YR 11 REVISION / EXAM PRACTICE

50% LEFT TO GO!

Component 1

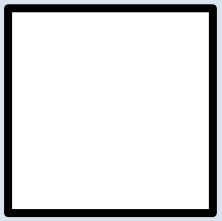
Design & Technology in the 21st Century

Written examination : 2 hours

100 marks (**50%** of final grade)

Section One: Core Knowledge and understanding

Section two: in-depth knowledge of design & Technology



Component 2

Design and Make Task

Project work : 35 hours of lessons during Year 11

100 marks (**50%** of final grade)

WHY THE EXAM IS SO IMPORTANT!

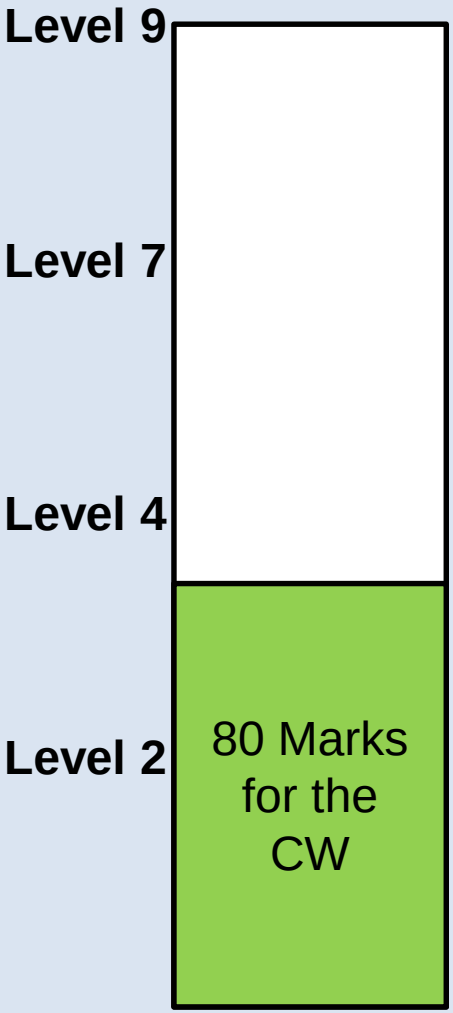
Let's say you got 80 marks out of 100 for your coursework! That is around a level 7!

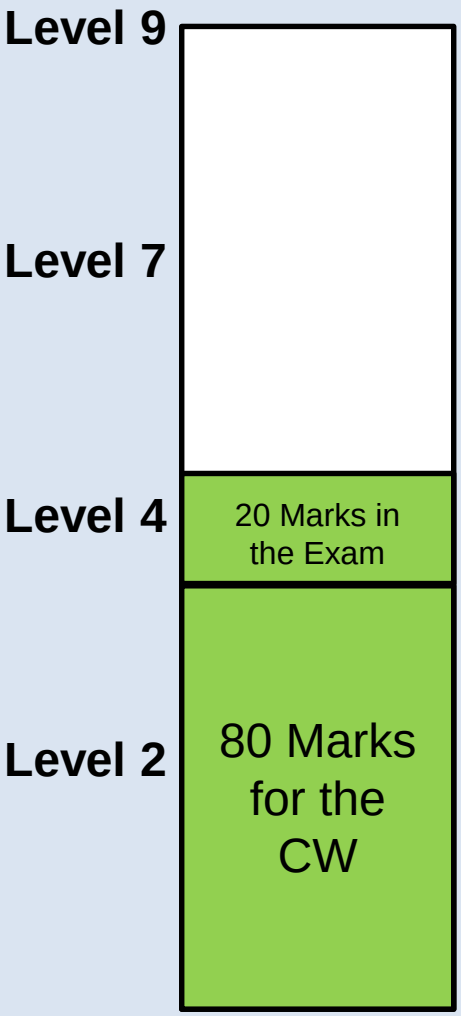
Out of 200 (CW & Exam Combined) this means you have reached around a level 3 overall!

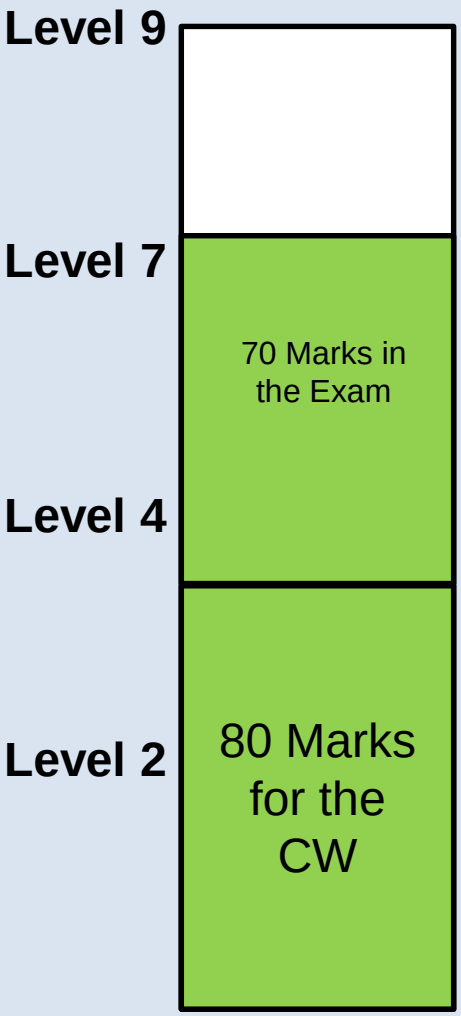
Therefore if you got 20 out of 100 in the exam this would move your overall level up to around a 4!

That is why the exam is so important! Especially if you didn't do as well in the coursework as you'd hoped!

WHY THE EXAM IS SO IMPORTANT!







WHY THE EXAM IS SO IMPORTANT!

Basically, listen in class, make sure you understand and Revise!

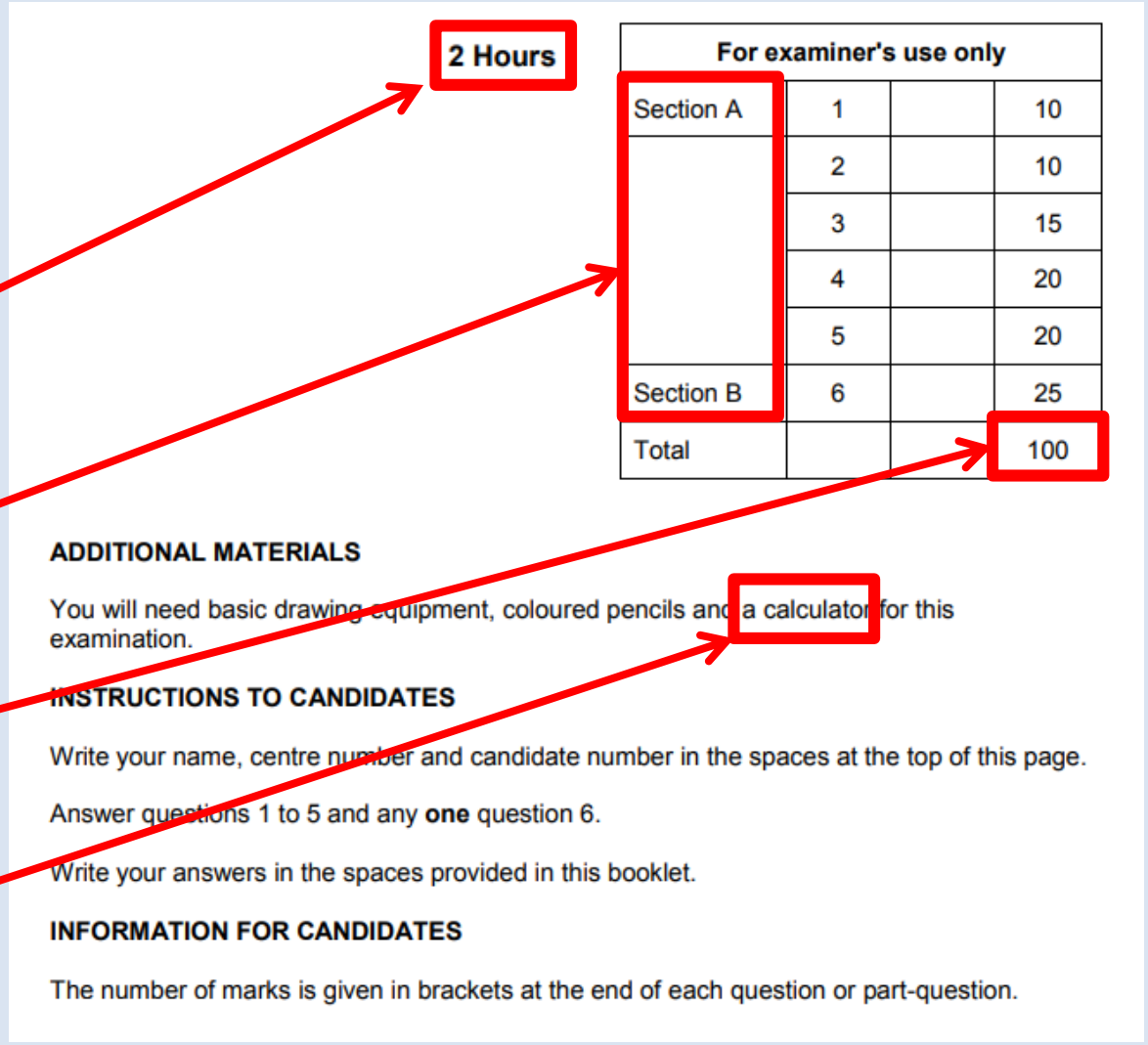
A REMINDER OF THE EXAM DETAILS

The following lessons have been created to ensure you are all ready for the exam and have a clear idea of the layout of the paper and what to expect.

A REMINDER OF THE EXAM DETAILS

To start with, let's start with the basics. Just to start!

- The exam is 2 hours long
- There are two sections; Section A and section B
- The exam is out of 100 marks
- You must have a calculator



2 Hours

For examiner's use only			
Section A	1		10
	2		10
	3		15
	4		20
	5		20
Section B	6		25
Total			100

ADDITIONAL MATERIALS

You will need basic drawing equipment, coloured pencils and a calculator for this examination.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer questions 1 to 5 and any **one** question 6.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

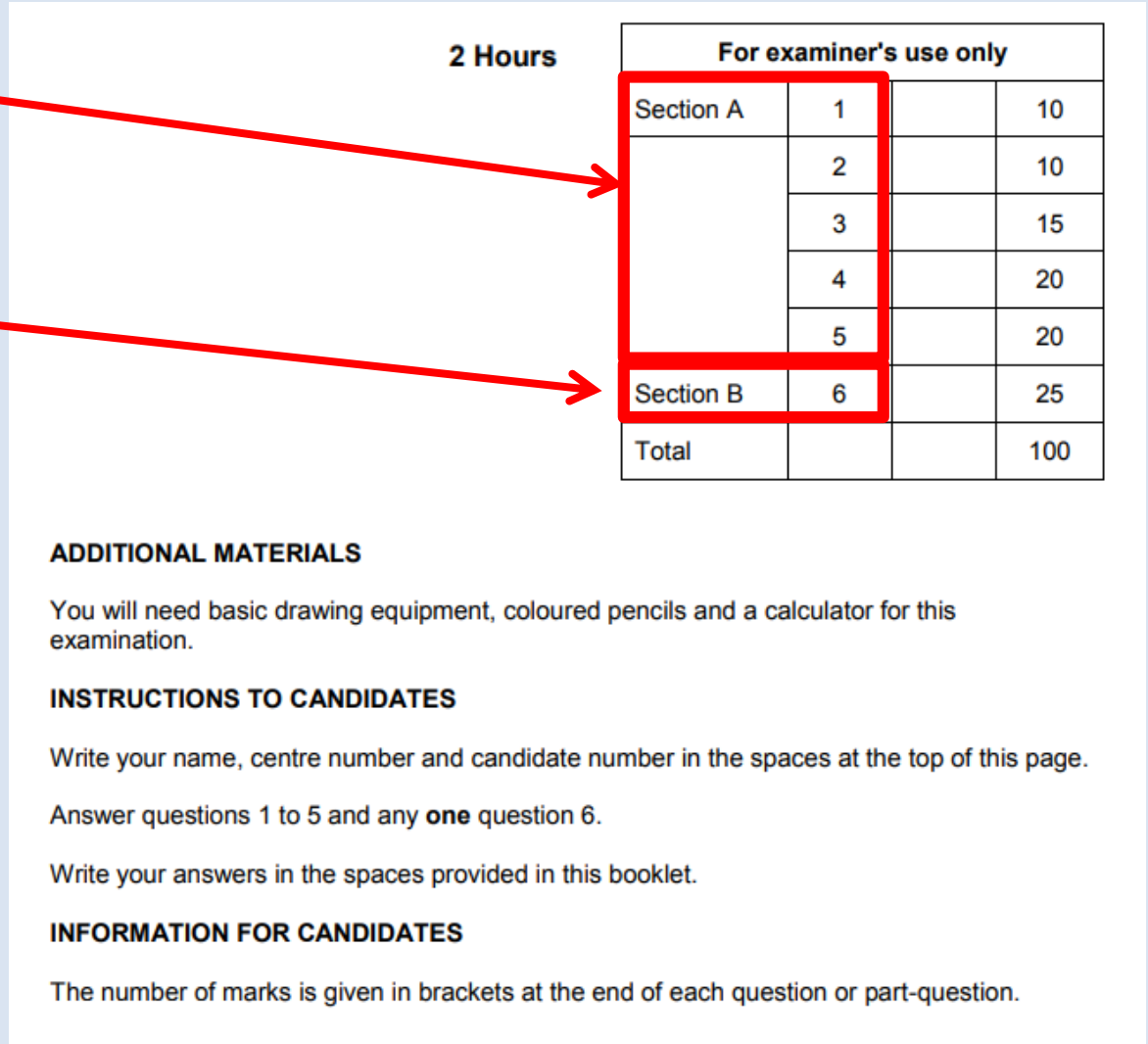
The number of marks is given in brackets at the end of each question or part-question.

A REMINDER OF THE EXAM DETAILS

You must answer all of the questions in section A / Questions 1 to 5.

When it comes to Section B / Question 6 you must only answer one of the sections; either:

- Electronic systems and Mechanical devices
- Paper & Boards
- Natural & Manufactured Timber
- Ferrous & Non Ferrous Metals
- Thermosetting & Thermoforming Plastics
- Fibres & Textiles



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A REMINDER OF THE EXAM DETAILS

This is all there is to warn you in the exam paper that you must only answer one of the questions!

Section B

Answer **one** of the questions in this section

Our advice is to read through all of the different sections and **choose to answer the question 6 that you think you will be able to get the most marks on!**

Have a **look at the 5 mark maths questions in each of the section** and work out which one you think you can answer! This will also help you to decide!

It will probably be between these three sections:

6. Natural and manufactured timber

6. Papers and Boards

6. Thermosetting and thermoforming plastics

Your Revision Matrix

Nando's

The PERi-ometer

Most of us know the good old thermometer. Because some like it hot and some not. We take revision seriously in Design & Technology so you need to use this matrix to track your revision to make sure you are ready for the exam. Once you have listened to a podcast or completed a Homework sheet just tick a box!

		Podcast		Home Work Sheet		Pages in Textbook		Area Confidence	Nando's Rating
Design & Technology and our world	Impact of New Technologies	1		3,6		3 - 9		☹ 😐 ☺	L&H
	Ethics and the Environment	2		2,6		11 - 13		☹ 😐 ☺	Medium
	Energy Generation	3		7,3		14 - 18		☹ 😐 ☺	L&H
Electronic Systems & Programmable Components	Electronic Systems	4		4		33 - 34		☹ 😐 ☺	Medium
	Programmable Components	5		4		35 - 36		☹ 😐 ☺	Hot
Mechanisms	Mechanisms	6		5,7		25 - 32		☹ 😐 ☺	Hot
	Calculations for Mechanisms	7		5,7		25 - 32		☹ 😐 ☺	Extra
Materials	Papers and Boards	8		1,2		40 – 42 **128 - 161**		☹ 😐 ☺	Medium
	Timbers	9		1,2		52 – 54 **276 - 311**		☹ 😐 ☺	Medium
	Metals	10		1,2		37 – 39 **86 - 127**		☹ 😐 ☺	Medium
	Plastics	11		1,2		43 – 46 **162 - 201**		☹ 😐 ☺	Medium
	Textiles	12		1,2		47 - 51		☹ 😐 ☺	Medium
Smart Materials	Smart Materials	13		6		19 - 24		☹ 😐 ☺	Hot

*All revision materials can be found on: www.sohamdt.com in PDF format.

THE LAYOUT OF THE REVISION LESSONS

Each Lesson will focus on a specific area which will follow your Revision Matrix to keep everything nice and simple!

Each lesson will be broken down into two 25 Minute chunks:

- **Going through the content / watch videos whilst you make notes in your booklet on the first sheet (25 Mins)**
- **Answering exam style questions / Going through a mini quiz to summarise (25 Mins)**

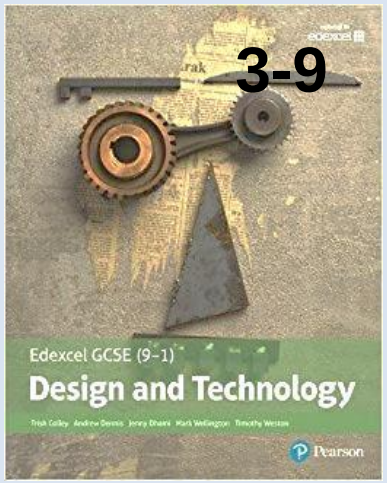
Your homework will then be to go home and listen to the podcasts and go on BBC Bitesize to recap on the three sections covered in the week.

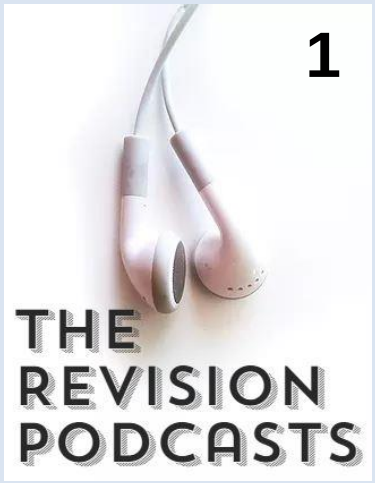
ANY QUESTIONS?

Now before we begin let's look at this picture of two adorable puppies. Because….why not?

Section 1

DESIGN AND TECHNOLOGY AND OUR WORLD: IMPACT OF NEW TECHNOLOGIES





IMPACT OF NEW TECHNOLOGIES

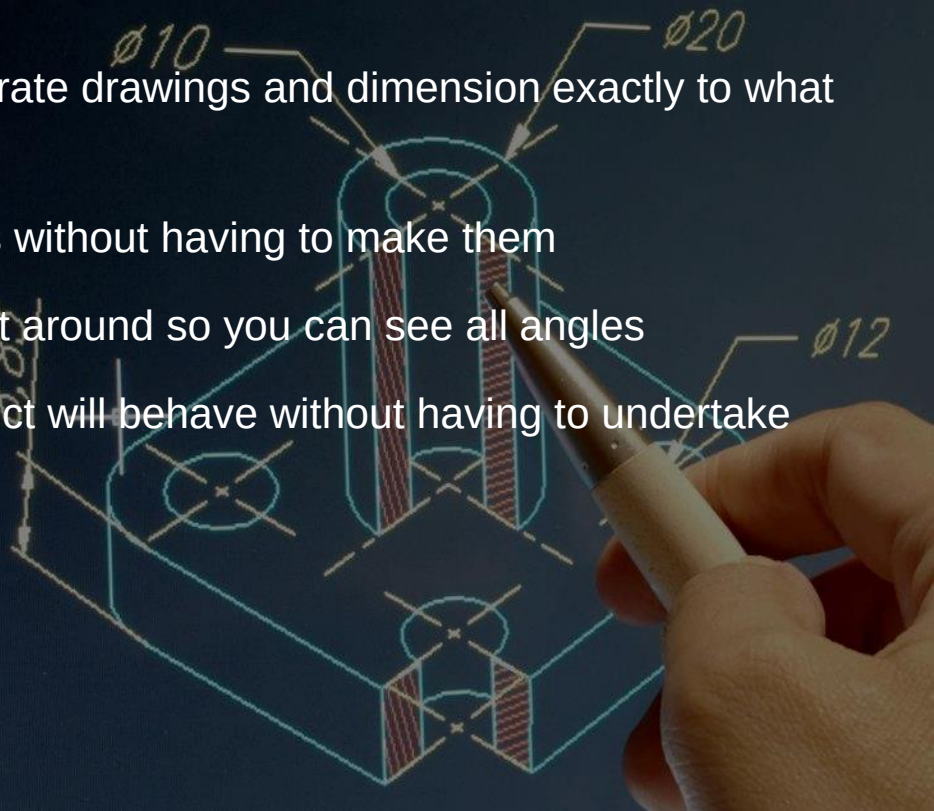
Let's watch a video! Remember to make notes on the first sheet!

COMPUTER AIDED DESIGN / CAD

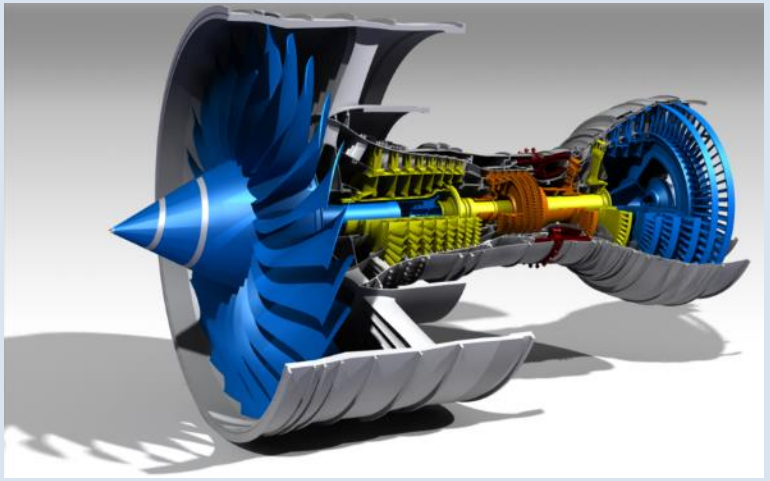
CAD software is used to create precision 2D or 3D drawings, models or technical illustrations. It is commonly used by designers, architects,
engineers and artists.

Designers can use computer packages like 2D Design, Autocad, Google SketchUp to design, Model and Test ideas before they go into production. It is particularly useful because;

- Computers can be used to make changes to a design and edit it without having to redraw it.
- Computers can be used to produce very accurate drawings and dimension exactly to what is drawn.
- Computers can produce photorealistic models without having to make them
- You can see what it will look like in 3D – spin it around so you can see all angles
- Computers can show or simulate how a product will behave without having to undertake expensive testing.



