units are incredibly DANGEROUS. You may read the screen, but do not touch any other parts of it.

It is ILLEGAL to tamper with a consumer unit. These are installed by your power company and only qualified engineers may fix or replace them with permission.

All homes have an electricity supply installed, however electrical energy can be expensive. It can be difficult for many people to pay for it and is a source of stress and worry for many adults.

There are different companies that supply electricity and people can swap supplier, but prices can still be high.

Explain what is meant by the term 'Fuel Poverty'

Explain the risks associated with 'Fuel Poverty'?

TEACHER MARK

CONTROLLING ELECTRICAL ENERGY

Electricity is of little use if it cannot be controlled. Thankfully, designers and engineers have a range of components that solve that problem.

Describe the function of each component below and provide an example of a product where it may be found.



PUSH SWITCH



TOGGLE SWITCH



TILT SWITCH



THERMISTOR



LDR



PROCESSOR

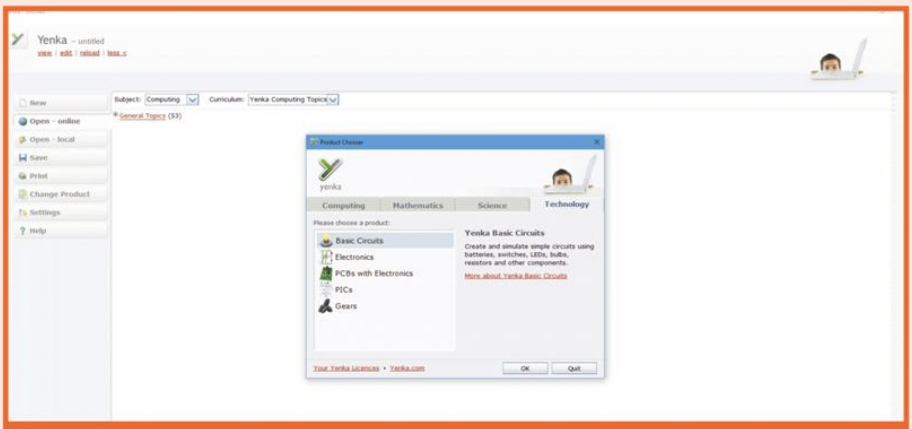
SIMULATING CIRCUITS

Simulation software is a computer tool that allows designers and engineers to prototype different electronic circuits.

Circuits can be shown using pictures of components or the British Standard symbols used by designers and engineers.

You will be learning to use this simulation software.

Your teacher will give you a range of tasks and challenges for you to complete.



Different smulation software is available for engineers. We will use software called 'Yenka' to simulate our circuits. Your teacher will give you a series of challenges.

Explain why an electrical and electronic engineer may wish to similate a circuit before constructing it from real components.

State the name of each component and sketch the British Standard symbol.



Explain why an electrical and electronic engineer use symbols rather than pictures to represent components.

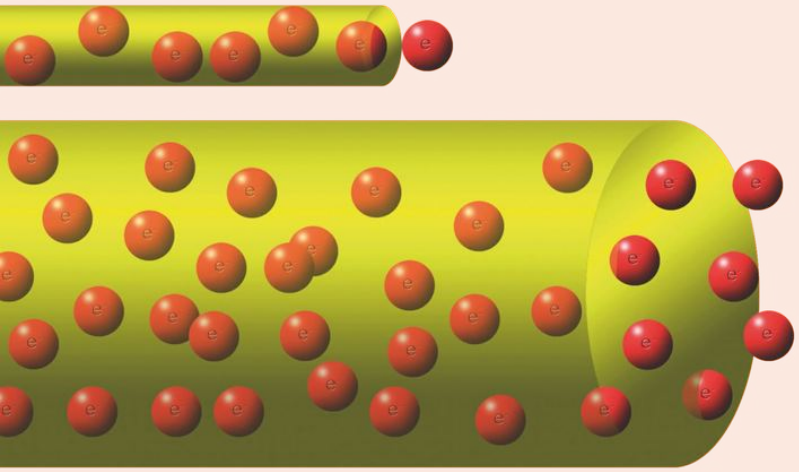
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RESISTING ELECTRICAL ENERGY

Electricity flows along 'conductors', however even conductors try to stop or 'resist' the flow of electrical current. Resistance is the name of force acting against the flow of electricity.

Every component has some level of resistance.

Resistance is measured in 'ohms', with the Greek letter Ω omega used for units.



Describe why a **thin** wire resists electrical current more than a **thicker** wire of the same material.

Electrical and electronic engineers need to know how electricity is flowing in a circuit. Three factors are very important: the voltage, the current and the resistance of the circuit (or a component).

Designers and engineers can use mathematics to calculate the values to these three factors, or we can use a piece of equipment called a 'multimeter'

MULTIMETER

A mulitmeter can 'read' lots of values relating to electricity such as voltage (v), current (A) and resistance (Ω)





A resistor is a special component, used to reduce the voltage in a circuit, by converting electrical energy into heat energy.