EXAMPLE OF CAD DESIGNS WHICH HAVE BEEN RENDERED

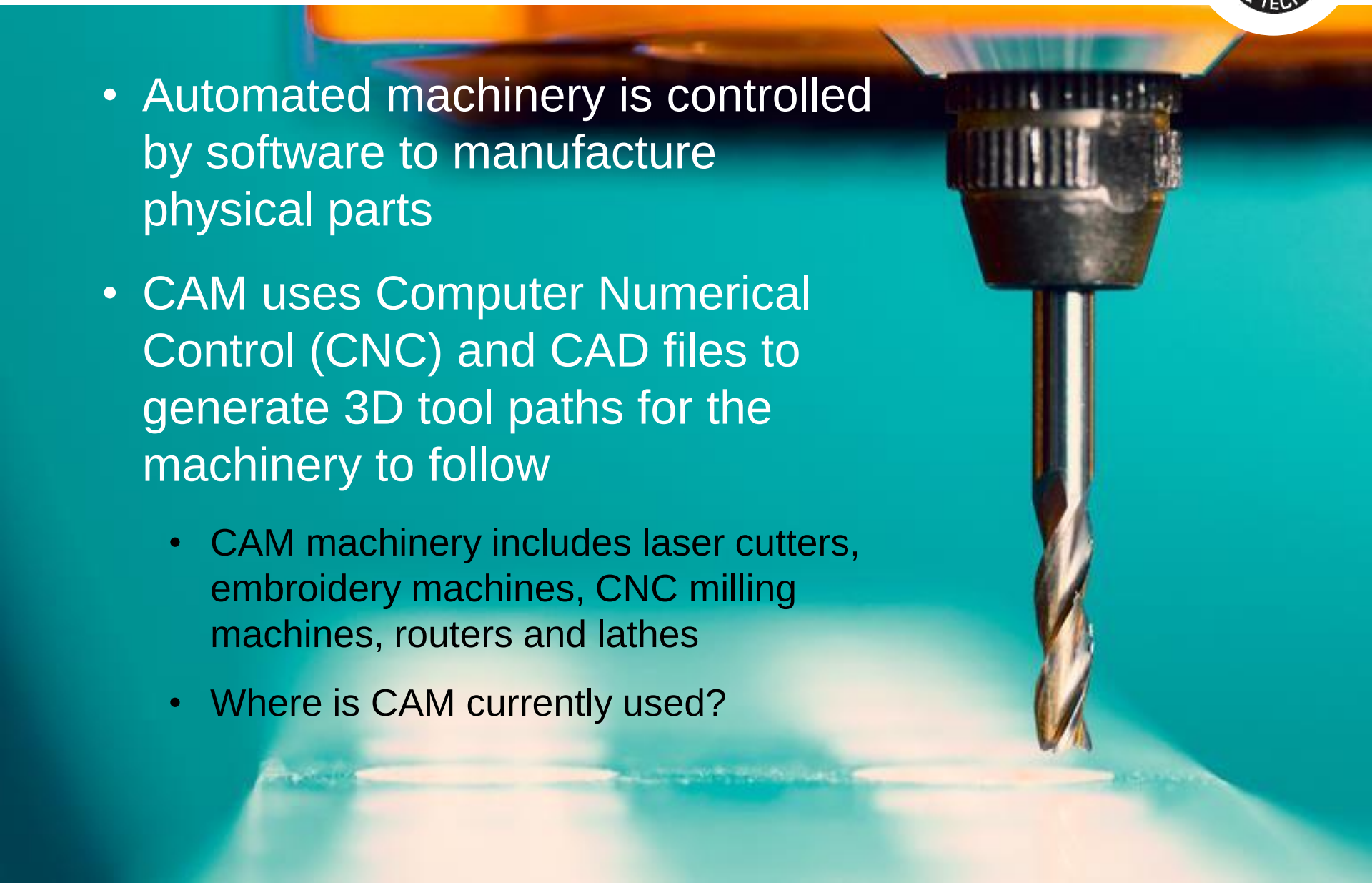


ADVANTAGES AND DISADVANTAGES

Advantages of CAD	Disadvantages of CAD
Designs can be created, saved and edited easily, saving time	CAD software is complex to learn
Designs or parts of designs can be easily copied or repeated	Software can be very expensive
Designs can be worked on by remote teams simultaneously	Compatibility issues with software
Designs can be rendered to look photo-realistic to gather public opinion in a range of finishes	Security issues - Risk of data being corrupted or hacked
CAD is very accurate	
CAD software can process complex stress testing	

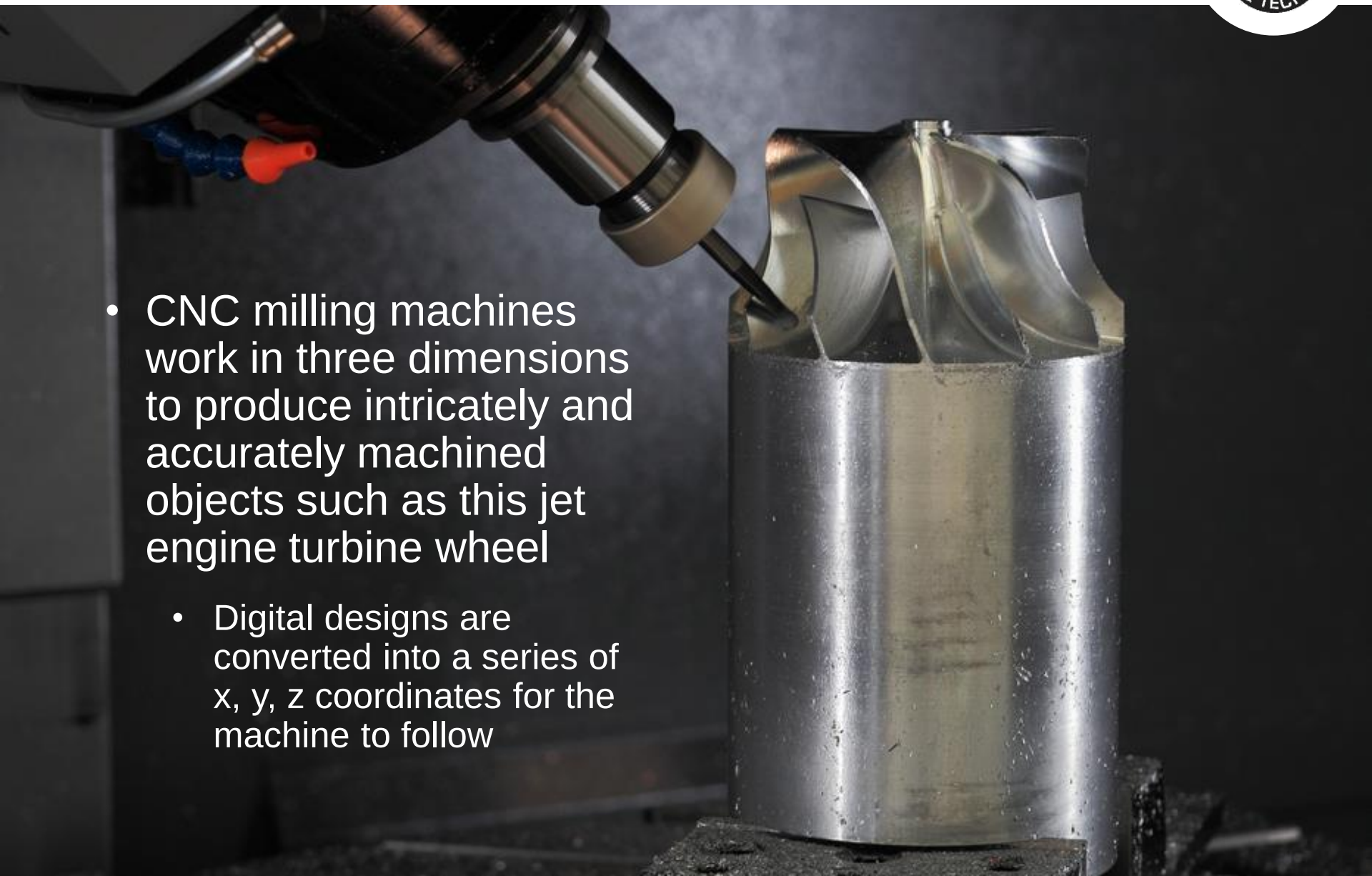
PG ONLINE

COMPUTER AIDED MANUFACTURE / CAM



- Automated machinery is controlled by software to manufacture physical parts
- CAM uses Computer Numerical Control (CNC) and CAD files to generate 3D tool paths for the machinery to follow
  - CAM machinery includes laser cutters, embroidery machines, CNC milling machines, routers and lathes
  - Where is CAM currently used?

CNC MILLING MACHINES



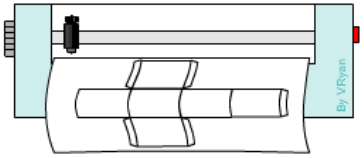
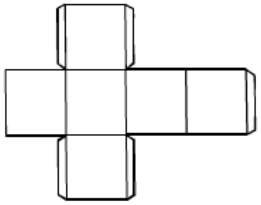
- CNC milling machines work in three dimensions to produce intricately and accurately machined objects such as this jet engine turbine wheel
  - Digital designs are converted into a series of x, y, z coordinates for the machine to follow

CNC LASER CUTTING

- By cutting at different speed rates, laser cutters can burn through or etch the surface of a material
- They can cut complex shapes in a wide range of materials including:
  - Paper
  - Polymers
  - Timber
  - Metals and
  - Textile based materials

VINYL CUTTING

A vinyl cutter is a type of computer-controlled machine. Small vinyl cutters look like computer printers. The computer controls the movement of a sharp blade. This blade is used to cut out shapes and letters from sheets of thin self-adhesive plastic (vinyl).

INPUT	PROCESS	OUTPUT
		
COMPUTER AIDED DESIGN (CAD) SOFTWARE IS USED TO DESIGN THE DEVELOPMENT / NET OF A SIMPLE PACKAGE.	THE SOFTWARE CONVERTS THE DESIGN INTO COORDINATES. THE CUTTER FOLLOWS THE COORDINATES, CUTTING OUT THE PACKAGING SHAPE.	THE WASTE CARD IS REMOVED, REVEALING THE FINAL DEVELOPMENT / NET. THIS IS THE OUTLINE OF THE PACKAGE. THE FLAT DEVELOPMENT IS FOLDED ON PERFORATED LINES, ALSO CUT BY THE VINYL CUTTER.

3D PRINTING

The action or process of making a physical object from a three-dimensional digital model, typically by laying down many thin layers of a material in succession.

ADVANTAGES AND DISADVANTAGES

Advantages of CAM	Disadvantages of CAM
Computers do not make mistakes if programmed properly	CNC Machines can cost a lot of money, more than manual machines
Computers give reliable and consistently high standards of manufacture	Specialist knowledge is needed to programme computers
Computers achieve quicker production times	May lead to rise in unemployment (less workers needed)
Complex shapes and designs can be created easily	
Production can run 24 hours a day, 7 days a week, so more efficient	
Designs can be produced quickly to gather public opinion in a range of finishes	

QUALITY CONTROL / ASSURANCE / BSI / FAIRTRADE

Quality Control is a system set in place by a manufacturing company to ensure products are made to a high standard.

A high quality product must:

- Function properly
- Meet the criteria set in the design and manufacturing specification
- Satisfy customer expectations
- Be free of imperfection

Quality Assurance ensures that the product is ‘fit for purpose’.

British Standard Institution: BSI is an independent company which sets out clear rules and guidelines for companies to follow in the designing and manufacturing of their products.

Fair trade is a trading partnership that ensures workers in **developing countries** are given suitable working conditions and are paid a fair wage.

SCALES OF PRODUCTION

One Off - This is when only **one product** is made at a particular time. This one off product could be a prototype a one off object or a hand made object. Prototypes are made to see if a product works before it goes into large scale production. One off production takes a long time and often means it is expensive.

Batch - This is when a **series of products** which are all identical are made jointly in either large or small numbers. Once these have products have been made once more of the same products may be made using the same equipment.

Mass production - involves the product going through many stages of a production line. There are workers and machines at certain stages along the line that are responsible for making certain parts of the product. This means the product is often made over days or even weeks depending how complicated it is. This product is often quite reasonably priced due to the large scale production techniques used.

Continuous - This is where a product is continuously produced over a period of hours, days, weeks or even years.

BIOMETRICS

Biometrics is where parts of a person's body are used for identification purposes. Examples used are finger prints.

Voice recognition - pitch, tone and frequency of voices are unique and can be analysed to identify people

ROBOTICS

The use of robots is just one part of automation. The difference between robotics and automation is that robots use **artificial intelligence (AI)** to collect information and improve the performance of a particular procedure. Robotics have proven popular because of their ability to increase efficiency and handle harmful materials that humans can't, but they are very expensive.

Advantages of robotics	Disadvantages of robotics
Increased efficiency - can work at a constant speed without tiring	Very expensive to set up and repair
Can handle harmful materials	Need constant power
More precise	Loss of jobs
Faster speed	Training needed to supervise them

VIRTUAL REALITY

Virtual reality is where computers are used to create an artificial environment that users can interact with as if it were real.

Eye Goggles produce the 3D images that make up the artificial world. The goggles project slightly different views into each eye and this fools your brain into thinking that the scene is 3D. Virtual chairs look solid.

TECHNOLOGY PUSH – MARKET PULL

Technology push
Research and development in science and industry can lead to new discoveries, which can be used to improve existing products or develop new ones. This is known as **technology push**, and it happens before there is **consumer** demand for a product. Research and development are valuable for companies who are the first to introduce a new, **innovative** product.

Market pull is when product ideas are produced in response to market forces or customer needs. Examples of this include the development of cameras, which have become smaller, more lightweight and higher performing as a result of customer needs.

EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

D&T AND OUR WORLD - IMPACT OF NEW TECHNOLOGIES

1) What are the benefits of the Fairtrade scheme? (2)

Fair trade is an institutional arrangement designed to help producers in developing countries achieve better trading conditions. Members of the fair trade movement are happy to pay higher prices to exporters, as well as improved social and environmental standards.

2) Why are Laser Cutters used in industry to produce the parts for products? (3)

Laser cutters are:
- Very accurate
- Much quicker than cutting by hand
- Can cut very complex shapes
- Can cut multiple identical pieces at once

3) Discuss Technology Push Market Pull mean in relation to cameras? (4)

Camera technology has developed a lot in the last 50 years.
- People have wanted cameras to be smaller and since they were put into a mobile phone people have got used to having a camera with them all of the time and very portable.
- Camera technology has advanced to ensure they are smaller, more portable but also take higher quality pictures.
- The circuit boards and components have reduced in size without taking away from the power of cameras.
- Less people are buying stand alone cameras now as they come with all smart phones.

4) Evaluate the benefits and disadvantages to robotics being used to manufacture cars. (5)

Advantages:
- Robots are highly accurate
- Robots can perform tasks much quicker than humans
- Robots do not need breaks or sleep / Don't need to be paid
- Robots can work continuously 24hours a day

Disadvantages:
- Robots' are expensive to set up and buy
- Robots are taking away people's jobs
- Robots require a lot of maintenance expertise to programme
- They need constant power

Purple pen time! Swap with a classmate!

D&T AND OUR WORLD - IMPACT OF NEW TECHNOLOGIES

5) State which production method would be used to produce these products and explain why: (4)

Mass Production:
A high quantity of pens are required all of the time in a lot of industries and professions around the world.

Mass Production:
A high quantity of these cars are required all of the time until the next model comes out.

Batch Production:
Most products are made in batches. These boots will be made in a batch of thousands. The demand for them is not like the car or pen.

One-Off:
A high quality one-off product which takes a long time to make using hand skills / highly skilled worker.

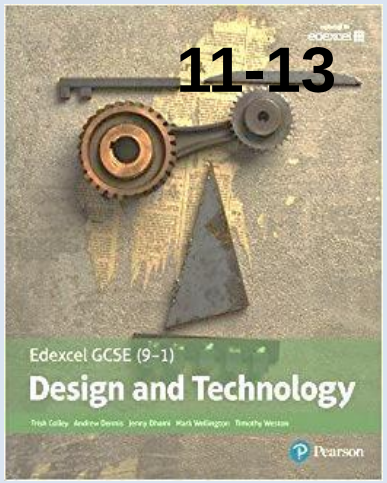
Purple pen time! Swap with a classmate!

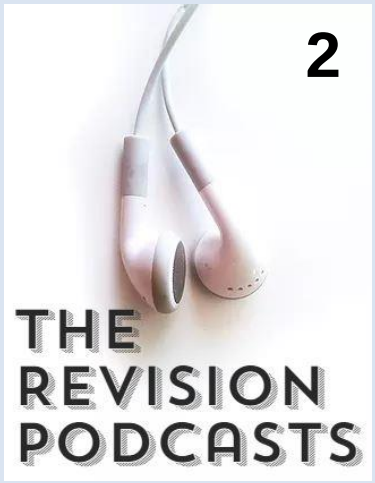
PUPPY OF THE DAY

Awwwwww!

Section 2

DESIGN AND TECHNOLOGY AND OUR WORLD: ETHICS AND THE ENVIRONMENT





SUSTAINABILITY

Let’s watch a video!

SUSTAINABILITY

Sustainability is a **HUGE** subject! It is about protecting and preserving what we have today so that life is easier tomorrow. Recycling, buying sustainable products and protecting the environment - Sustainability involves all of this!

It is the job of the designer, Manufacturer and the Consumer to think sustainably to try to help the planet.

THE 6 R'S

The 6R's are important to designers, manufacturers and consumers.

They are used by designers to reduce the environmental impact of products. They can also be used to evaluate the environmental impact of other products.

The 6Rs stand for:

RETHINK: Do we make too many products? Design in a way that considers people and the environment.
REFUSE: Don't use a material or buy a product if you don't need it or if it's bad for people or the environment.
REDUCE: Cut down the amount of material and energy you use as much as you can.
REUSE: Use a product to make something else with all or parts of it.
RECYCLE: Reprocess a material or product and make something else.
REPAIR: When a product breaks down or doesn't work properly, fix it.

RECYCLING

1. **Primary:**
   Giving/selling something you don't use anymore to someone else to use.

2. **Secondary** or Physical recycling:
   Taking waste and **physically reprocessing** it to form new material that can be used to make stuff

3. **Tertiary** or Chemical Recycling:
   Taking waste and **chemically reprocessing** it to form new material that can be used to make stuff

NON-RENEWABLE RESOURCES

Fossil fuels are a finite resource, meaning that they cannot be replaced once extracted from the ground. In 2015, 80 per cent of energy consumed in the world came from fossil fuels. In early 2018, the UK's dependence on fossil fuels was at a low of 77 per cent.

Examples include:

- Coal
- Natural gas
- Oil

Finite resources are **non-renewable** and will eventually run out. Metals, plastics and **fossil fuels** (coal, natural gas and oil) are all examples of finite resources.

GREENHOUSE GASES

They create a layer in the atmosphere that traps the Sun's rays, these heat up the Earth and can cause very harmful effects;

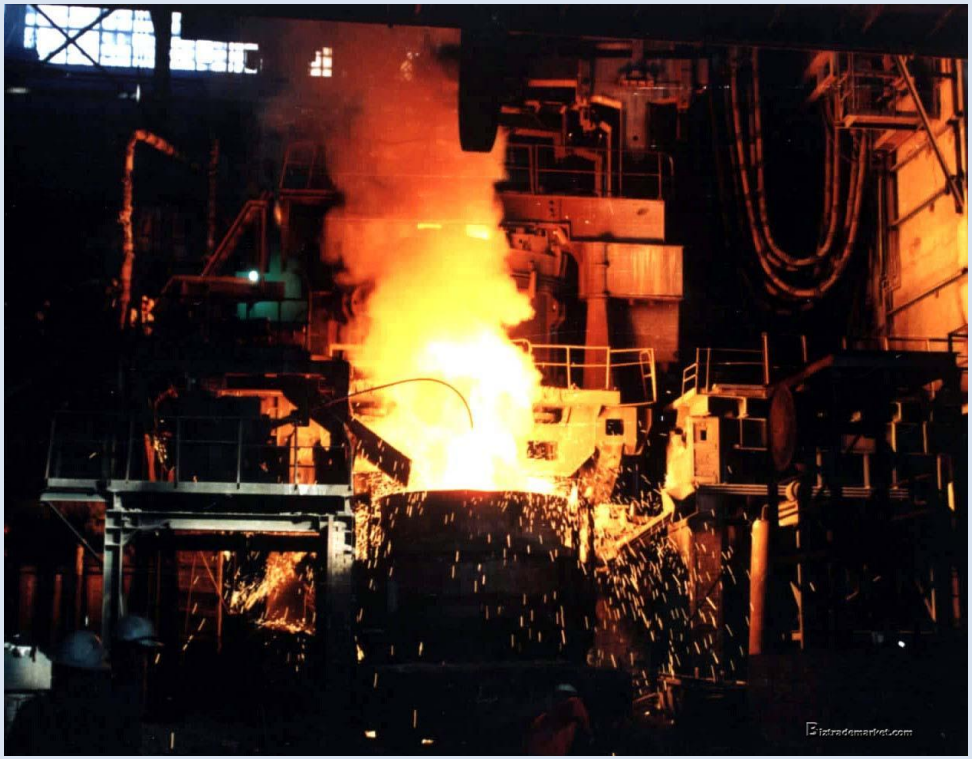
- Rise in sea level so land shrinks
- Plants die and land becomes desert
- Animals have nothing to eat and die
- Weather becomes more extreme – tsunamis, hurricanes droughts etc.

What makes Carbon Dioxide?

BURNING STUFF!!

WHY DO WE BURN STUFF?

1. To make heat



In Industry – Extracting natural resources (metal), making synthetic materials (plastics)

At Home – Cooking food and heating rooms and offices

WHY DO WE BURN STUFF?

2. To make electricity

WHY DO WE BURN STUFF?

3. To make movement

In Industry – Moving products around the globe (planes, trains, lorries, boats etc.)

At Home – Moving people around (cars, motorbikes, buses, trains etc.)

WHY DO WE BURN STUFF?

4. To get rid of it

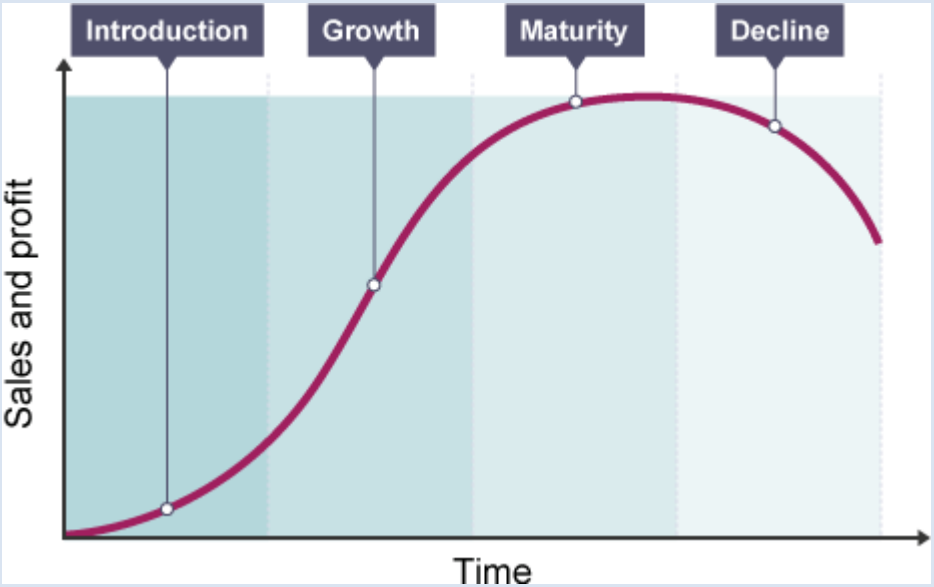
Incineration is a main way of disposing of waste

CLIMATE CHANGE

Manufacturing processes in factories or the use of day-to-day products like cars can cause harmful chemicals, such as carbon monoxide and nitrogen oxides, to be released.
These chemicals pollute the air and natural land. Worldwide environmental awareness has led to limitations on the levels of pollution and emissions of **greenhouse gases.**

PRODUCT LIFECYCLE

The diagram below shows a **product life cycle**, highlighting the four different stages a product goes through in its life. Companies can use this cycle as part of their planning of products.
Keeping a record of sales over time ensures **money, materials and energy** are not wasted when the product has stopped selling, lessening the potential impact on the environment.



PLANNED OBSOLESCENCE

Planned obsolescence is the practice of designing products that will have a limited **life cycle** and that will become obsolete and require to be replaced, such as disposable razors.
Modern mobile phones are a good example as they need continual software upgrades and they are soon replaced by new better-performing models.
Planned obsolescence is generally bad for the environment as it creates more waste. The mobile phone companies make more money though.

EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

D&T AND OUR WORLD - ETHICS AND THE ENVIRONMENT

1) What is climate change? (2)

Manufacturing processes in factories or the use of day-to-day products like cars can cause harmful chemicals, such as carbon monoxide and nitrogen oxides, to be released. These chemicals pollute the air and natural land causing the earth to heat up.

2) Explain three reasons why we burn stuff? (3)

- To make heat
- To make electricity
- To make movement
- To get rid of stuff

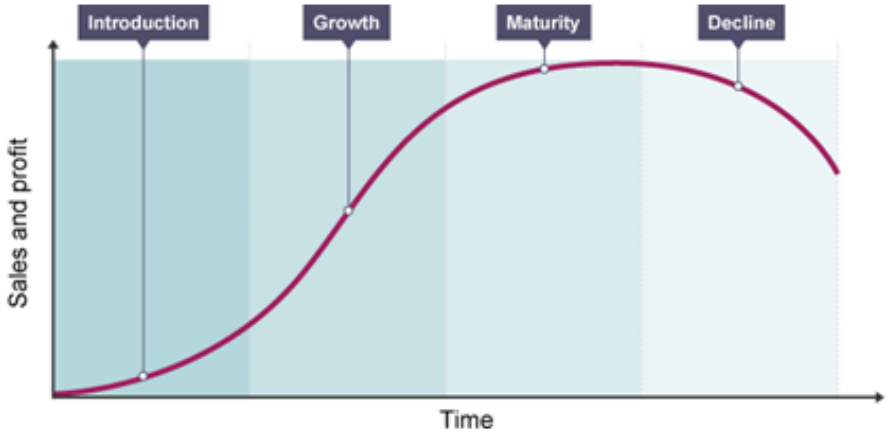
3) Discuss the differences between primary and secondary recycling? (4)

Primary recycling is taking a product to a charity shop or putting it on Ebay to recycle it.

Secondary recycling is where the product is broken down into its separate parts or materials to be recycled at a plant.

4) Using the graph below, what is meant by a product lifecycle? (5)

- Every product has a life cycle
- The four stages a product goes through in a market - launch, growth, maturity and decline.
- Materials that are sourced to make it need to be thought about
- What happens to the product at the end of its life?
- How many processes are used to manufacture the product?
- How long will the product be used?
- Will it be easy to recycle?



Purple pen time! Swap with a classmate!

5) Why would Samsung use planned Obsolescence for their range of "Galaxy S" mobile phones? (4)

Software upgrades / Samsung want to make as much money as possible / They will hold back technology until the next model comes out / The technology will exist by they will deliberately not put it into their current phone / They will make sure that people will want to upgrade after a year of owning a new phone because the new model has something better / Technology will improve with every model to entice people to buy them

Galaxy S 2

Galaxy S 10

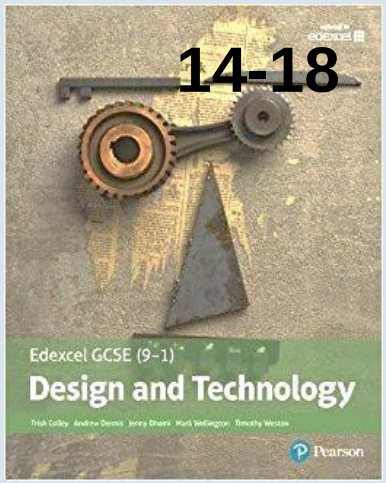
Purple pen time! Swap with a classmate!

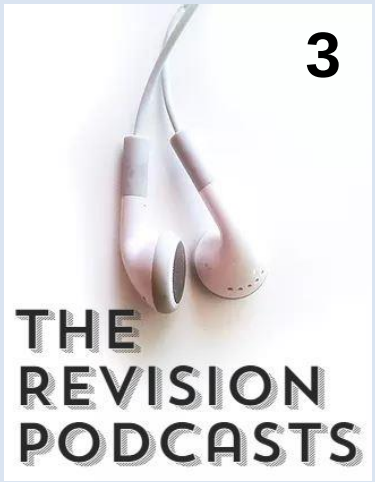
PUPPY OF THE DAY

Shhh! He's sleeping!

Section 3

DESIGN AND TECHNOLOGY AND OUR WORLD: ENERGY GENERATION





NON-RENEWABLE ENERGY SOURCES

COAL

Advantages
Stable, large-scale and high power electricity generation
Relatively cheap to extract and convert
Reliable

Disadvantages
Emits pollution such as CO2, Sulphur, Mercury, Selenium and Arsenic
Technologies to reduce emissions are expensive
Mining impacts significantly on landscape

OIL

Advantages
Stable, large-scale and high power electricity generation
Relatively cheap to extract and convert

Disadvantages
Highly polluting
Oil extraction impacts on landscape
Oil extraction risks environmental disasters

GAS

Advantages
Stable, large-scale and high power electricity generation
Relatively cheap to convert
Cleaner than coal or oil

Disadvantages
Highly polluting

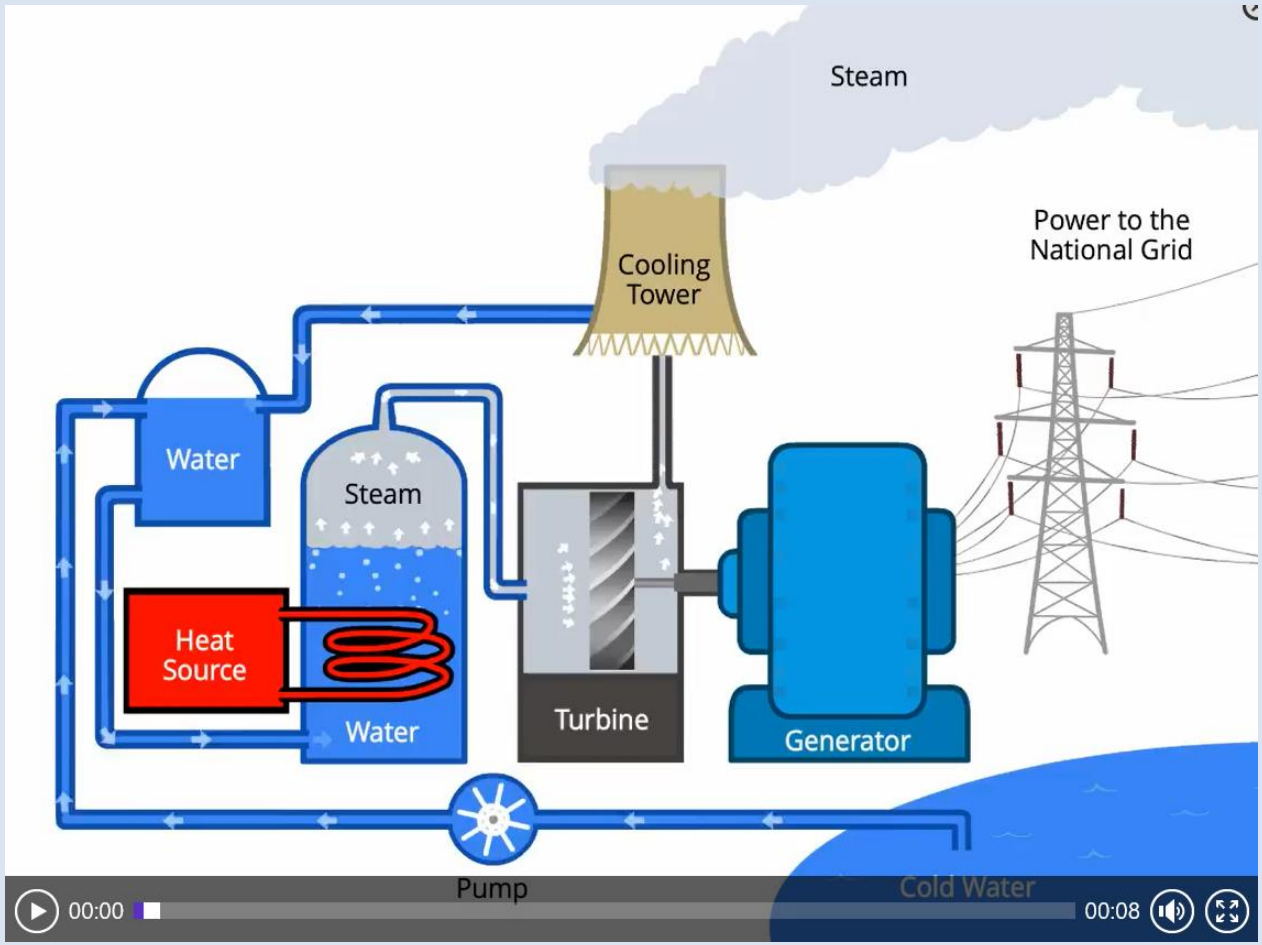
POWER STATIONS

We get most of our energy from burning fossil fuels. Unfortunately these are running out and are harming our planet / warming it up.
Levels of pollution have increased dramatically during the last 50 years.

Natural resources are being used at increasing rates and we are not replacing them at the same rate. This is having a detrimental effect on the planet.
The amount of energy needed to manufacture products is enormous.
Emissions from large plants or factories are at a dangerous level (this can cause serious environmental damage in some areas).

POWER STATIONS

Click on the image and scroll to the bottom of the web page to watch a simple animation of how a power plant works! – These use coal as the heat source!



NUCLEAR POWER

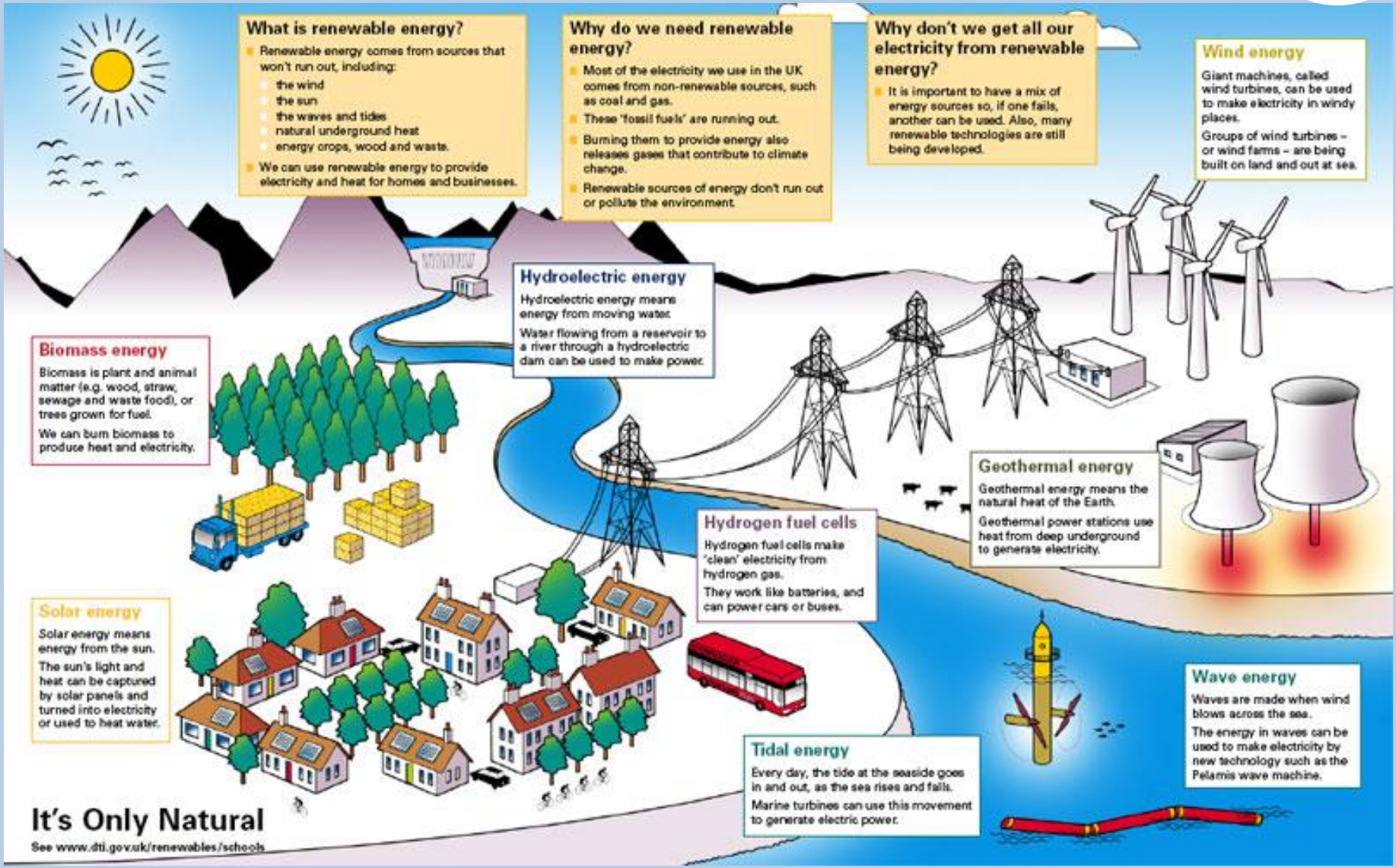
In 2018, nuclear energy generated around one fifth of the country's electricity. A huge amount of energy can be produced through the nuclear process using a relatively small amount of **uranium**. The energy is produced as heat through the **fission** **process**.

Advantages of nuclear	Disadvantages of nuclear
No harmful gases are released in the process	Nuclear power stations have to close after around 40 years of use when the uranium becomes less efficient at heating the water
More efficient than fossil fuels	Disposal of uranium is difficult and costly
	Cost of nuclear power stations is very large

RENEWABLE ENERGY SOURCES

Renewable energy plays an important role in reducing greenhouse gas emissions. When renewable energy sources are used, the demand for fossil fuels is reduced. Unlike fossil fuels, non-biomass renewable sources of energy (hydropower, geothermal, wind, and solar) do not directly emit greenhouse gases.

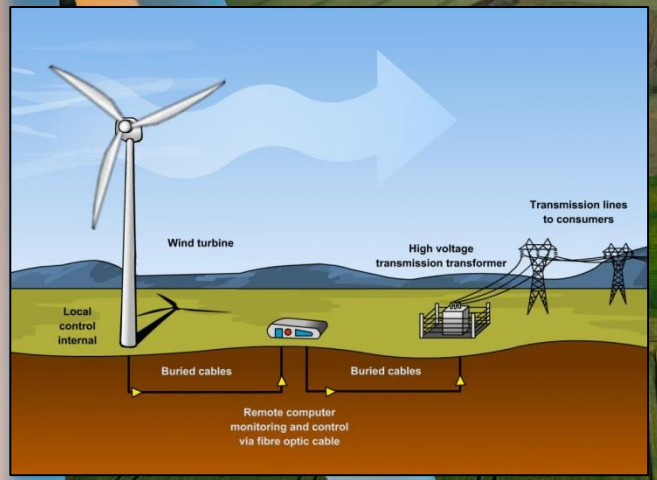
RENEWABLE ENERGY SOURCES



WIND POWER

The terms wind energy or wind power describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power.

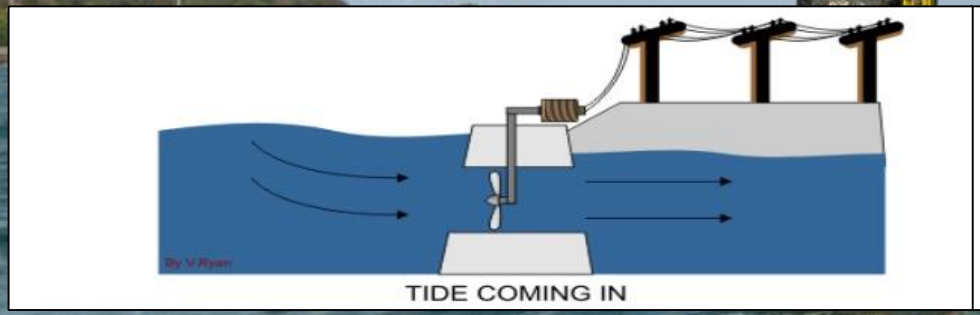
Advantages of wind	Disadvantages of wind
Wind energy is constantly available and sustainable	When there are periods of low wind, little or no energy is produced
There is no cost for wind and the running cost of a wind turbine is relatively low	They cost a lot to build and put in place
	Some people do not like the look of wind turbines or feel that they spoil the natural landscape

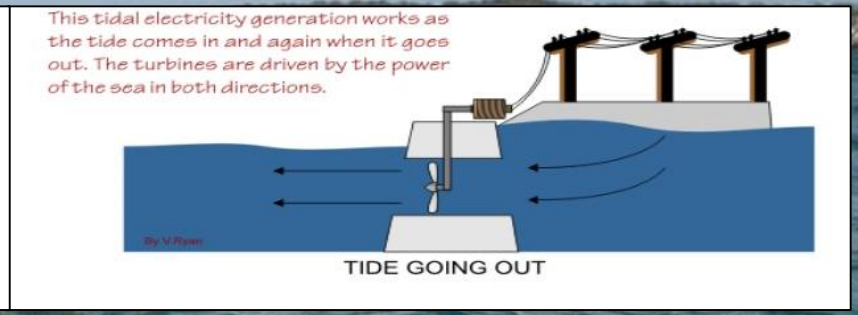


TIDAL POWER

Tidal power or tidal energy is a form of hydropower that converts the energy obtained from tides into useful forms of power, mainly electricity. Although not yet widely used, tidal energy has potential for future electricity generation. Tides are more predictable than the wind and the sun.

Advantages of tidal	Disadvantages of tidal
Clean, renewable energy source	Construction of tidal barrages is expensive
Tidal power plants will last for a long time	Environmental impact of tidal barrages is unknown
Could produce a fifth of the UK's needs as it is an island surrounded by the sea	





SOLAR POWER

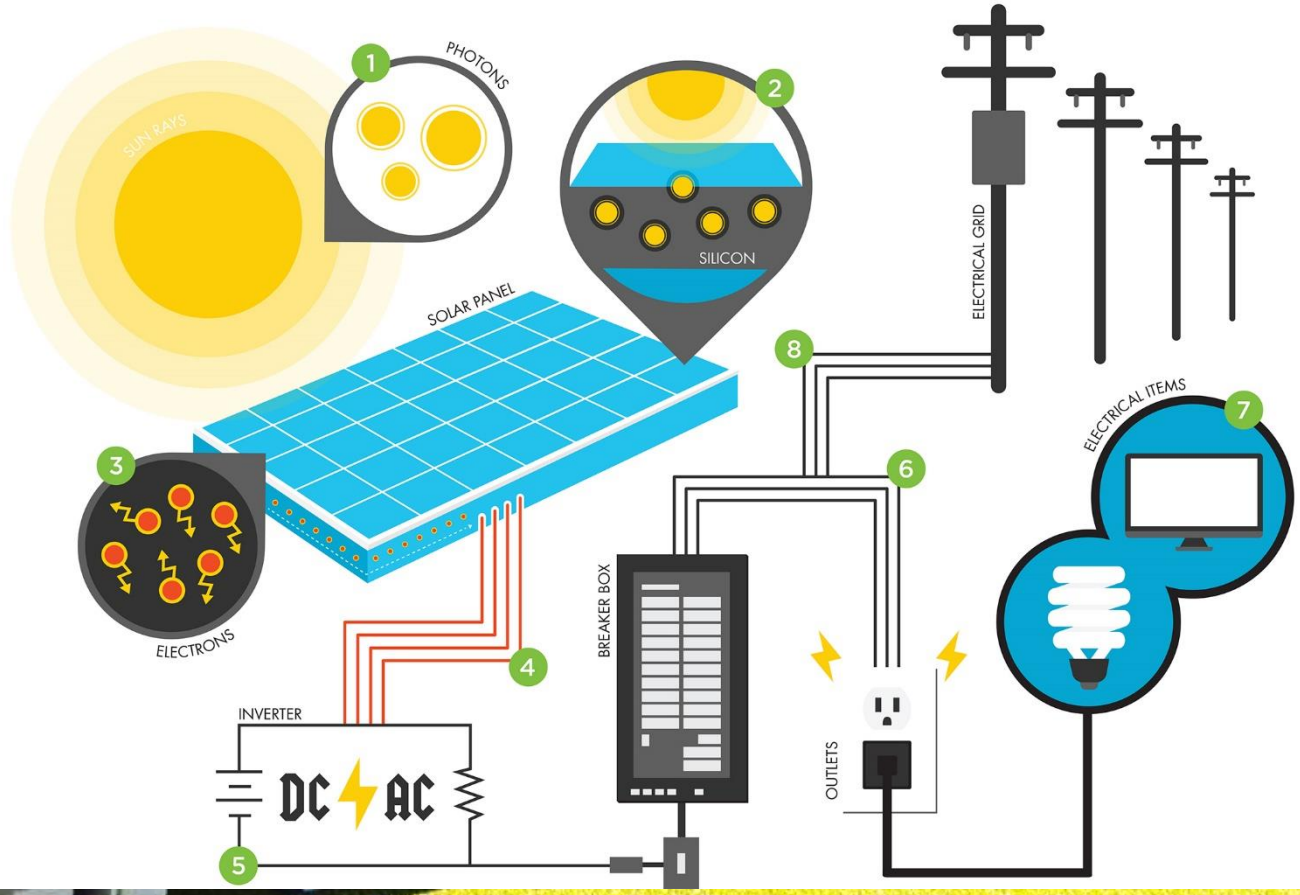
When there is a really large surface area on the top of a roof it is easy to gather and store electricity. You will see these solar panels on the roof of the science / MFL block, and they are facing the sun.

Advantages of solar	Disadvantages of solar
Clean, renewable energy source	Some people do not like the look of solar panels or feel that they spoil the appearance of a building
Reduces household energy bills	Costs a lot to install
	Does not produce much electricity when there is considerable cloud cover, during the winter months or at night

SOLAR POWER

How Solar Energy Works...

1. Sunlight contains tiny particles of energy called photons.
2. When the sun's rays hit a solar panel, material inside the panel – usually silicon – absorbs the photons.
3. The photons excite the electrons inside the silicon's atoms until they begin to dart around and break away, forming an electrical current.
4. Copper wiring inside the panel serves as a highway for the current.
5. This direct current (DC) travels out of the panel through a control device called an inverter, which changes it to the alternating current (AC) we use.
6. The electricity then passes from breaker boxes to outlets throughout the building.
7. Electrical items such as computers and lights can then run on this pollution-free solar energy!
8. Whatever isn't used goes back into the electrical grid so it can be used by someone else.



SOLAR POWER

Many fields are now full of solar panels which are converting the suns rays into energy for many many homes!

Sun Power have just finished creating the worlds largest solar power plant in California.

SOLAR POWERED BATTERY CHARGER

These small battery chargers would have to be in the sun for two days to get a full charge! As you can see below, solar powered phone chargers have to have a large amount of surface area in order for them to work properly and charge a phone.

BIOMASS

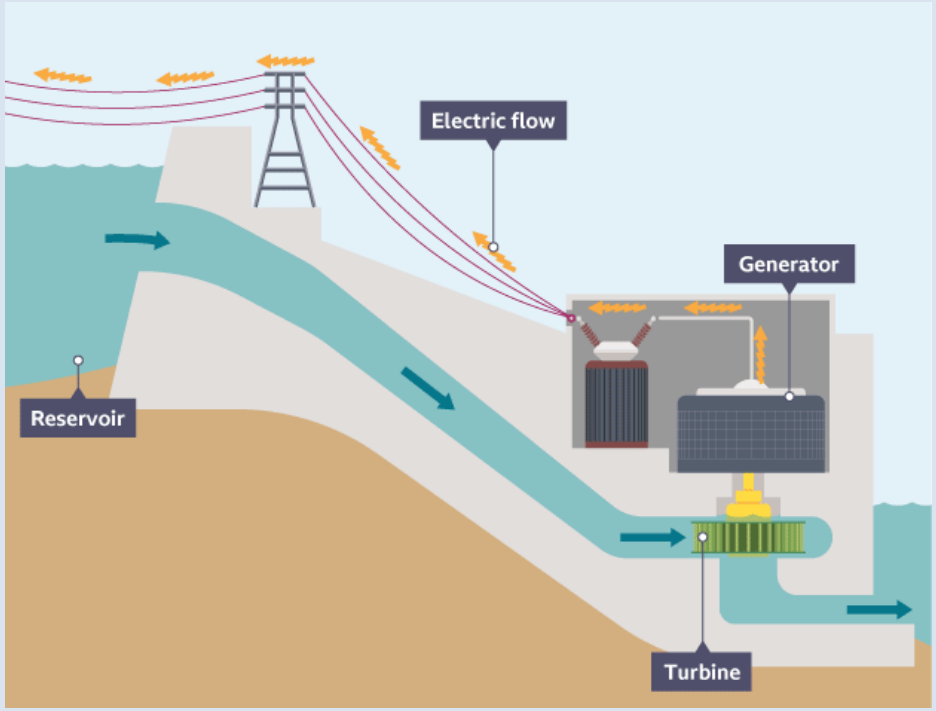
Biomass energy involves growing plants or using animal materials, not for consumption but so that they can be burned to produce heat. Plants such as rapeseed or willow are specifically grown as biomass crops so that they can be burned in a furnace.

Advantages of biomass	Disadvantages of biomass
Clean, renewable energy source	Creates atmospheric pollution when burned
Carbon dioxide is released in the process and can be reused by plants	Land used for energy crops may be needed for other purposes such as agriculture
Replacement plants can be grown very quickly to ensure a good supply	

HYDRO

Hydroelectric schemes use a **dam** to block a valley or a major river, often creating a **reservoir** behind the dam.

Once the water has built up behind the dam, it is directed and released by **valves** through turbines. The turbines turn generators to produce electricity. The water is then pumped back up to the reservoir during the night when the energy needs of the public are lower.