Resistors come in various sizes, values (ohms, Ω) and can handle different levels of current.



The British Standard symbol for a resistor is very simple! Shown above...

SERIES CIRCUITS

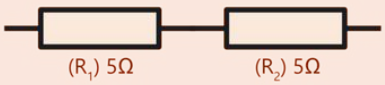
It is important for engineers to work out the total resistance (RT) of a circuit.

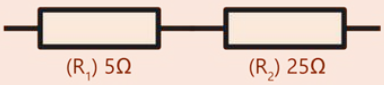
In 'series' circuits, where one component comes after another, the resistance of each component is simply added together.

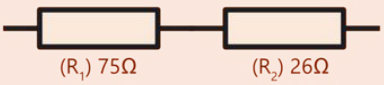
We use the following equation:

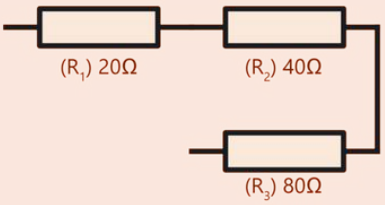
$$R_T = R_1 + R_2 + R_3 + \ldots$$

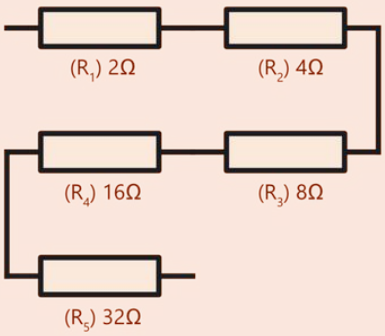
Calculate the 'Total Resistance' (R_T) of each of the following circuits:











PARALLEL CIRCUITS

It is important for engineers to work out the total resistance (RT) of a circuit.

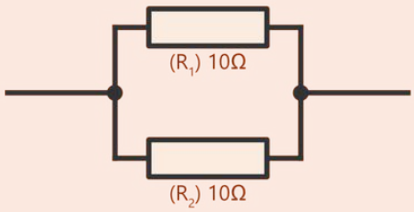
In 'Parallel' circuits, where the electrical current splits between two components, it is slightly trickier to work out the total resistance.

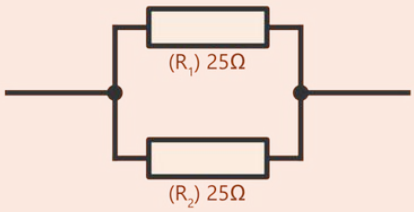
The total resistance of a parallel circuit will be smaller than the value of the smallest resistor in that parallel circuit.

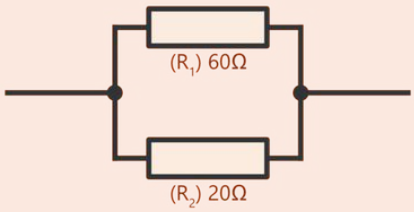
The equation we use is shown below:

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

Calculate the 'Total Resistance' (R_T) of each of the following circuits:





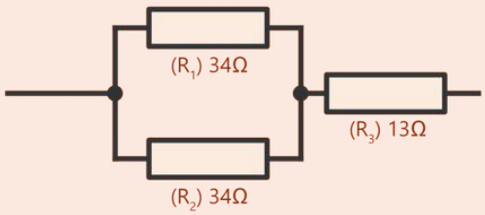


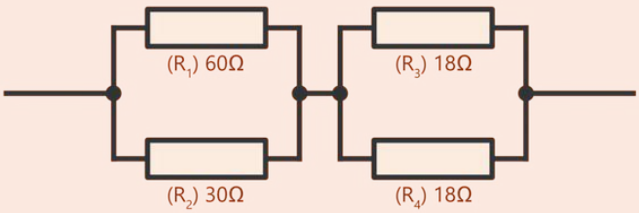
$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

$$R_T = \frac{10 \times 10}{10 + 10}$$

$$R_T = \frac{100}{20}$$

$$R_T = 5\Omega$$





LEARNING CHECKLIST

You have (hopefully) learned a lot about electronic and electrical engineering. You will soon have an assessment covering the topics in this project. To prepare for this assessment, a table of topics have been show below. If you are comfortable with each of the topics, you are ready for your exam and will hopefully do well.

Check-off how many topics your understand. If you struggle with any, read your notes and speak to your teacher.

I can describe the term 'voltage'.	
I can describe the term 'current'.	
I can describe the term 'resistance'.	
I can describe the term 'fossil fuel'.	
I can describe the term 'renewable energy'.	
I can state the name of three parts of the atom.	
I can state the name of three forms of energy.	
I can describe the term 'insulator'.	
I can describe the term 'conductor'.	
I can describe different types of batteries.	
I can explain the term 'fuel poverty'.	
I can explain why engineers use simulation software.	
I can explain why engineers use British Standard symbols to represent components.	
I can state four symbols for components.	
I can calculate total resistance in series circuits.	
I can calculate total resistance in parallel circuits.	

TEACHER MARK



COURSE NOTES V1.0

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