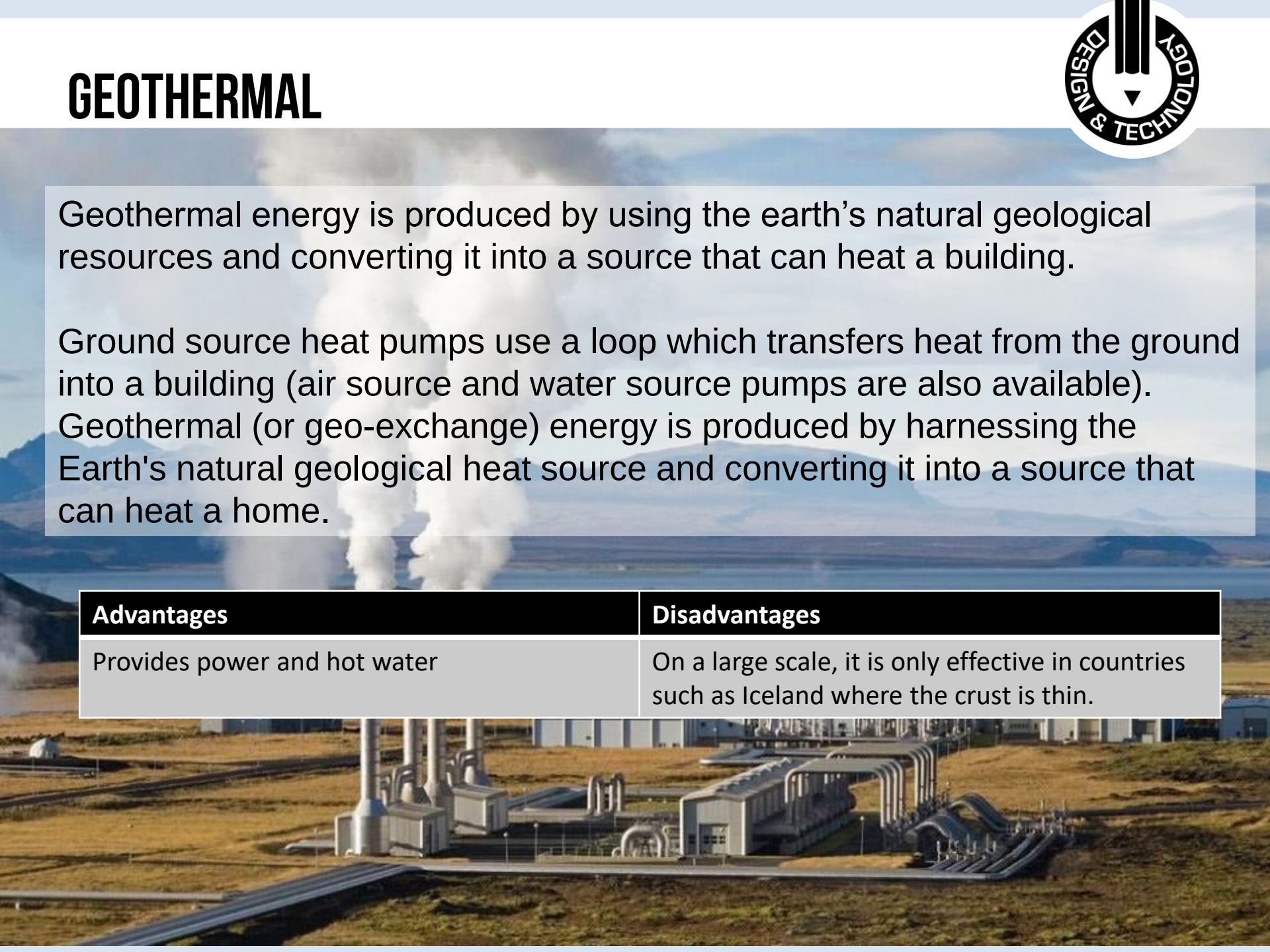
Advantages of hydroelectricity	Disadvantages of hydroelectricity
Clean, renewable energy source	Construction of dams is expensive
Valves can be opened very quickly to produce energy at peak times	The cost of pumping the water back up is high
No pollution when running it	Affects the wildlife by flooding the valley

GEOTHERMAL

Geothermal energy is produced by using the earth's natural geological resources and converting it into a source that can heat a building.

Ground source heat pumps use a loop which transfers heat from the ground into a building (air source and water source pumps are also available). Geothermal (or geo-exchange) energy is produced by harnessing the Earth's natural geological heat source and converting it into a source that can heat a home.

Advantages	Disadvantages
Provides power and hot water	On a large scale, it is only effective in countries such as Iceland where the crust is thin.



BATTERY POWER

The two main types of batteries that are commonly used are ‘single-use’ and ‘rechargeable’. The single-use batteries, sometimes referred to as primary types, are commonly **alkaline** batteries, and these are readily available in supermarkets and shops.

All batteries are available in a range of sizes and shapes - tiny batteries known as **button-cell batteries** power calculators and hearing aids, while very large batteries power cars and trucks

Hearing Aid Battery

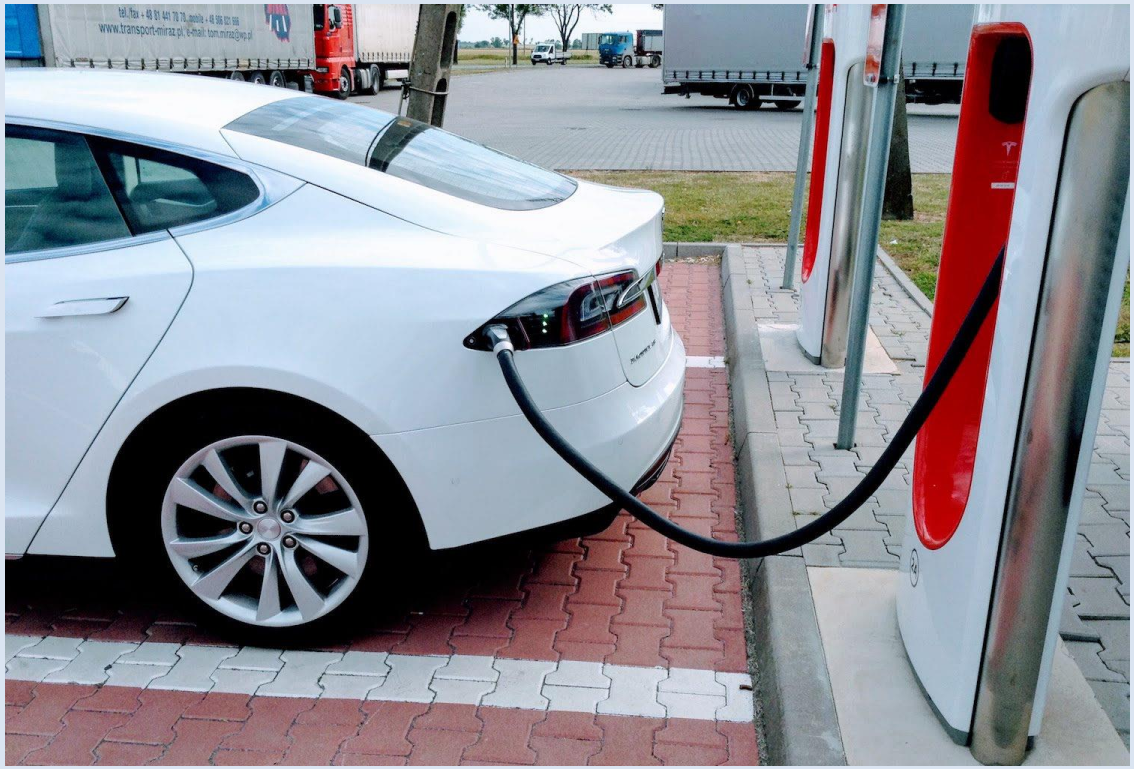
Tesla Car Battery

Rechargeable batteries:

- Are more expensive to purchase than single-use batteries
- Can be recharged
- Are more economical in the long term
- Have a limited lifespan

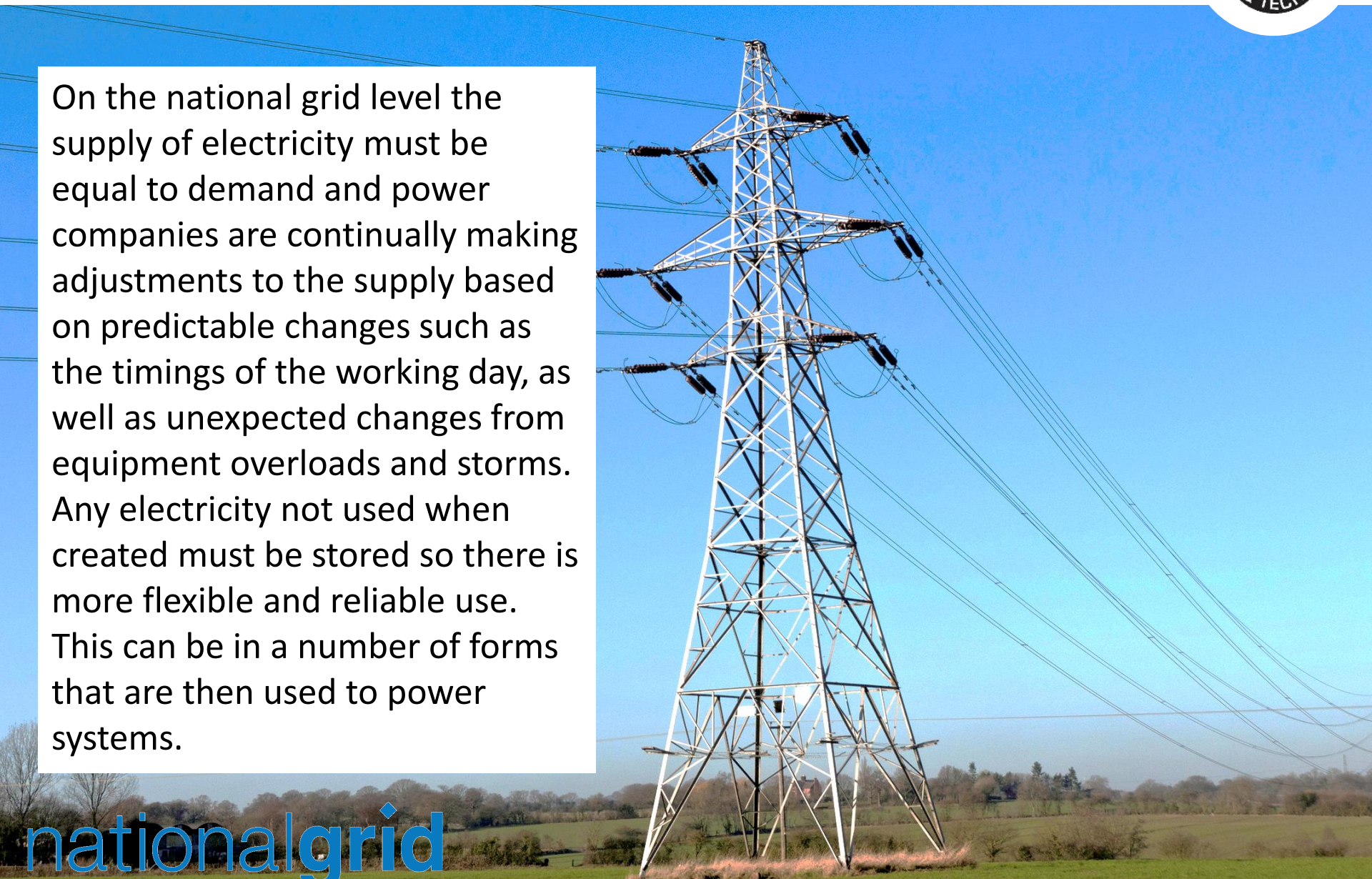
ELECTRIC CARS

Electric vehicles are powered by an electric motor, rather than a tradition combustion engine that runs on petrol or diesel as a source of fuel. Electric vehicles create fewer exhaust emissions compared to a vehicle with a petrol engine. When the energy stored inside the motor has run out, the batteries are recharged using energy supplied from the **National Grid**, through a wall socket or charging unit.



STORAGE OF ENERGY

On the national grid level the supply of electricity must be equal to demand and power companies are continually making adjustments to the supply based on predictable changes such as the timings of the working day, as well as unexpected changes from equipment overloads and storms. Any electricity not used when created must be stored so there is more flexible and reliable use. This can be in a number of forms that are then used to power systems.



EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

D&T AND OUR WORLD - ENERGY GENERATION

1) Explain two disadvantages of using solar power (2)

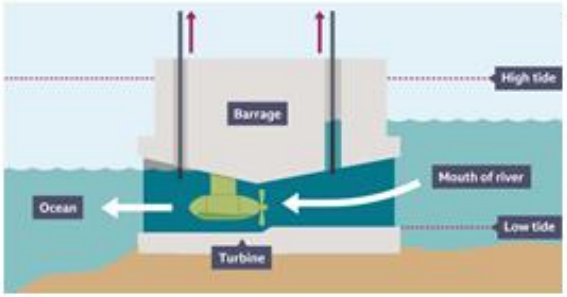
- Can't predict how much sun there will be / Unreliable
- Solar cells are still expensive
- Need a lot of solar cells to generate large amounts of energy

2) Write down three fossil fuels? (3)

- Coal
- Oil
- Natural Gas

3) Using the image to the right, discuss why tidal power could be used in the UK to produce a fifth of all power? (4)

- We live on an island – Lots of sea
- Tides are reliable – There are always tides
- The tides produce a huge amount of force
- The units don't look as ugly as wind turbines
- There is endless room in the shores around the UK



4) Evaluate the effectiveness of using battery powered electric cars in the UK? (5)

- Battery power is a lot more sustainable than using Petrol or diesel
- No fumes are produced from a battery powered car
- There are a lot more charging points around the UK now
- Car still needs to be charged which could come from burning fossil fuels
- Better for the planet if the charging came from renewable energy like solar or wind
- Batteries can now last much longer as the technology has improved

Purple pen time! Swap with a classmate!

D&T AND OUR WORLD - ENERGY GENERATION

5) Complete the grid? (4)

Renewable energy	Advantages	Disadvantages
Solar - uses sunlight to generate energy through solar cells	• Large amounts of energy available. • Relatively cheap to set up	The panels can be expensive initially, less sunlight in winter months
Wind - uses the wind to generate energy through wind turbines	Does not pollute the air	• Contributes small amount to energy needs • Expensive to set up • People don't like the look of them
Biomass - uses organic materials to generate energy through burning to create gases	A good use of waste crops	Crops need to be available, burning them can pollute the air
Water - uses falling water to generate energy through turning watermills	• Clean • Quick • Efficient at peak times	Can affect the flow of water, costly to set up initially
Geothermal - uses heat from deep underground to generate energy	• Provides power and hot water	To operate the pumps elecricity is still needed

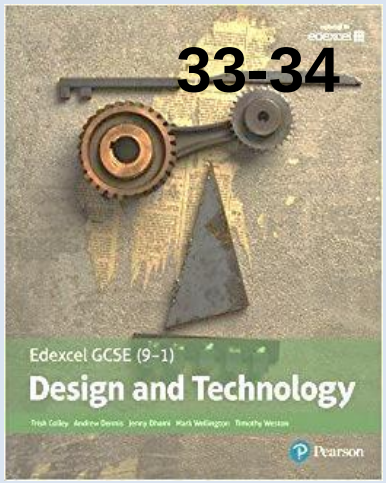
Purple pen time! Swap with a classmate!

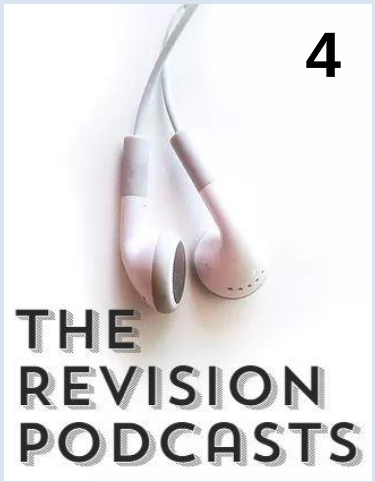
PUPPY OF THE DAY

Snuggly!

Section 4

ELECTRONIC SYSTEMS & PROGRAMMABLE COMPONENTS: CIRCUITS

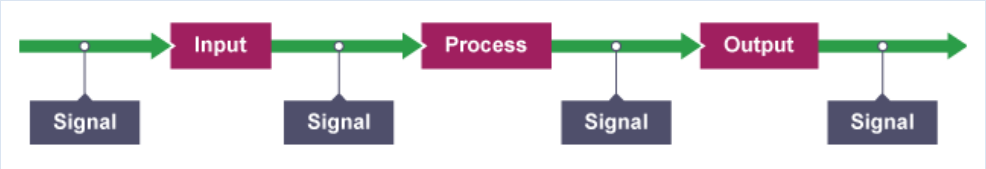




SYSTEMS

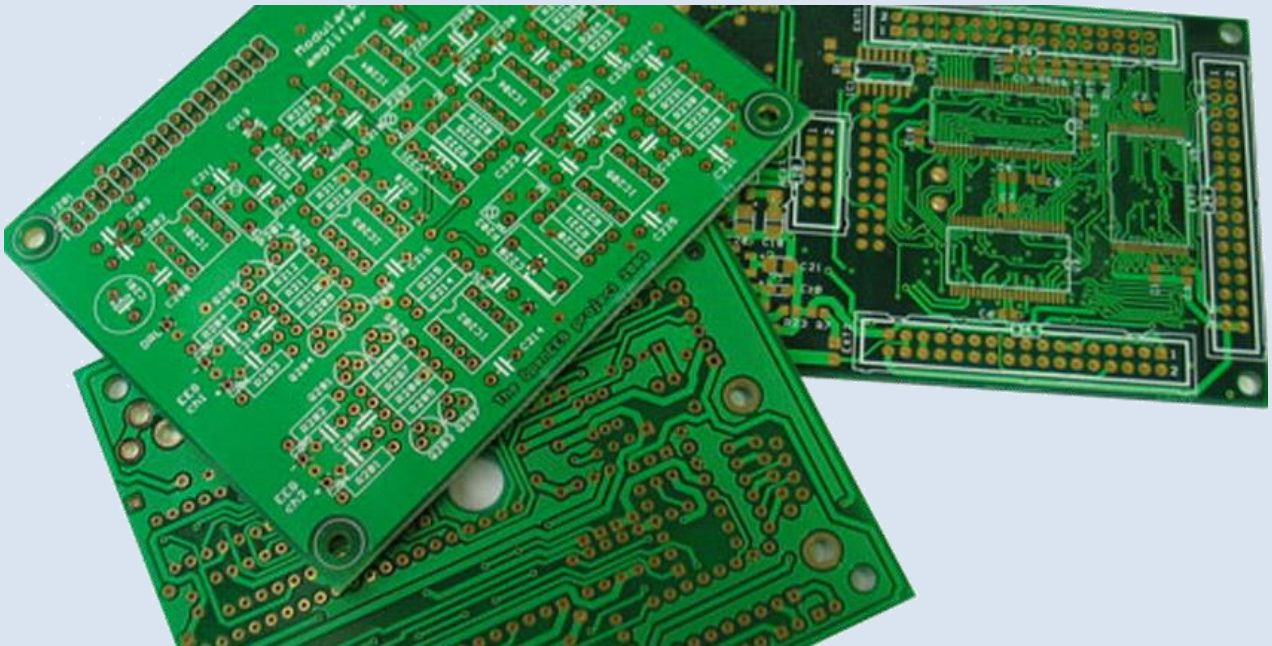
ELECTRONIC SYSTEMS

The systems approach to designing with programmable electronic devices is vital in understanding how today's electronic devices are programmed together with how they operate in the real world.



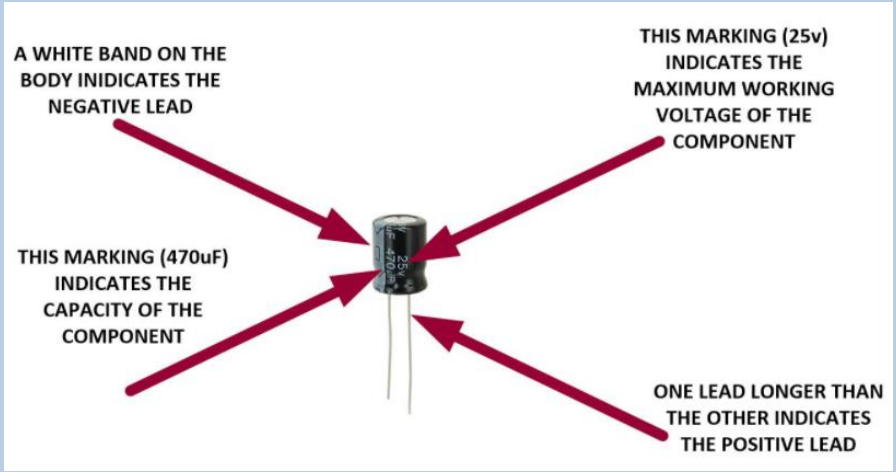
PCB / PRINTED CIRCUIT BOARDS

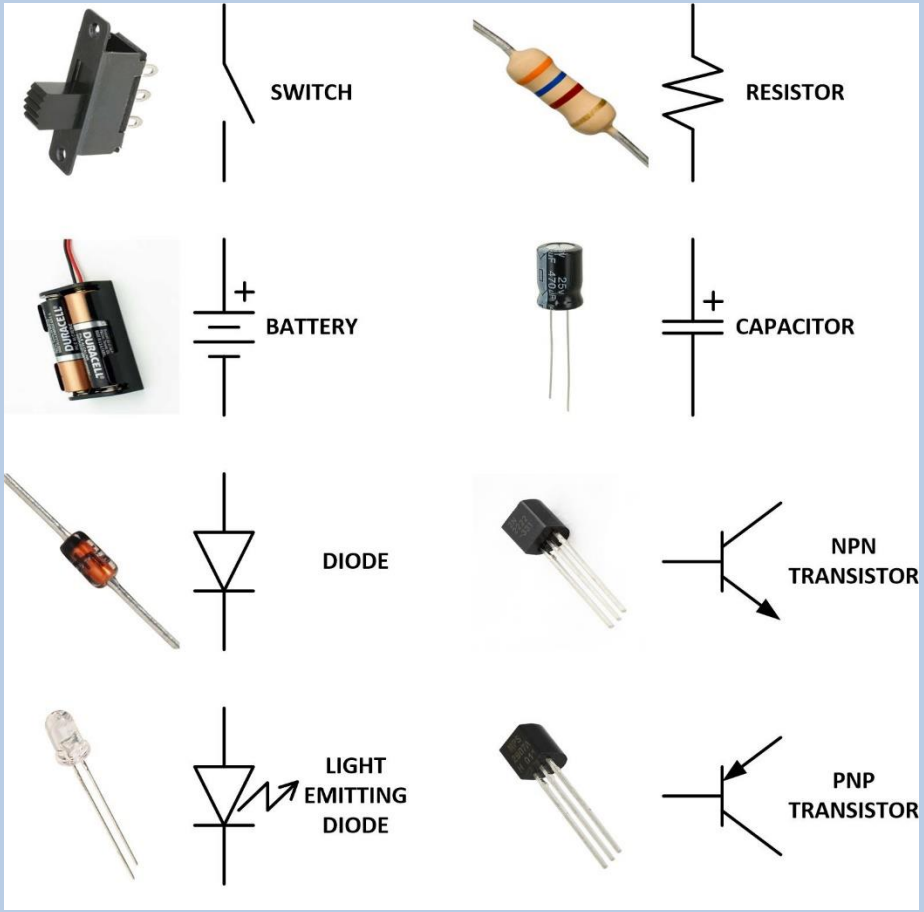
A printed circuit board mechanically supports and electrically connects electronic components or electrical components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated onto and/or between sheet layers of a non-conductive substrate.
All electronic products will have a circuit board which houses the components and the microprocessors for the products.



ELECTRONIC COMPONENTS

Electronic components are the building blocks of all electronic devices, like mobile phones and TVs. There are many different types of electronic components and they come in all shapes and sizes. Some are so tiny you have to pick them up with tweezers! We give all these little guys names like "resistors", "capacitors", "diodes" and "transistors". But there are so many variations that most have their own special codes or values too, just so we can tell them apart.

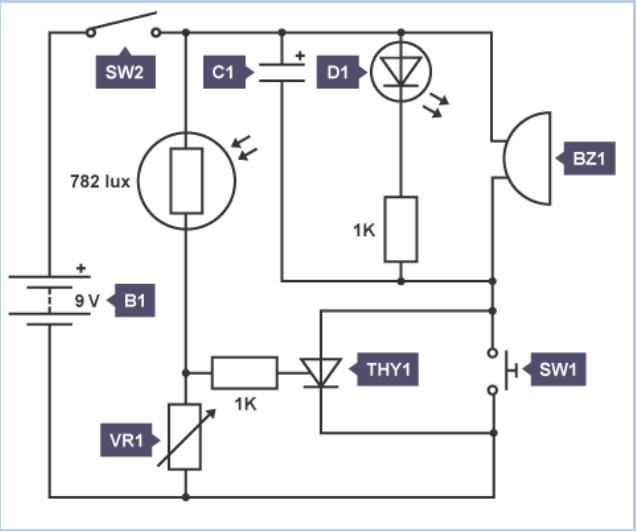




ELECTRONIC COMPONENTS

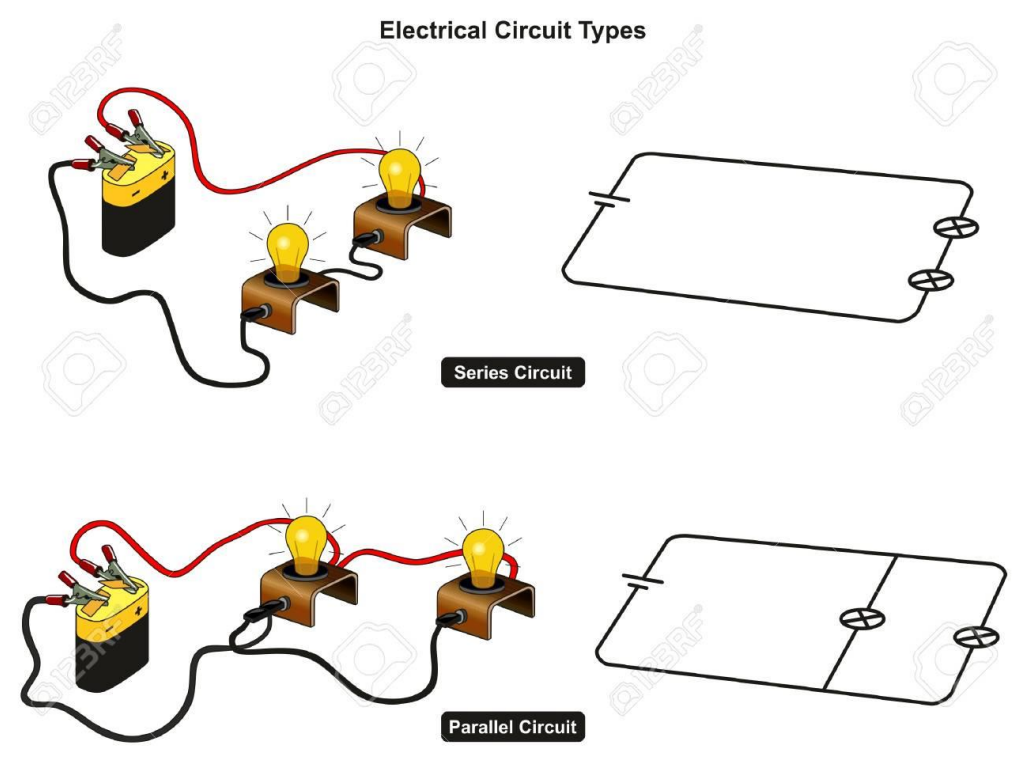
All electronic components have different symbols as seen below which can be used in circuit diagrams:

Cell	Battery	Push-to-make (PTM) switch	Push-to-break (PTB) switch	Diode	Light-emitting diode (LED)
Buzzer	Loudspeaker	Lamp	Single pole single throw (SPST) switch	Single pole double throw (SPDT) switch	Thyristor
Resistor	Variable resistor	Thermistor	Light dependent resistor (LDR)	Motor	Voltage rails



CIRCUITS

The main **difference between series** and **parallel circuits** is that, **in series circuits**, all components are connected **in series** so that they all share the same current whereas, **in parallel circuits**, components are connected **in parallel** so that they all have the same potential **difference between** them. **(The current is split up).**



INPUTS

Input devices allow systems to understand changes in the environment around them. Examples include a **sensor** such as a **light-dependent resistor (LDR)** that senses light levels for street lamps to know when it is dark, or **thermistors** that detect when it is too hot or cold in a room.

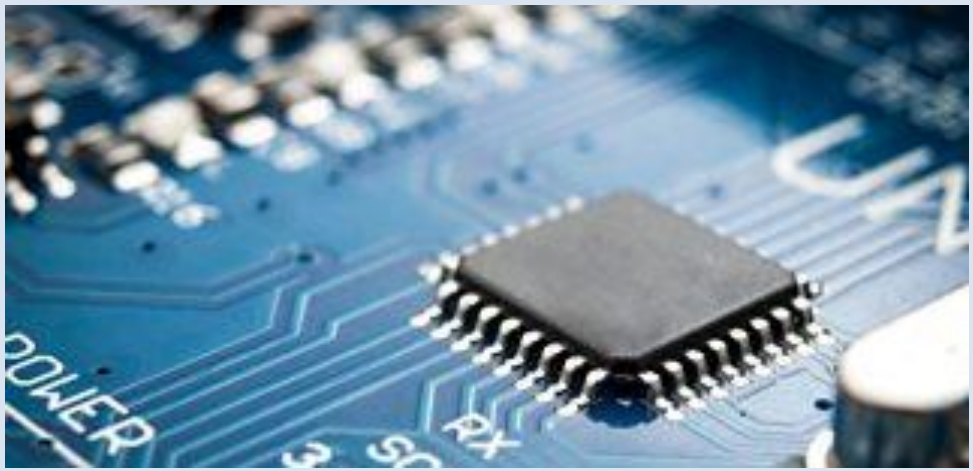
Input devices take a signal from the physical or 'real world' and turn it into an electronic signal that a process device, such as a microcontroller, can understand and act upon.

PROCESS DEVICES

Process devices take the signal from the **input** stage of a system and act on it by changing it in some way - for example, introducing a time delay, counting the number of times something happens or making decisions. **Programmable components**, such as microcontrollers, are often used for this purpose.

Integrated circuits are tiny chips that contain **resistors**, **capacitors** and **transistors**, which work together to complete the process they have been designed for, eg a timer, counter or **microcontroller**.

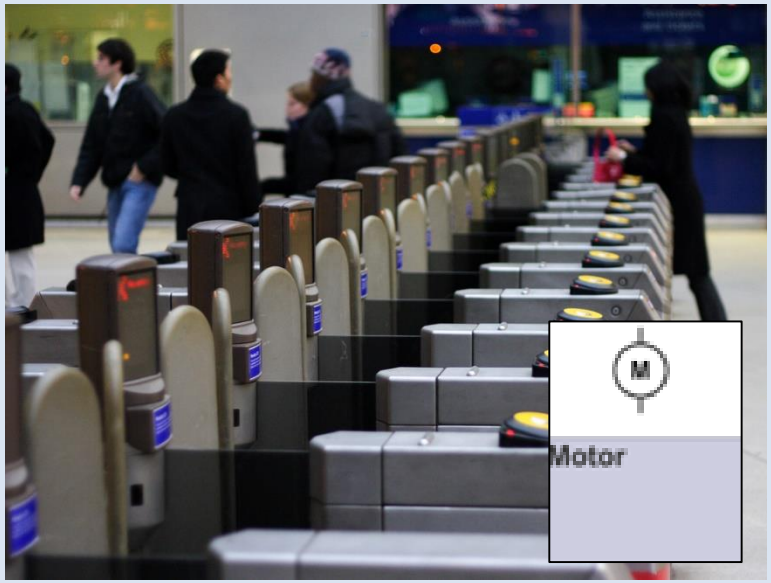
Integrated Circuit



Microprocessor – Found in computers and mobile phones

OUTPUTS

Output devices allow a system to present information back into the ‘real’ world. Examples can be seen everywhere, from car indicators to doorbell buzzers or information displays.



Output devices take the signal from the process device of a system and turn it back into a physical or ‘real-world’ signal, such as light or sound.

OUTPUTS – LED'S

Filament lamps are increasingly being replaced with energy-saving LED's.

LED bulbs also **last a lot longer** as well as take up **less electricity.** They can also be made from plastic which is less dangerous and **do not get as hot.**

They do cost more money but **save money in the long run**.

FLOWCHARTS

Flowcharts are clear diagrams showing the individual steps that will take place in the process. They can be handwritten but are commonly used electronically within software to control a system on a computer. The shapes of the boxes always show a specific purpose:

Symbol	Name	Function
	Start / End	An oval shape represents the start or end of a process
	Input / Output	A parallelogram represents input or output
	Decision	A diamond represents a decision
	Process	A rectangle represents a process
	Arrow	An arrow is a connector that shows relationships between the different shapes and what they represent

EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

ELECTRONIC SYSTEMS - CIRCUITS

1) Name an input and an output for a computer? (2)

- Typing on the keyboard / Clicking the mouse
- Monitor displaying something / Printing / Speakers

2) Name three products that will contain a PCB? (3)

Phone / Smartwatch / Computer / Printer / Laser cutter / Microwave / Washing machine / Digital watch / TV etc…

3) Looking at the flow chart details to the right, why are they commonly used to show how a system is controlled? (4)

- Universally recognised symbols
- Easy to follow
- Nice and clear
- Can be easily created using computer a program
- Can be drawn out easily

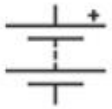
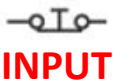
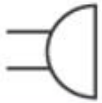
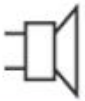
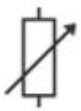
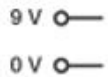
4) LED light bulbs have replaced traditional light bulbs in a lot of homes. Why is this? (5)

- They have a much longer life
- They are much more energy efficient
- They have a higher brightness
- Can come in a range of colours
- Low heat
- Plastic is a safer material than glass for some

Symbol	Name	Function
	Start / End	An oval shape represents the start or end of a process
	Input / Output	A parallelogram represents input or output
	Decision	A diamond represents a decision
	Process	A rectangle represents a process
	Arrow	An arrow is a connector that shows relationships between the different shapes and what they represent

Purple pen time! Swap with a classmate!

5) Write **INPUT** or **OUTPUT** next to the components which are an Input or an Output? (4)

		 INPUT	 INPUT		
Cell	Battery	Push-to-make (PTM) switch	Push-to-break (PTB) switch	Diode OUTPUT	Light-emitting diode (LED) OUTPUT
			 INPUT	 INPUT	
Buzzer OUTPUT	Loudspeaker OUTPUT	Lamp OUTPUT	Single pole single throw (SPST) switch	Single pole double throw (SPDT) switch	Thyristor
			 INPUT		
Resistor	Variable resistor INPUT	Thermistor INPUT	Light dependent resistor (LDR)	Motor OUTPUT	Voltage rails

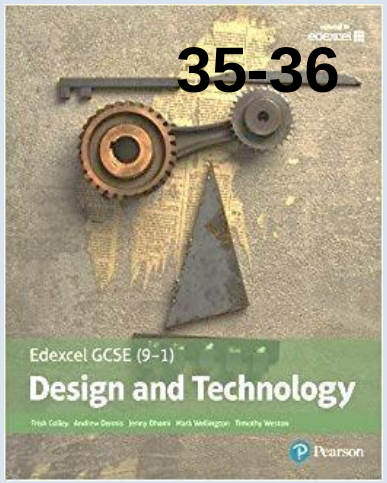
Purple pen time! Swap with a classmate!

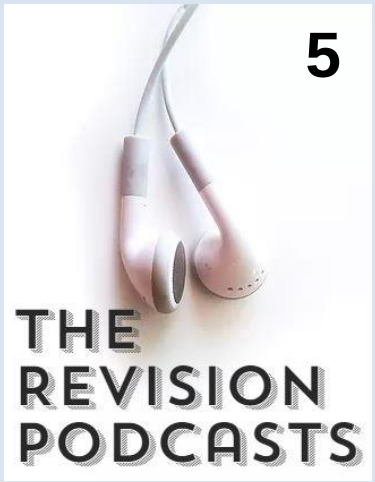
PUPPY OF THE DAY

Intense!

Section 5

ELECTRONIC SYSTEMS & PROGRAMMABLE COMPONENTS: PROGRAMMABLE COMPONENTS



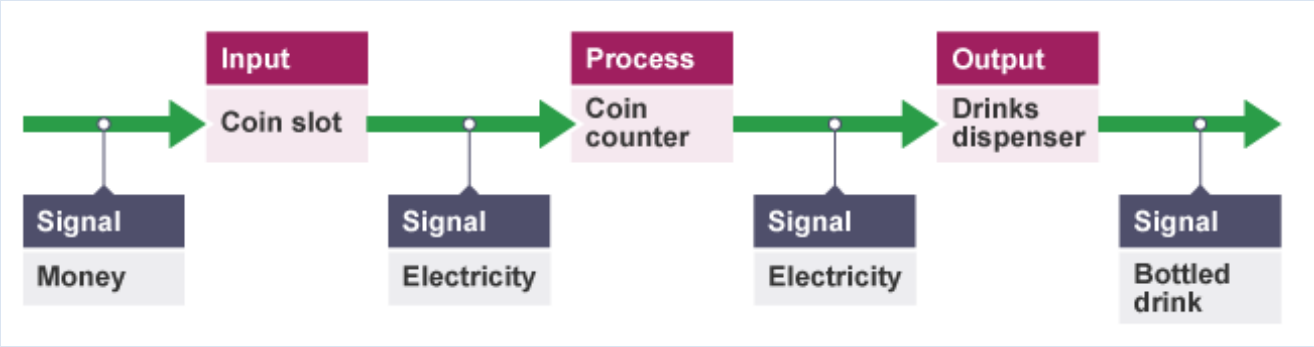


SYSTEMS

Systems are often designed using a system block diagram that considers the **‘input, process and output’** of a system:

How the system will work is the ‘process’ and the **‘input’** is the part of the system that enables the process to start happening. They work together by sending signals to each other to make something happen. There can be more than one element in each section:

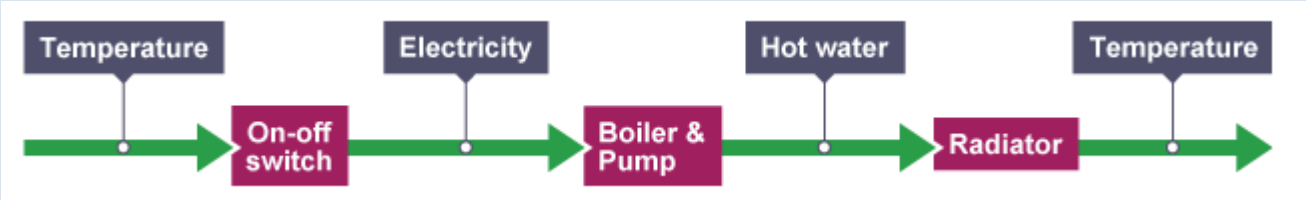
•input - starts the process
•process - the thought process in the middle
•output - the response or outcome



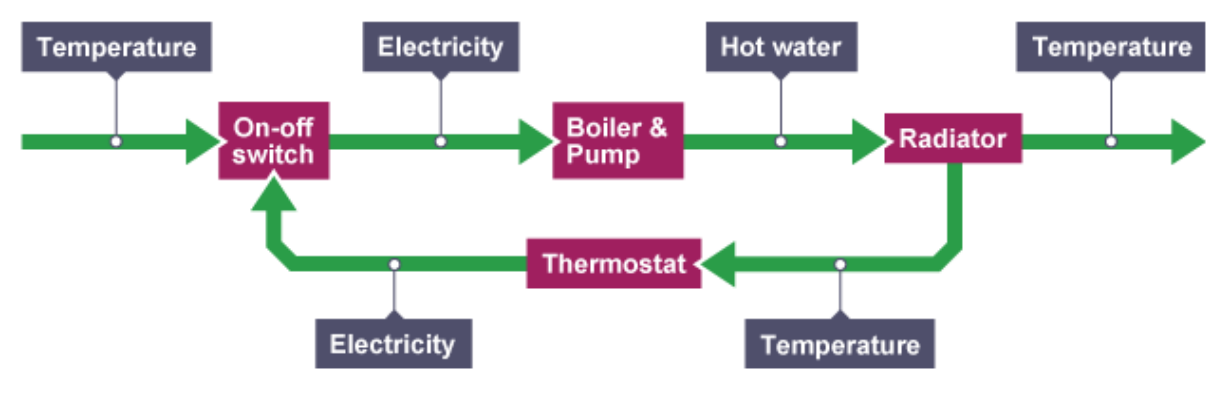
Vending Machine system diagram

OPEN / CLOSED LOOP SYSTEMS

Open loop systems are the simplest type of system. The **input** sends an electronic signal to the process, and the process signals the output to respond.



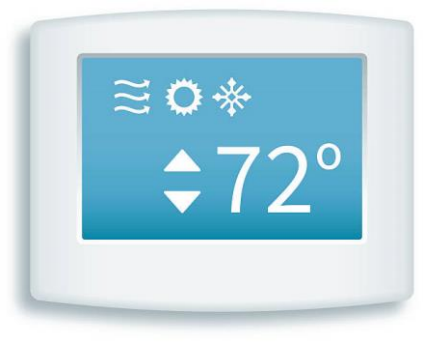
Closed loop systems have an added dimension of **feedback**, where a signal from the output is sent back to the input. The **feedback** information controls the input and provides an automated system.

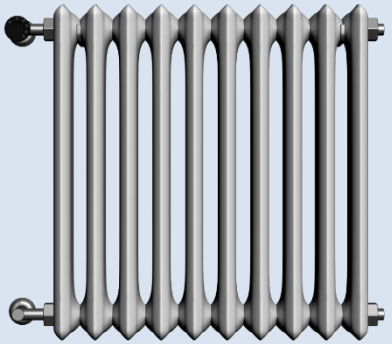


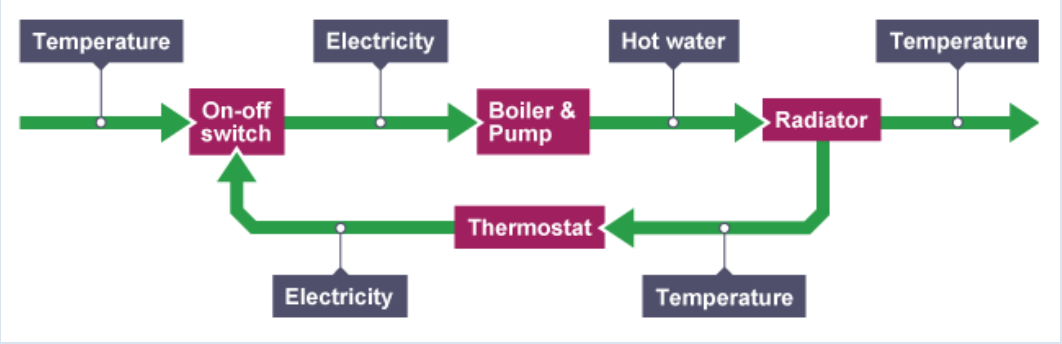
OPEN / CLOSED LOOP SYSTEMS

Simplified: The thermostat tells the boiler to turn off when a house gets to the correct temperature. This is known as feedback.

The thermostat senses what the heat is and communicates back to the boiler.

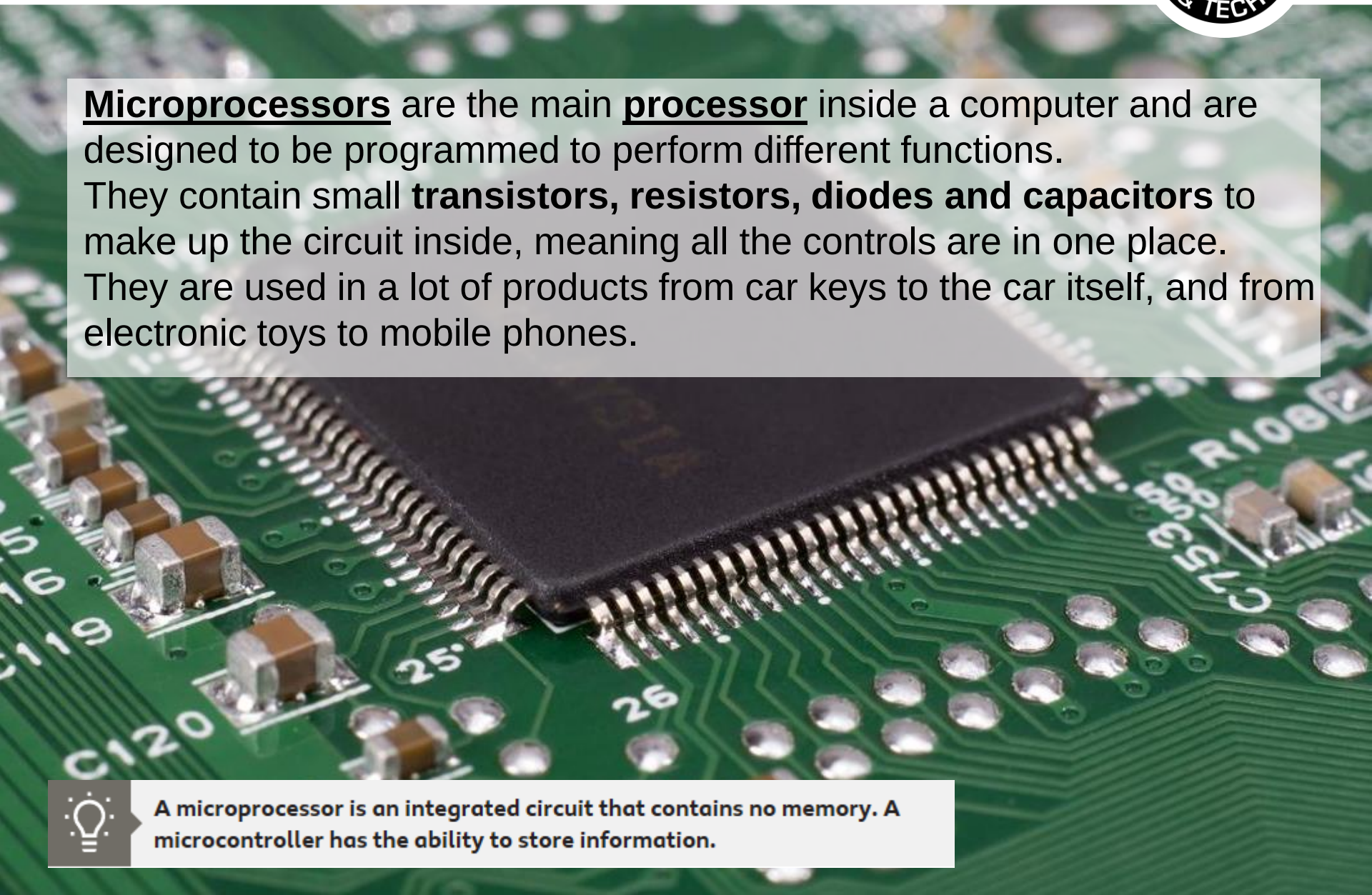






MICROPROCESSORS

Microprocessors are the main **processor** inside a computer and are designed to be programmed to perform different functions.
They contain small **transistors, resistors, diodes and capacitors** to make up the circuit inside, meaning all the controls are in one place.
They are used in a lot of products from car keys to the car itself, and from electronic toys to mobile phones.



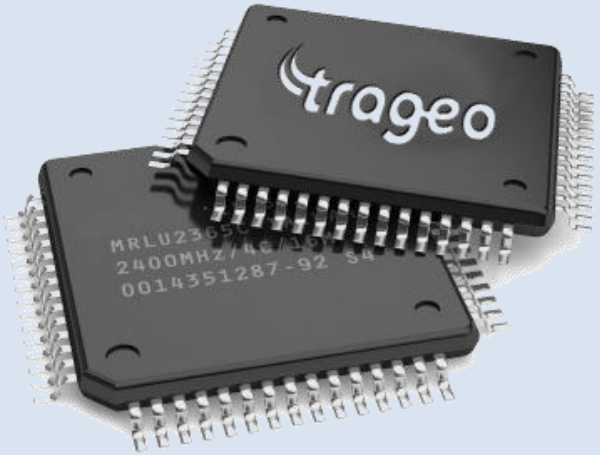
A microprocessor is an integrated circuit that contains no memory. A microcontroller has the ability to store information.

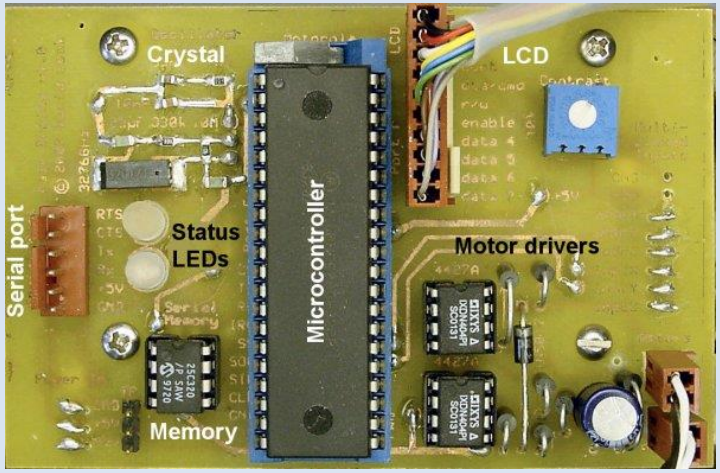
MICROCONTROLLERS

Microcontrollers provide **functionality** and give intelligence to products and systems. From mobile phones to washing machines, many everyday products are controlled by these devices.

Microcontrollers

A microcontroller is an example of a single board computer (SBC) and is manufactured as an **integrated circuit (IC)**. It can be **programmed** to perform different processing functions.





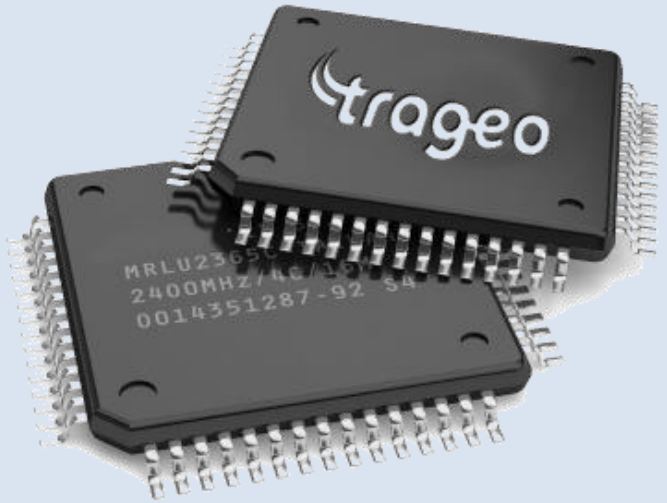
PROGRAMMING MICROCONTROLLERS

In order for **microcontrollers** to work correctly they must be **programmed**. This can be achieved using a wide range of **software**, **hardware** and different **programming languages**.

Programming methods:
Microcontrollers can be programmed using a range of different methods. These include:
text-based programming languages, such as BASIC, C++ and Python
block-based programming editors
flowchart software

How are they Programmed?

- The program needs to be written using text code or flow charts.
- The program will then be tested.
- The program will then be downloaded onto the microcontroller.
- They can be downloaded or updated in the circuit or using a USB cable or put into a downloader.



EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

ELECTRONIC SYSTEMS - CONTROL SYSTEMS / PROGRAMMABLE COMPONENTS

1) What is an open loop system? (2)

- The simplest type of system
- The input sends an electronic signal to the process.
- The process signals the output to respond.

2) Explain why feedback is an important feature when controlling a central heating system for a house? (3)

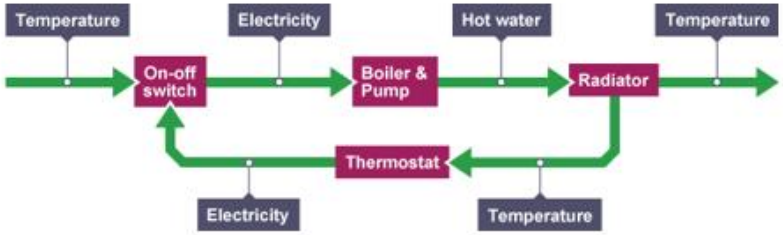
- Feedback is required so the boiler can turn on or off.
- It is important to make sure the house is kept at the right temperature.
- It is important to control the temperature to keep costs down.

3) Using the diagram to the right, what happens when Mr Mason goes out for the day and leaves his thermostat on automatic? (4)

- The thermostat should regulate the temperature.
- The thermostat will have a temperature set that it will not go below it.
- The thermostat will tell the boiler to come on and heat the house if it gets too cold.
- Once the temperature is reached, the thermostat will tell the boiler to turn off.

4) Discuss in detail how microcontrollers are programmed? (5)

- They can be programmed using a range of different software.
- They can be programmed using Text / Block Based and Flowchart software.
- The program needs to be written using text code or flow charts.
- The program will then be tested.
- The program will then be downloaded onto the microcontroller.
- They can be downloaded or updated in the circuit or using a USB cable or put into a downloader.



Purple pen time! Swap with a classmate!

5) Reading the information about Microcontrollers, why are they so vital in a new smart phone? (4)

- Programming is fantastic because it can reduce the size of the product which is perfect for a phone.
- The microcontrollers in the phone can be updated many times.
- Microcontrollers can control multiple inputs and outputs which is key for a smart phone.
- Microcontrollers are very small so many can be fitted into a smart phone and not effect size or weight.

Advantages and disadvantages of using microcontrollers

Advantages

- The size of a circuit can be significantly reduced. This is because programming replaces physical components.
- They can be reprogrammed many times. This allows changes to be made without replacing actual components.
- They have pins for connecting several input and output devices, adding to flexibility.

Disadvantages

- They often cost more than traditional integrated circuits. They are therefore not always the best option for simple systems.
- Programming software and hardware is required. This can be expensive to buy.
- The language of the system must be learned and this adds to training costs.

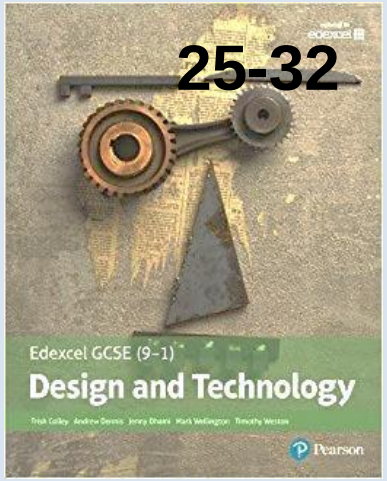
Purple pen time! Swap with a classmate!

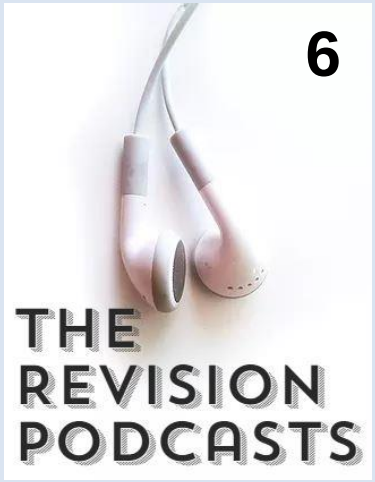
PUPPY OF THE DAY

Just taking a load off!

Section 6

MECHANISMS

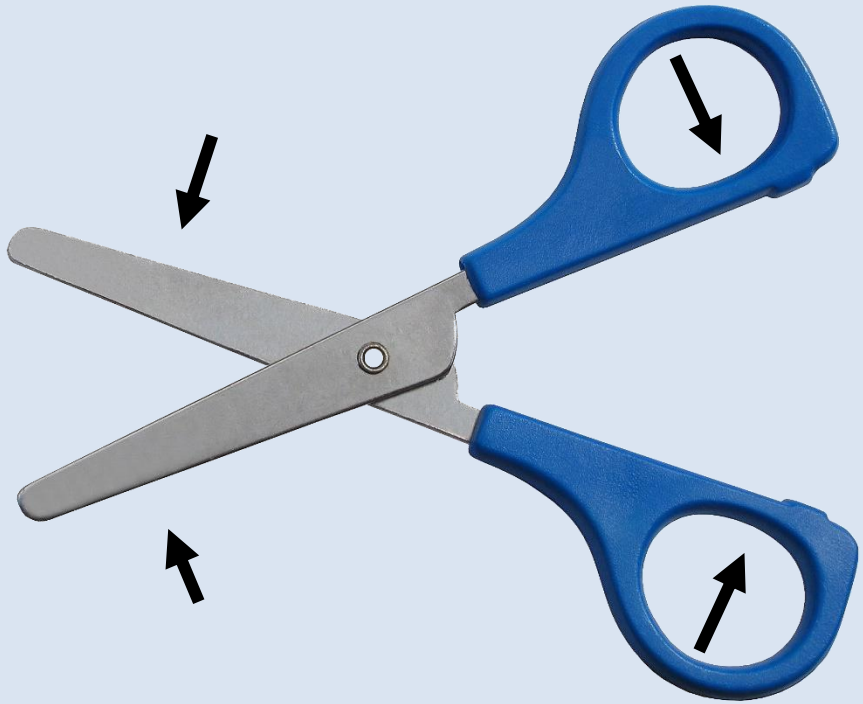




WHAT IS A MECHANISM?

Most products rely on movement to work, eg in a pair of scissors the blades need to move together to cut. This movement is called a **motion**, and the motion of a product may be hidden or visible.

For products to move and give an **output motion**, a **force** or an **input motion** is required. Squeezing the scissor handles provides the input motion, which pushes the blades together, and the output motion is the blades cutting the material.



WHAT IS A MECHANISM?

In the example of Mr Mason's Road Bike:

•Input - the force applied to the pedals by the cyclist's feet

•Process - the chain turns the gear system, converting the energy produced to cause …

•Output - the wheels turn and the bike moves

THE 4 TYPES OF MOTION: LINEAR

THE 4 TYPES OF MOTION: ROTARY

THE 4 TYPES OF MOTION: OSCILLATING

Movement that swings back and forth

THE 4 TYPES OF MOTION: RECIPROCATING

Movement that goes back and forth in a straight line

LEVERS

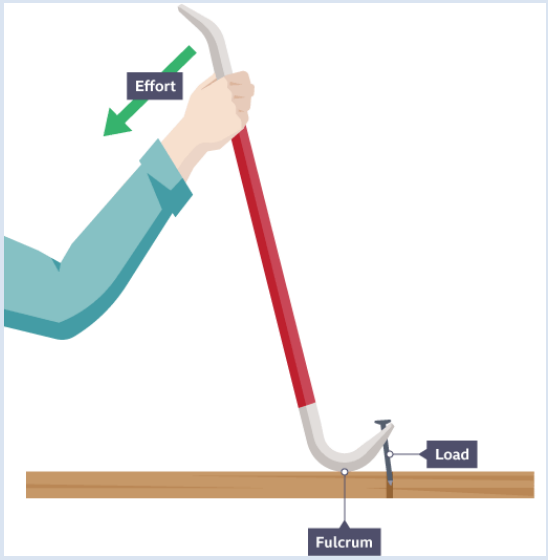
Levers use **mechanical advantage** to make lifting or applying pressure easier. All levers are made of a bar and a **pivot**, called a **fulcrum**. Levers have three main parts:

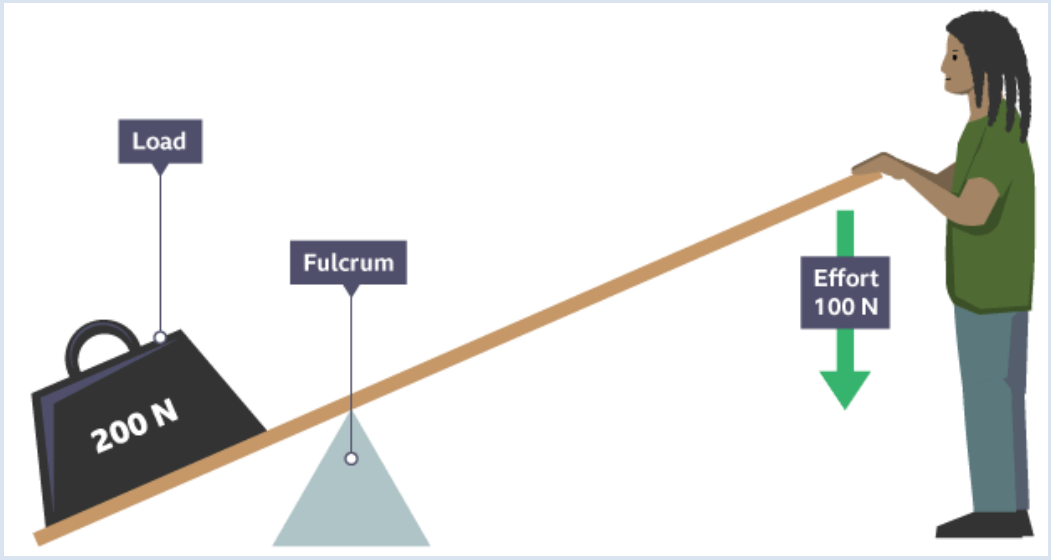
effort - the amount of force applied by the user, also referred to as the **input**

fulcrum - where the lever pivots

load - the weight that needs to be moved, also referred to as the output

Mechanical advantage is the amount of help you get using a machine in comparison to doing something with just human effort, and it is created by levers.

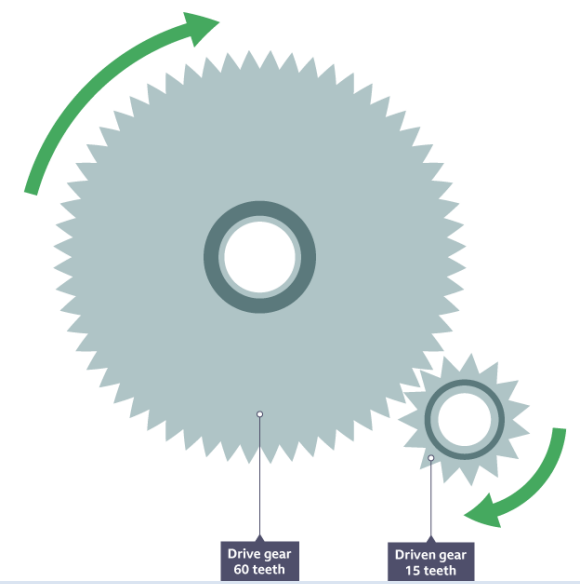




GEARS

Gears are wheels with **<u>teeth</u>** around the outside, the simplest form of which is a spur gear. When several wheels are interlocked, they can transfer motion from one place to another, eg in some hand whisks or on bikes.

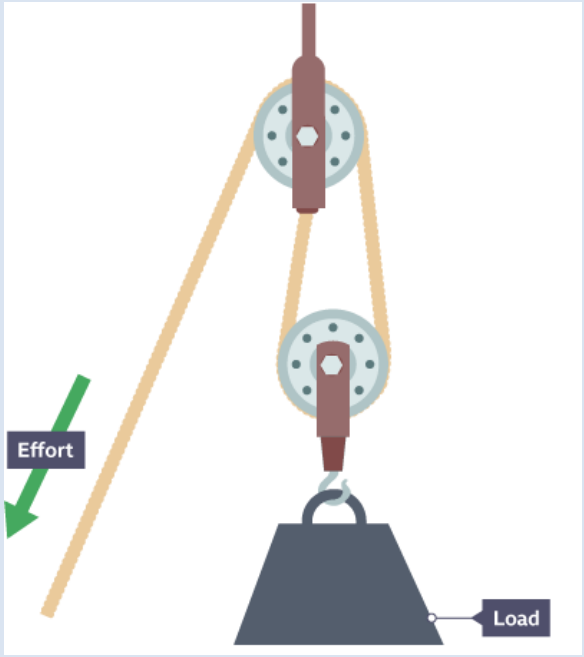
Gears can change the direction or the speed of movement. As there are teeth around the edge of the gears they grip together and so can withstand a greater force, enabling them to move large items such as cars or bicycles.

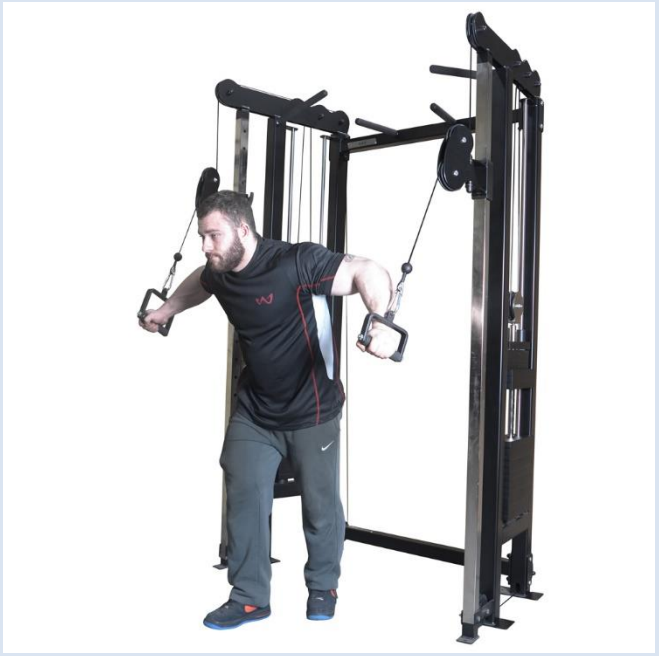


PULLEYS

Pulleys use **mechanical advantage**, similar to levers, to lift up loads. Pulleys are wheel shaped with a groove that allows a cord to sit inside the groove. They can be used by hand or attached to a motorised **winch** to increase the amount of weight that can be lifted.

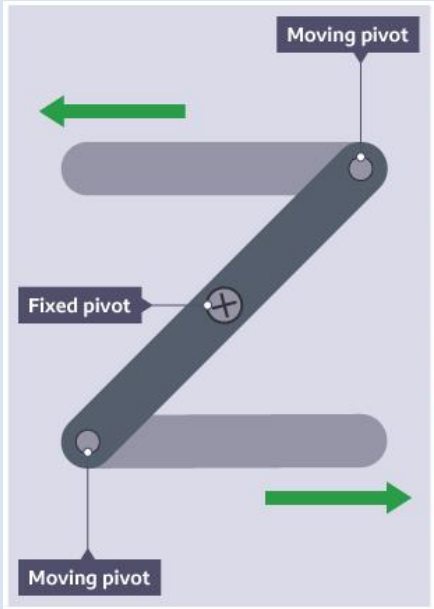
Pulleys are a simple and manoeuvrable way to move large objects. They are easy to transport to where they are needed and set up, but they do require somewhere stable to hang.

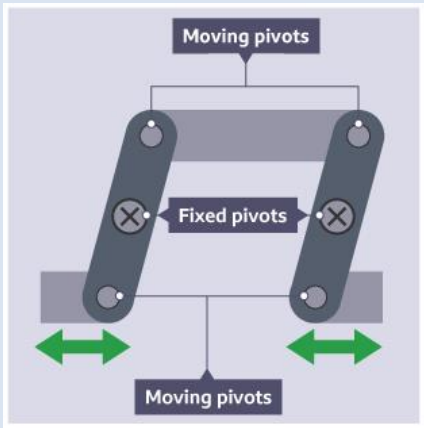


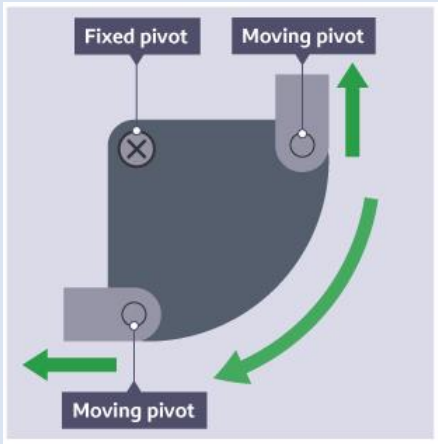


OTHER MECHANICAL SYSTEMS - LINKAGES

Levers can be joined together to form **linkages**. Simple linkages change the direction of motion and the amount of force.

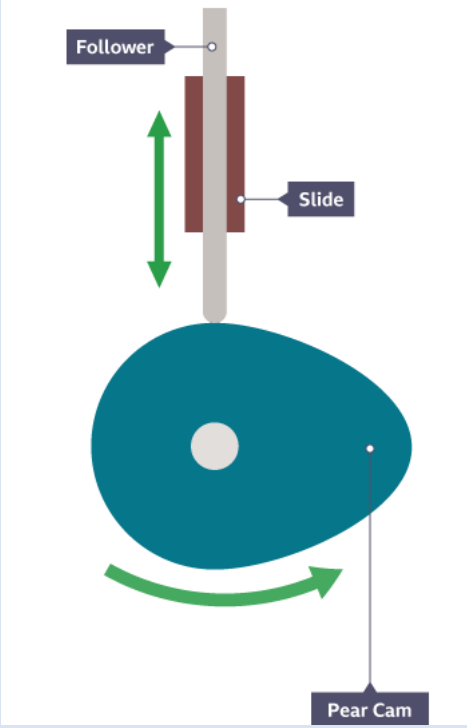


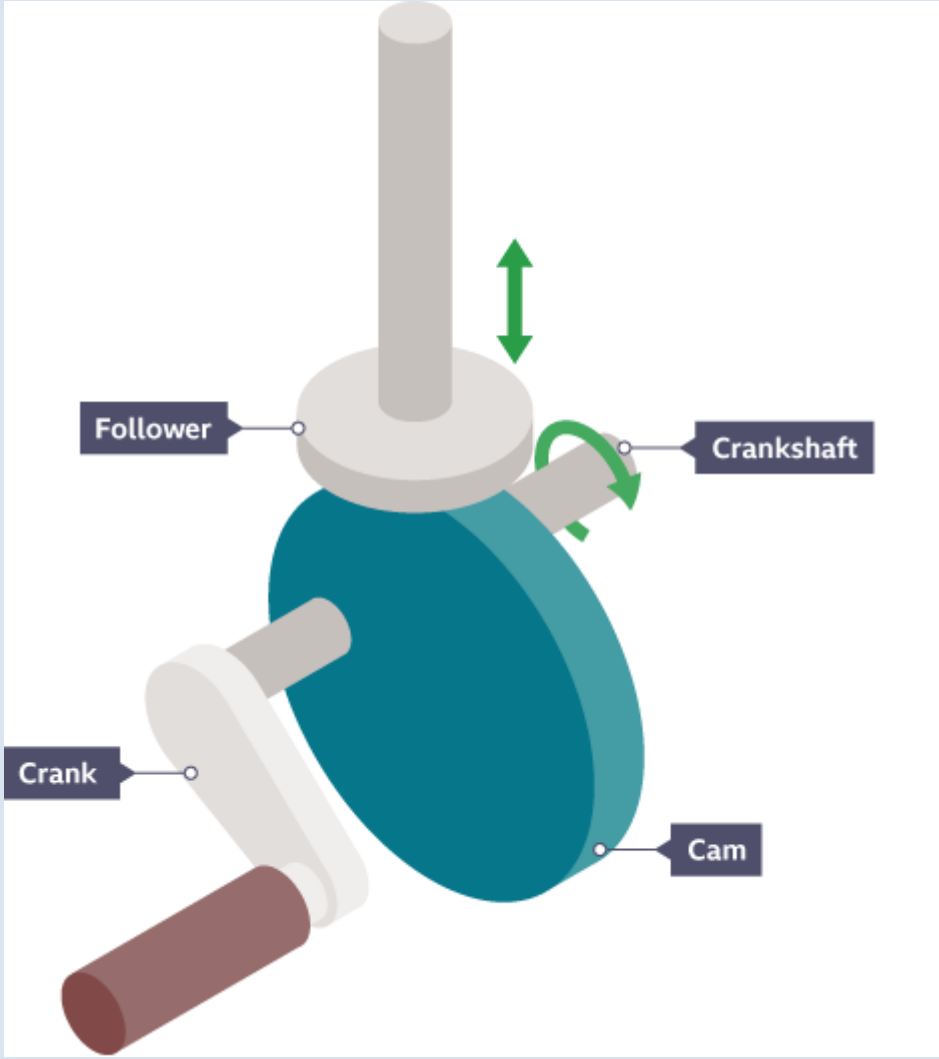




OTHER MECHANICAL SYSTEMS – CAMS

A **cam mechanism** has two main parts:
- A **cam** - attached to a **crankshaft**, which rotates
- A **follower** - touches the cam and follows the shape, moving up and down



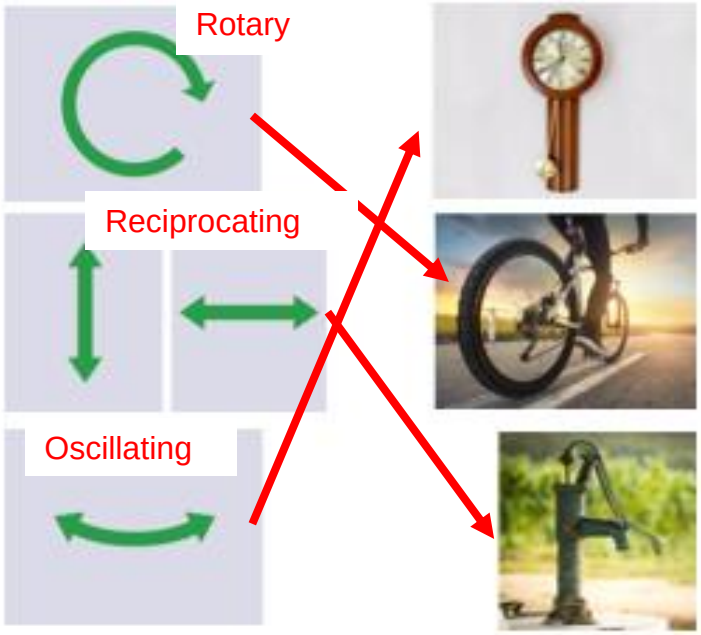


EXAM PRACTICE TIME!

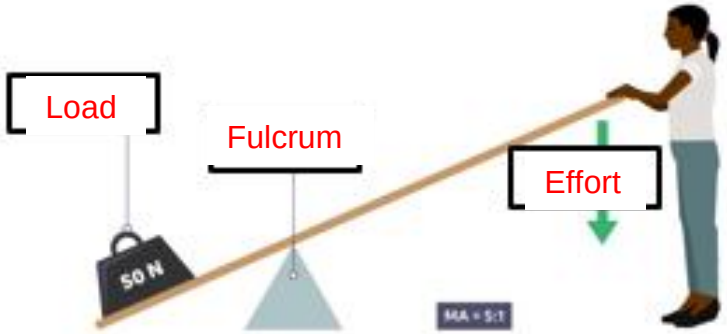
20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

MECHANISMS - PRINCIPLES OF MECHANICAL DEVICES

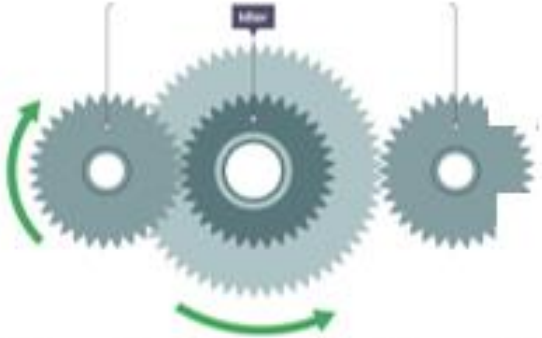
1) Match the correct motion with the image and name it: (3)



2) Label the diagram with **LOAD, FULCRUM** and **EFFORT:** (3)



3) Which way will the gear on the far right turn? (1) Clockwise



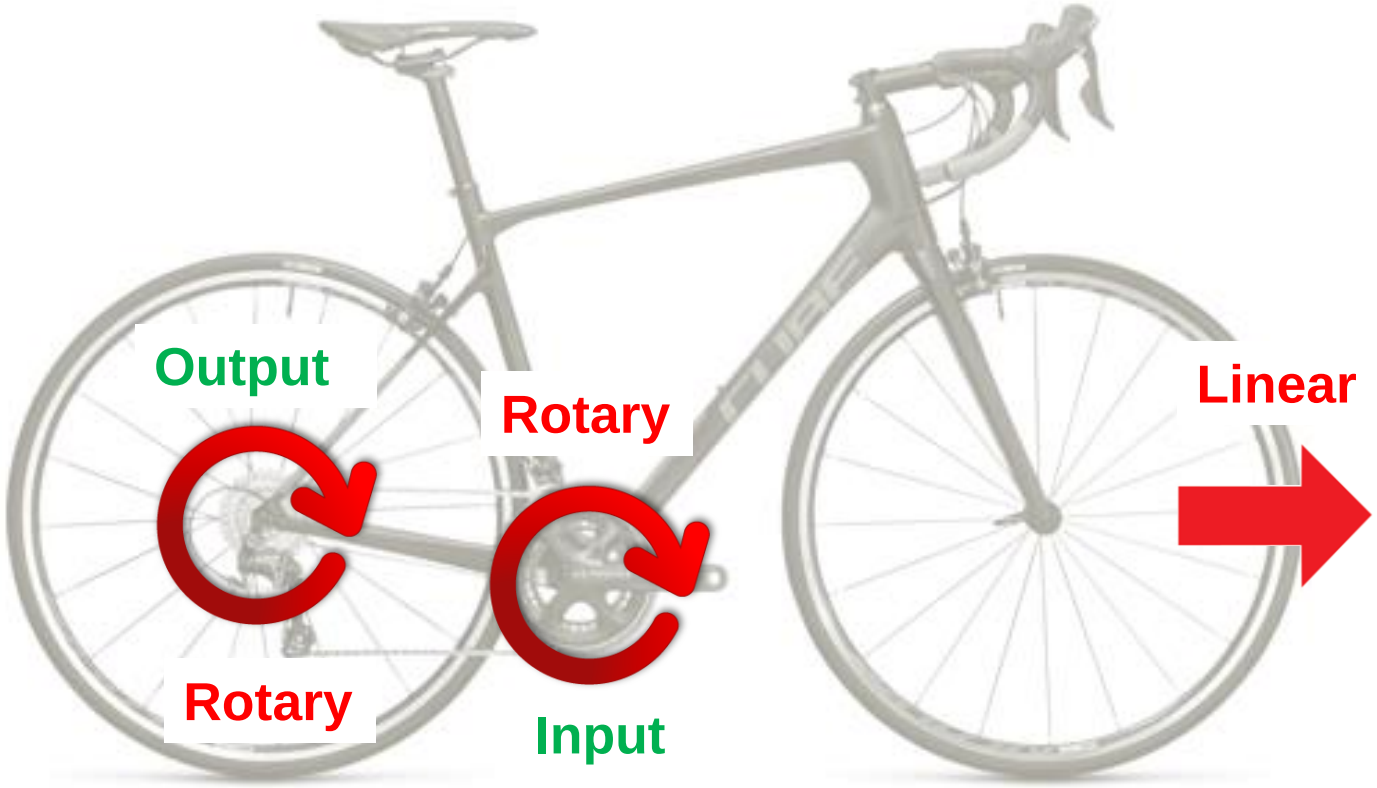
4) Discuss the benefits of using a pulley to move this heavy load (2)

- The use of a pulley increases the mechanical advantage making the load much easier to move.
- Depending on the pulley system, the load could be moved by anyone.

Purple pen time! Swap with a classmate!

5) Add annotation and arrows to the road bike labelling the different motions and the names of the types of motion shown (4)

Bonus Points:



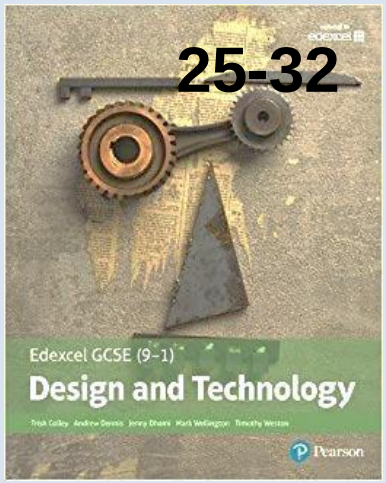
Purple pen time! Swap with a classmate!

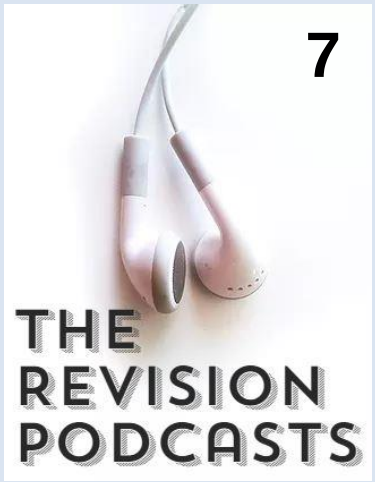
PUPPY OF THE DAY

Who you looking at!

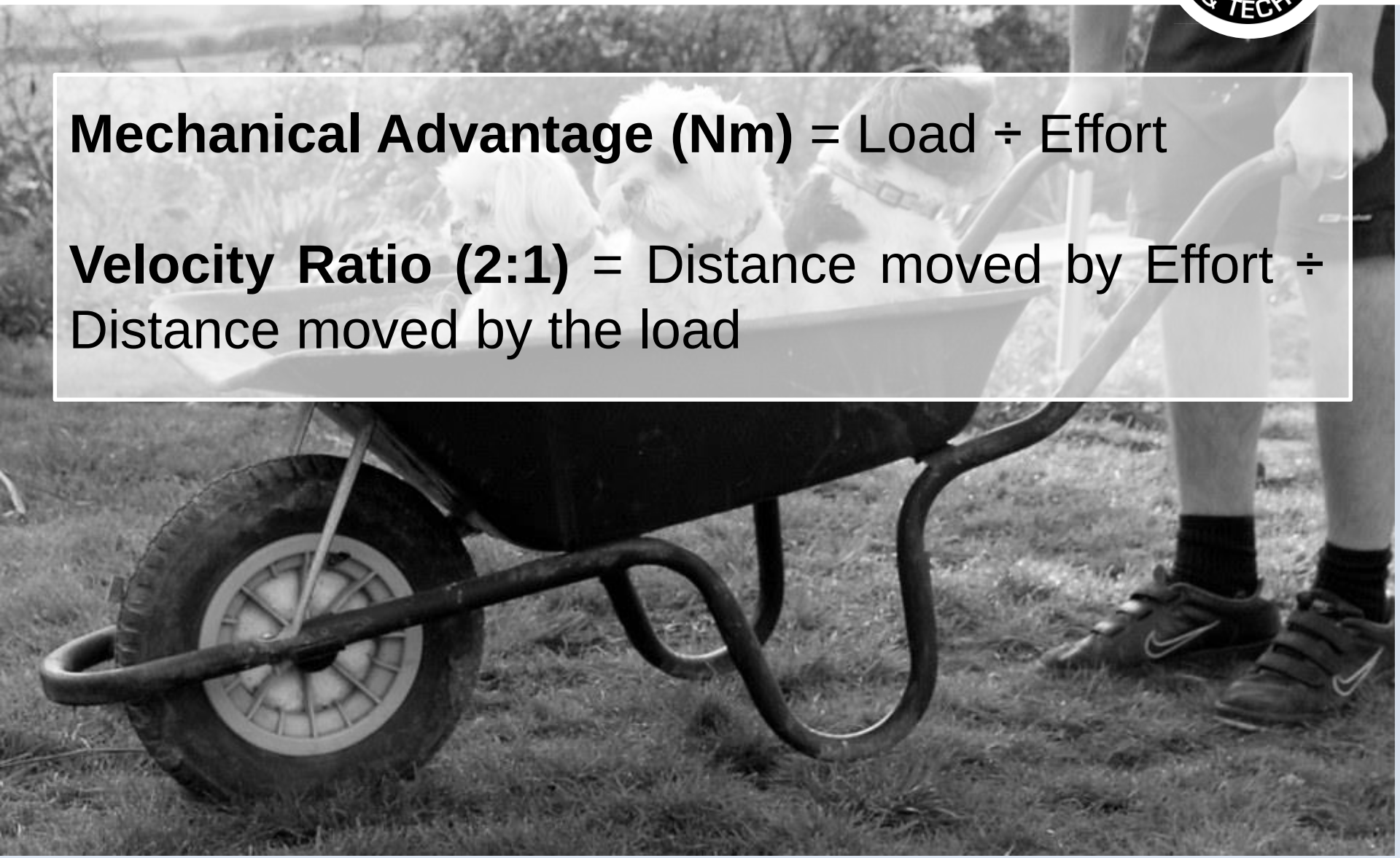
Section 7

CALCULATIONS FOR MECHANISMS





LEVERS



Mechanical Advantage (Nm) = Load ÷ Effort

Velocity Ratio (2:1) = Distance moved by Effort ÷ Distance moved by the load

GEARS

(The larger gear always equals 1)

Gear Ratio (2:1) Calculating the smaller gear = Number of teeth on the larger gear ÷ Number of teeth on the smaller gear

Output speed (RPM) = Input speed ÷ gear ratio

PULLEYS

Velocity Ratio (2:1) = Diameter of the driven pulley ÷ diameter of the driver pulley

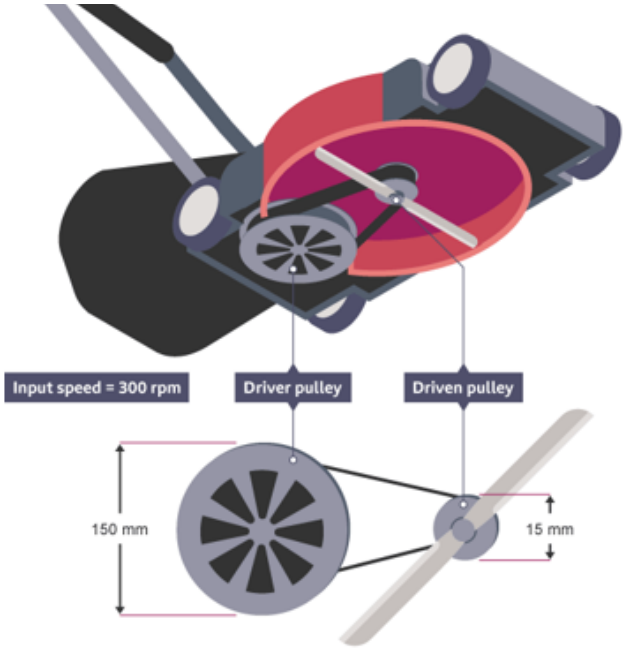
Output speed (RPM) = Input speed ÷ velocity ratio

EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

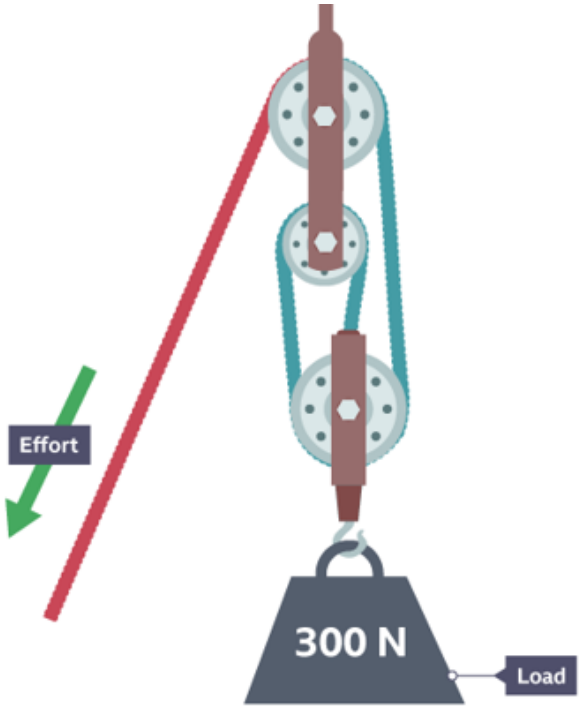
1) Calculate the velocity ratio and the output speed of the driven pulley on this lawnmower: (5)

Velocity ratio = diameter of the driven pulley ÷ diameter of the driver pulley
= 15 ÷ 150 = **0.1** or **1:10**
The smaller driver pulley turns ten times for every one turn of the driven pulley.
Output speed = input speed ÷ velocity ratio
= 300 ÷ 0.1 = **3,000 rpm**



2) The pulley system below features 300N of load and 3 pulleys. What weight is needed to pull the load? (Mechanical Advantage) (2)

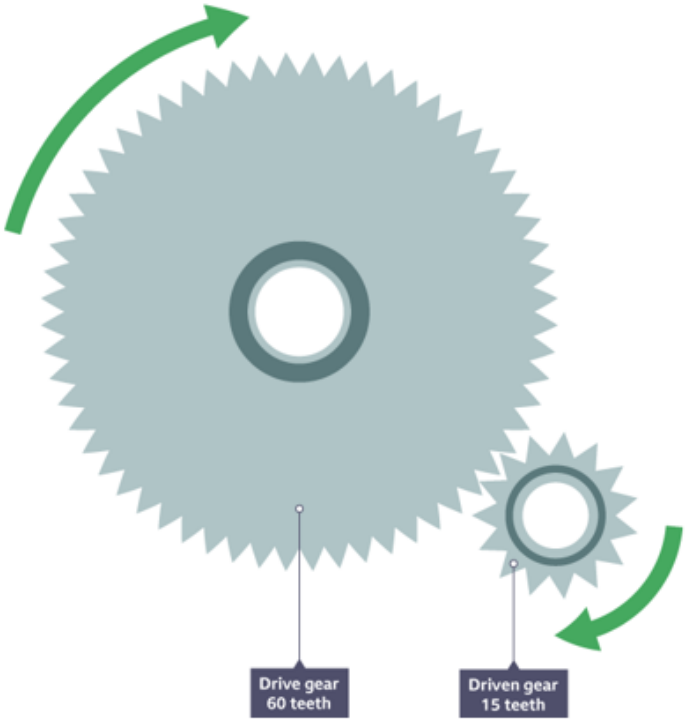
There are three pulleys therefore:
Weight = 300 ÷ 3
= **100 N**



Purple pen time! Swap with a classmate!

3) Calculate the gear ratio of this gear train: (2)

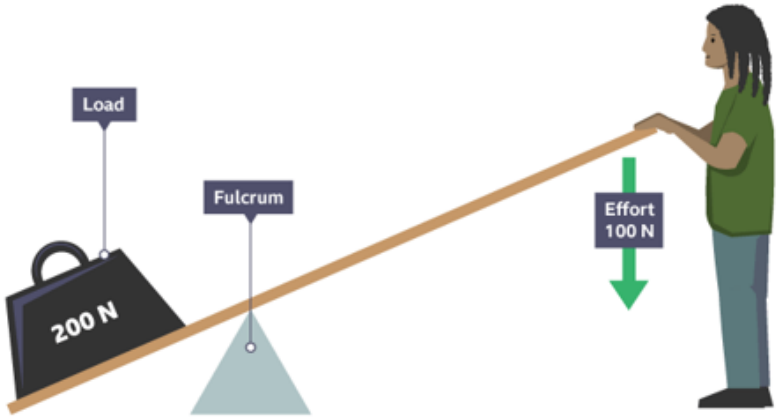
Firstly, the larger gear is always 1 (1:).
The larger gear has 60 teeth and the smaller gear has 15 so:
60 ÷ 15 = 4 for the smaller gear
Gear ratio = 1:4



4) What is the mechanical advantage of this lever? (2)

A person lifting a load of 200 N but only using 100 N of effort:

Therefore, the mechanical advantage = 200 ÷ 100 = **2Nm**



5) What type of lever is this? (1)

1st Order / Class 1

6) Name a class 1 lever: (1)

See Saw / Crowbar

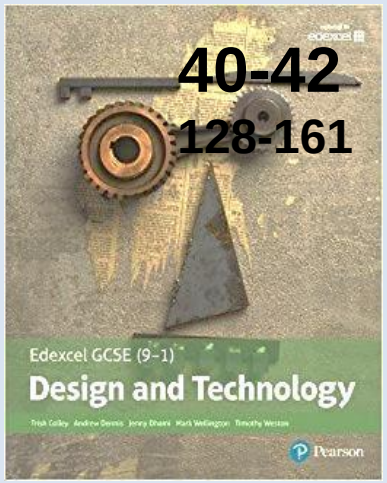
Purple pen time! Swap with a classmate!

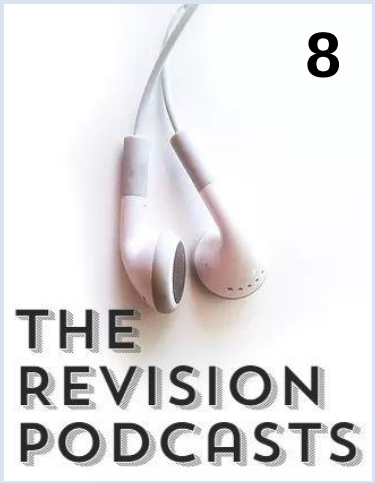
PUPPY OF THE DAY

What am i ?!

Section 8

PAPERS AND BOARDS





PAPERS AND BOARDS

HOW PAPER IS MADE

1) Tress are cut down and chipped into tiny pieces
2) The pieces are mixed with water and “Cooked” into a paste
3) The paste is bleached and chemicals added to give more strength
4) The paste is flattened and the water squeezed out
5) The flattened paste is dried out and becomes paper!

PAPERS

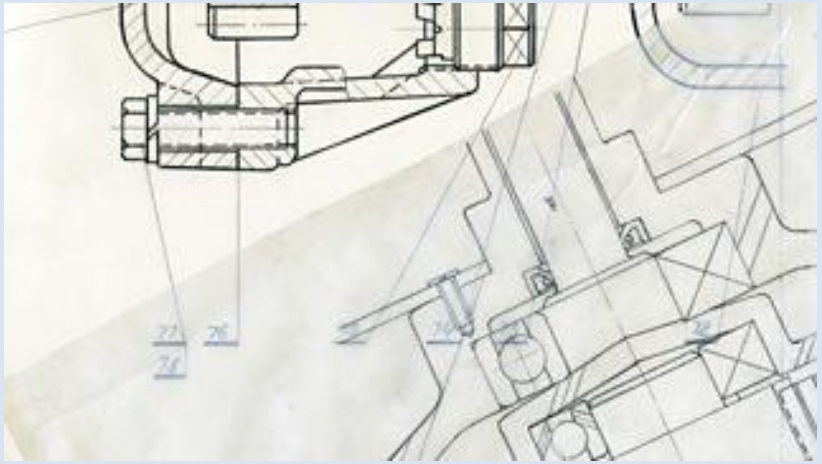
Papers are made from **wood pulp**. Their **density** is measured by their weight, in grams per square metre (gsm). The lower the gsm, the thinner the paper will be.

Paper	Properties	Uses
Tracing paper (40-90 gsm)	Thin, translucent (see-through), smooth and strong, doesn't absorb ink easily and drying times are longer	For copying drawings, sketches and intricate details
Layout paper (50 gsm)	Smooth finish, translucent (see-through), cheap to buy	For sketching and developing design ideas
Copier paper (80 gsm)	Smooth surface, bright white (bleached) to show print clearly, uncoated surface, takes colour well, cheap and readily available	For printing and photocopying
Cartridge paper (80-140 gsm)	Thick, textured surface, usually creamy, off-white colour, heavier weight than copier paper	For all colour mediums, including ink and watercolour, crayons and pastels

PAPERS

Paper	Properties	Uses
Tracing paper (40-90 gsm)	Thin, translucent (see-through), smooth and strong, doesn't absorb ink easily and drying times are longer	For copying drawings, sketches and intricate details
Layout paper (50 gsm)	Smooth finish, translucent (see-through), cheap to buy	For sketching and developing design ideas
Copier paper (80 gsm)	Smooth surface, bright white (bleached) to show print clearly, uncoated surface, takes colour well, cheap and readily available	For printing and photocopying
Cartridge paper (80-140 gsm)	Thick, textured surface, usually creamy, off-white colour, heavier weight than copier paper	For all colour mediums, including ink and watercolour, crayons and pastels

Tracing paper is perfect for an Architect drawing over plans because it is the most Translucent paper so the design can be seen underneath. It is also stronger than layout paper!



BOARDS

Board is categorised by weight as well as thickness; the weight is measured, like paper, in grams per square metre (gsm) and the thickness is measured in microns. One micron is 1/1,000th of a mm.

Board	Properties	Uses
Corrugated card (3,000+ microns)	Strong but lightweight, made from two layers with at least two or more fluted (crimped) sheets between, available in different thicknesses, not water resistant, can be recycled	Corrugations make it strong, protective and insulating; used in packaging
Mounting board (1,400 microns)	Rigid with smooth surface, available in a range of colours (commonly black and white)	Picture framing mounts, production of architectural models, to support concept designs for presentations
Folding boxboard (300-1,600+ microns)	Often made from recycled paper, isn't very thick but has good stiffness, can be easily recycled, scores well and bends without splitting	Packaging - particularly associated with packaging of goods found in a supermarket, eg frozen food boxes or cereal packets

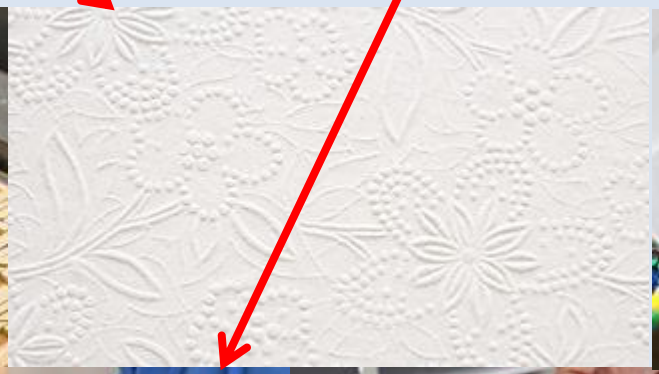
BOARDS

Board	Properties	Uses
Corrugated card (3,000+ microns)	Strong but lightweight, made from two layers with at least two or more fluted (crimped) sheets between, available in different thicknesses, not water resistant, can be recycled	Corrugations make it strong, protective and insulating; used in packaging

- The material is strong but lightweight (Good strength to weight ratio.
- Perfect for protecting whatever product is inside due to it having at least two layers.
- A good insulating material for whatever is inside.
- Relatively cheap when bought in bulk.
- Available in a range of different thicknesses.
- Can be recycled.

FINISHING PAPER AND BOARD

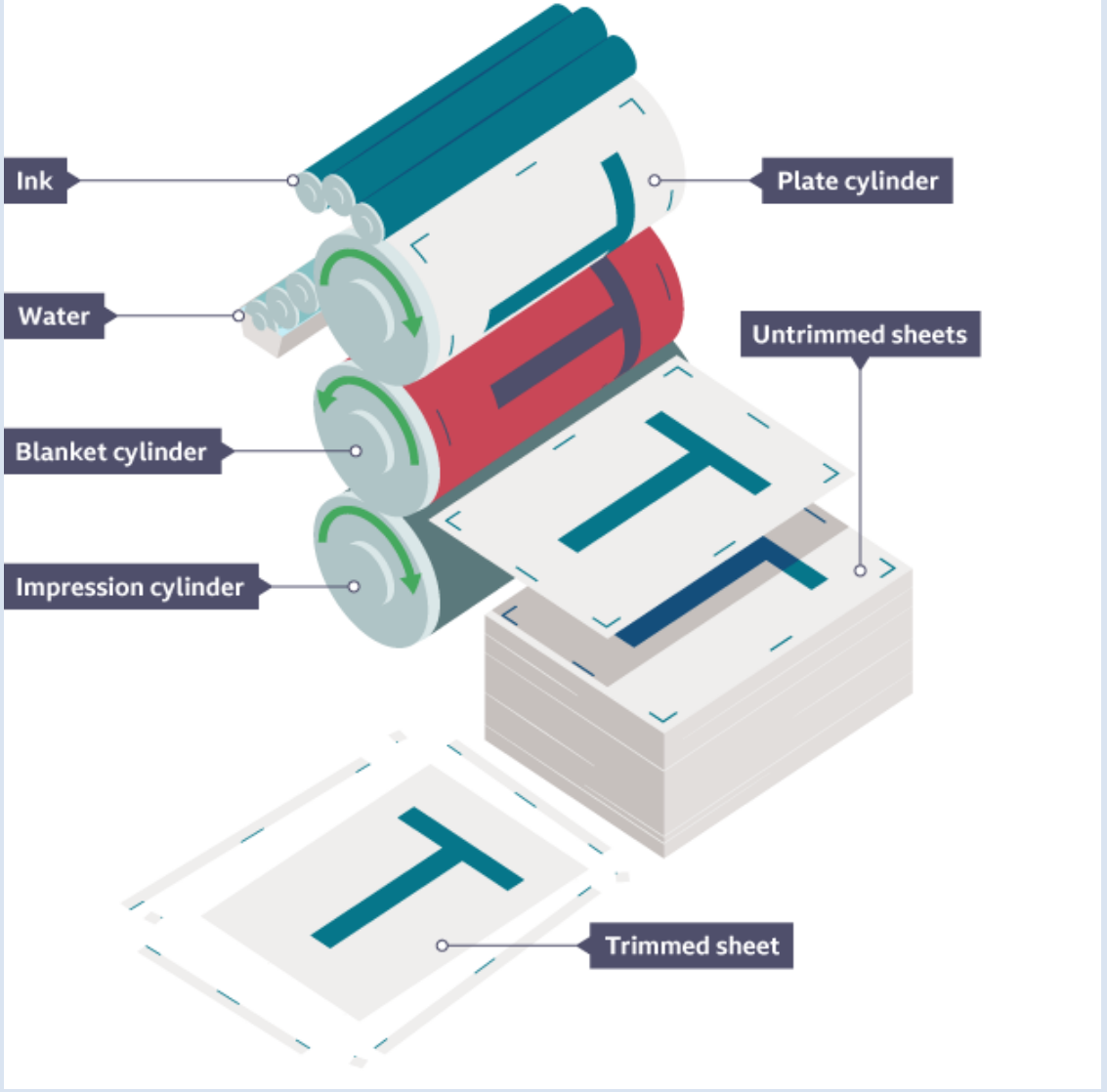
This is the final part after the product has been printed. It is given a finish such as **die cutting**, **embossing**, **foil stamping**, **laminating** and **binding**. The post-press process gives the product its final look.



PRINTING

The process of lithograph printing works by transferring (offset) an inked image from a plate to a rubber blanket, also known as a blanket cylinder, to the printed surface (paper or card).

Advantages of offset lithography
Print on many types of different papers
High image quality and clean images
Once set up it is a very fast process
Plates can print thousands of prints
Cost-effective, cheap plates
Quick to set up



EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

MATERIALS - PAPERS AND BOARDS

1) Which type of board is best for insulation? (2)

- Corrugated Card
- It is made from at least two layers with “Crimped” sheets
- Can get it very thick

2) Explain which type of paper you would use as an architect who wants to copy over existing plans: (3)

- Tracing paper
- It is the most Translucent paper so the design can be seen underneath
- It is also stronger than layout paper

3) Explain why printability might affect the quality of a finished product? (4)

- Printability is how easy a paper or board is to print onto.
- Smoothness would affect this / Ink could run.
- How well the paper or board absorbs the ink.
- How clean the surface is / Could be greasy.
- The thickness could affect it.
- The weight could affect it.

4) Amazon use corrugated cardboard for a lot of their packaging. Discuss why they use this material? (5)

- The material is strong but lightweight (Good strength to weight ratio.
- Perfect for protecting whatever product is inside due to it having at least two layers.
- A good insulating material for whatever is inside.
- Relatively cheap when bought in bulk.
- Available in a range of different thicknesses.
- Can be recycled.

Purple pen time! Swap with a classmate!

MATERIALS - PAPERS AND BOARDS

5) Evaluate this product in terms of its environmental impact? (2)

- The box is made of fully recyclable materials which is good for the environment as it is produced in large quantities.
- As a 'use once' product, the packaging is less environmentally friendly than a re-usable version.
- Using plastic is still not “ideal”.
- A light product so transportation costs are low.

6) Evaluate this product in terms of two safety considerations: (4)

- The small plastic cartons need to be fully sealed to ensure they don’t get contaminated. This is very important when making packaging which holds food.

- The packaging must be quality control checked during manufacture to make sure there are no sharp edges or risk of paper cut form the cardboard.

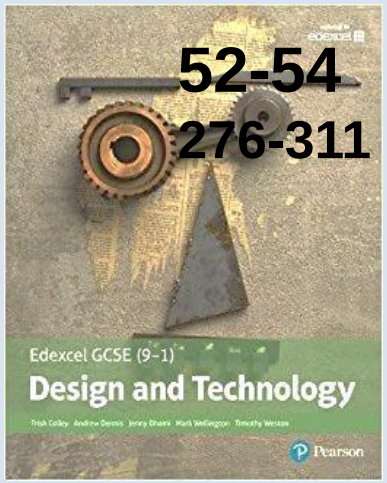
Purple pen time! Swap with a classmate!

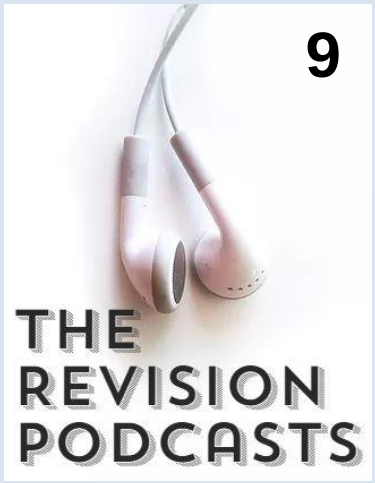
PUPPY OF THE DAY

I wonder what I'll be when I grow up?

Section 9

NATURAL AND MANUFACTURED TIMBER

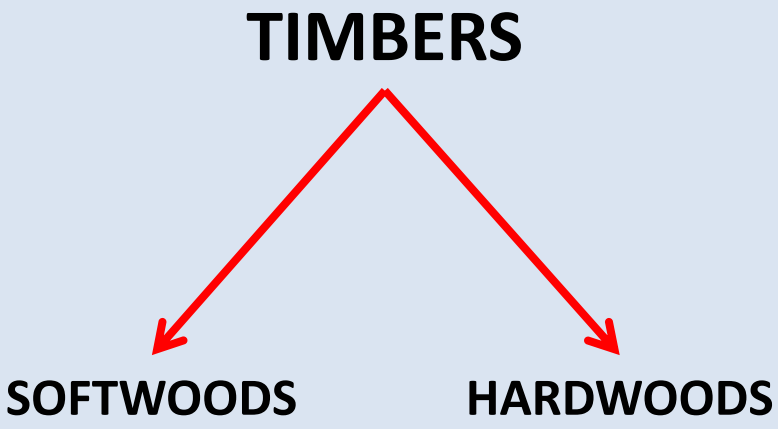




NATURAL & MANUFACTURED TIMBERS

TIMBERS AND MANUFACTURED BOARD

There are Timbers and there are Manufactured Boards. Timbers are natural (Trees) and Manufactured boards and Human-Made.



MANUFACTURED BOARDS

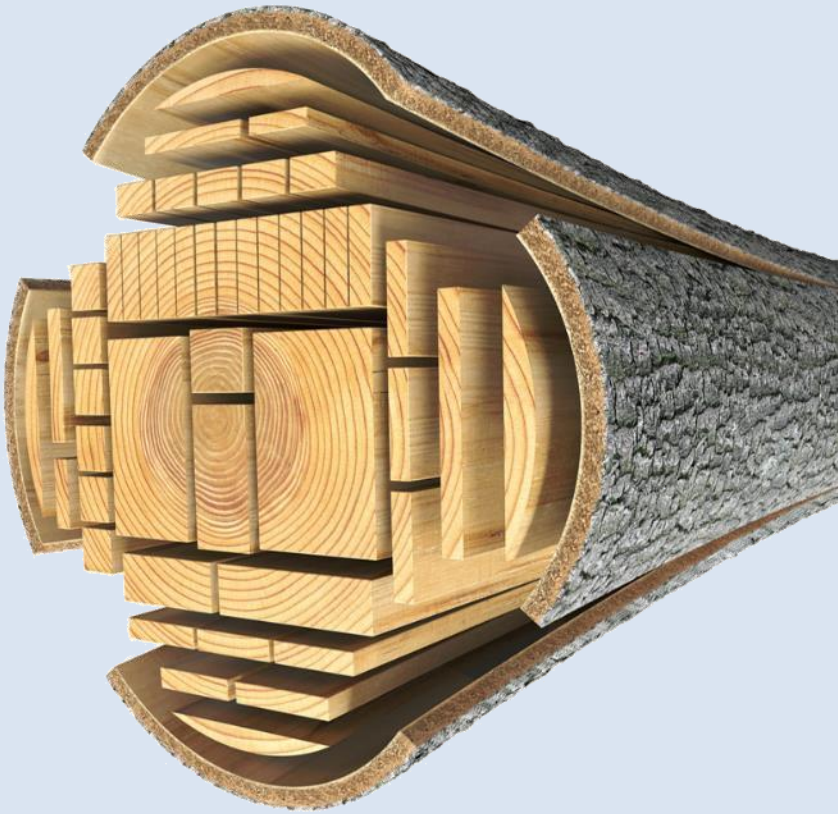
TIMBER FORMS

Timber comes in two states:

- PAR – Planed All Round
- Rough Sawn

Timber can come in a range of forms:

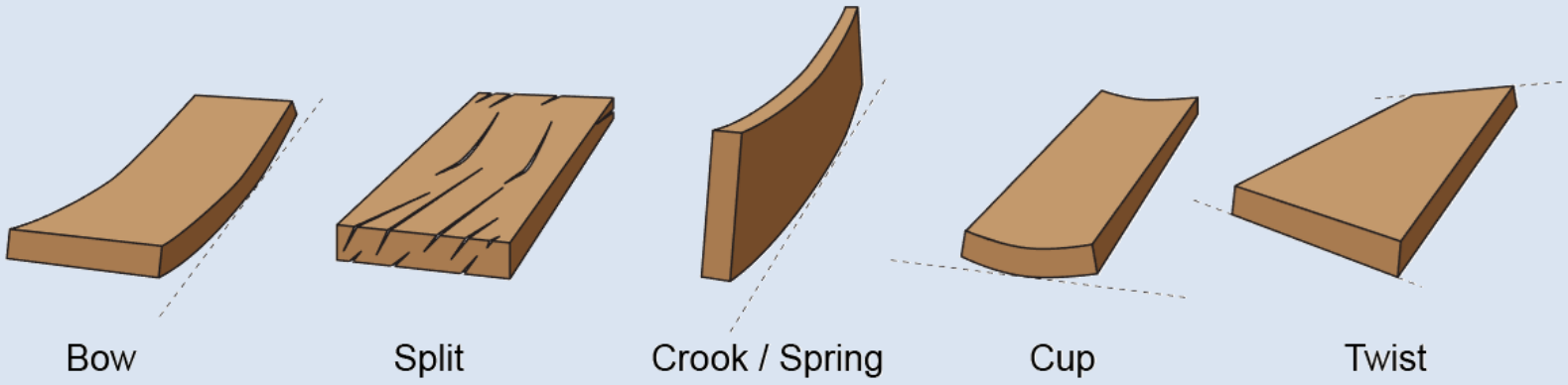
- Planks
- Boards
- Square sections
- Mouldings
- Strips
- Dowelling



FAULTS IN TIMBER

Faults can occur as timber dries after seasoning. These include:

- Bowing
- Splitting / cracking
- Springing
- Cupping
- Twisting



SOFTWOODS

Softwoods come from **coniferous** trees. These often have pines or needles, and they stay evergreen all year round - they do not lose leaves in the autumn. They are faster growing than hardwoods, making them cheaper to buy, and are considered a **sustainable** material.

Softwood	Properties	Uses
Paraná pine	Hard, straight-grained, strong and durable with a smooth finish, almost knot free, expensive and tends to warp	Quality, indoor joinery, eg staircases and built-in furniture
Scots pine	Straight-grained but knotty, fairly strong and easy to work with and paint, cheap	Indoor joinery, eg staircases and furniture - if used outdoors it needs regular protection
Western red cedar	Lightweight and knot free, has natural oils that protect it, easy to work but weak and expensive	Outdoors including building cladding

SOFTWOODS

We use pine at school as it is easy to work with, has a lovely attractive grain, can be painted and isn't too expensive.

Scots pine	Straight-grained but knotty, fairly strong and easy to work with and paint, cheap	Indoor joinery, eg staircases and furniture - if used outdoors it needs regular protection

HARDWOODS

Hardwoods come from **deciduous** trees, which have large flat leaves that fall in the autumn. Holly is one exception to this rule. Hardwoods take longer to grow, are not easily sourced and are expensive to buy.

Hardwood	Properties	Uses
Balsa	Soft and easy to form, lightweight, pale in colour, not durable but cheap	To make models
Beech	Close-grained, hard, strong and tough, can be challenging to work with and is prone to warping and splitting	Furniture, toys and tool handles, a veneer for worktops
Jelutong	A pale, close-grained timber, with medium toughness, easy to work with	Sculpture and pattern making
Mahogany	Deep reddish colour that is strong and durable, fairly strong and of medium weight, relatively easy to work with but prone to warping	Indoor furniture, panelling and veneers
Oak	Moderate-brown colour with unique and attractive grain markings, tough and durable, polishes well	High-quality furniture, kitchens units, flooring and for veneers as an expensive material

HARDWOODS

Balsa wood is an interesting hardwood because it is very light and soft, perfect for modelling!

Hardwood	Properties	Uses
Balsa	Soft and easy to form, lightweight, pale in colour, not durable but cheap	To make models

HARDWOODS

Teak is a beautiful hardwood. It is ideal for outdoor uses as it contains natural oils that protect if from water and cold weather. Teak is expensive which means it can only be used for expensive or luxury items. It is one of the hardest, strongest and most durable natural timbers in the world.

MANUFACTURED BOARDS

Manufactured boards are usually made from timber waste and **adhesive**. To make them more aesthetically pleasing they are often **veneered**. They are cheap to buy but will need protective coatings for longevity.

Manufactured board	Properties	Uses
Chipboard (particle board)	Large chips or flakes of wood glued together under pressure, brittle, difficult to shape and finishes poorly, absorbent to water and low in cost	Used for veneered worktops and flooring
Medium-density fibreboard (MDF)	A compressed board made from wood fibres glued together, smooth, light brown, can be veneered and painted, hard, keeps edges well on cutting, goes soggy when exposed to water if not protected	Used for kitchens and flat pack furniture
Plywood	Odd number of layers of veneer glued at 90 degree angles for strength, aesthetically pleasing outer layer, it is stiff and hard to bend unless glued into set shapes	Used for shelving work surfaces, floors and furniture

MANUFACTURED BOARDS

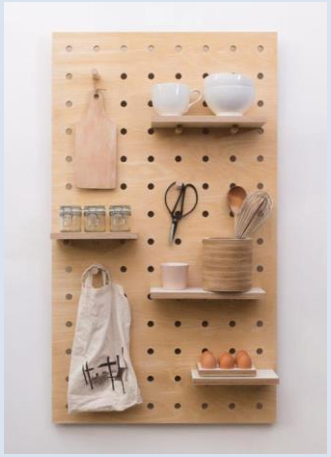
We use MDF in school as it is very cheap, strong, easy to work with and easy to paint. It needs to be painted though because of its appearance!

Medium-density fibreboard (MDF)	A compressed board made from wood fibres glued together, smooth, light brown, can be veneered and painted, hard, keeps edges well on cutting, goes soggy when exposed to water if not protected	Used for kitchens and flat pack furniture

MANUFACTURED BOARDS

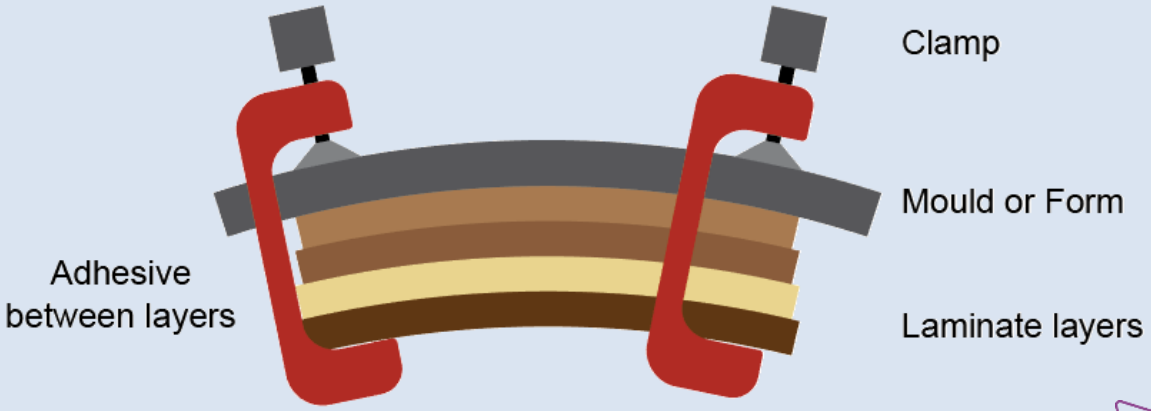
We use Plywood in school because it looks beautiful just like real timber but doesn't have any knots! It is getting quite expensive now though! Easy to work with and available in large sheets for project work because it is a manufactured board.

Plywood	Odd number of layers of veneer glued at 90 degree angles for strength, aesthetically pleasing outer layer, it is stiff and hard to bend unless glued into set shapes	Used for shelving work surfaces, floors and furniture



LAMINATION

- Laminating means layering. It is often used to create curved components
  - Strips of timber are glued and placed over a jig or former
  - Either clamps or a vacuum press are used to exert pressure on the lamination while the adhesive dries or cures
  - Why is a laminated structure stronger than regular timber?



PG ONLINE

WOOD TURNING

- Lathes are used to 'turn' wood on a plate or between two points whilst it is shaped with tools
  - The speed of the lathe is adjusted depending on the size of the wood being turned
  - Why would it be wise to select a lower speed if turning a large bowl or dish?
  - When might you require a higher speed setting?

EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

MATERIALS - NATURAL AND MANUFACTURED TIMBER

1) Discuss the properties of Hardwoods? (2)

- Hardwoods come from deciduous trees which take longer to grow.
- Hardwoods are not easily sourced.
- Hardwoods are expensive to buy (Generally).

2) Name the Manufactured Board: (3)

MDF

Chipboard

Plywood

3) Explain how the deck for this skateboard would be laminated? (4)

- Layers of flexi-ply (plywood) would be glued together.
- A mold or jig would be used to secure the layers in the correct shape.
- The layers would need to be clamped or put under pressure whilst drying.
- When the glue has dried the deck is removed from the jig/mold ready for sanding.

4) Discuss the advantages and disadvantages to using MDF to make a bookshelf instead of Pine? (5)

- MDF is better for the environment as it is made from timber waste.
- MDF is cheaper than Pine.
- MDF can be produced in large sheets
- MDF is easier to cut and work with as it doesn't have any knots.

- MDF isn't as attractive as pine.
- MDF needs to be painted or needs a veneer to finish it off.
- Working with MDF is more dangerous as it contains glue.

Purple pen time! Swap with a classmate!

MATERIALS - NATURAL AND MANUFACTURED TIMBER

5) The model house is made from Balsa wood and the deck of the boat is made from Teak. They are both Hardwoods but very different. Evaluate the properties of these timbers that make them perfect for these uses: (4)

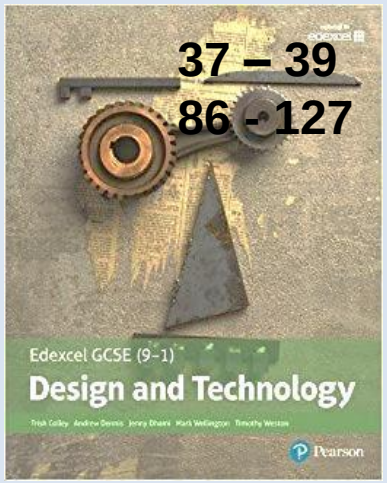
- Balsa is soft and easy to form which is perfect for modelling.
- It doesn't need to be durable and it is also cheap to buy.
- Thin sheets of Balsa can be cut with a craft knife which is perfect for modelling.

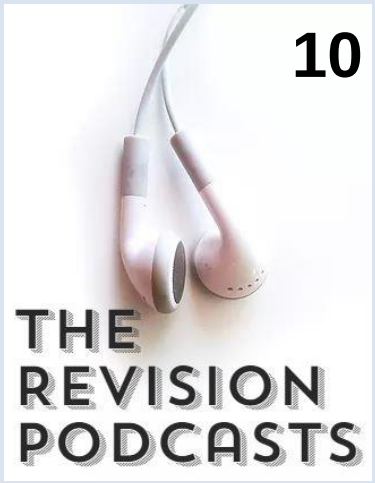
- Teak is ideal for outdoor uses as it contains natural oils that protect if from water and cold weather.
- Teak is expensive which means it can only be used for expensive or luxury items.
- It is one of the hardest, strongest and most durable natural timbers in the world.

Purple pen time! Swap with a classmate!

Section 10

FERROUS & NON-FERROUS METALS

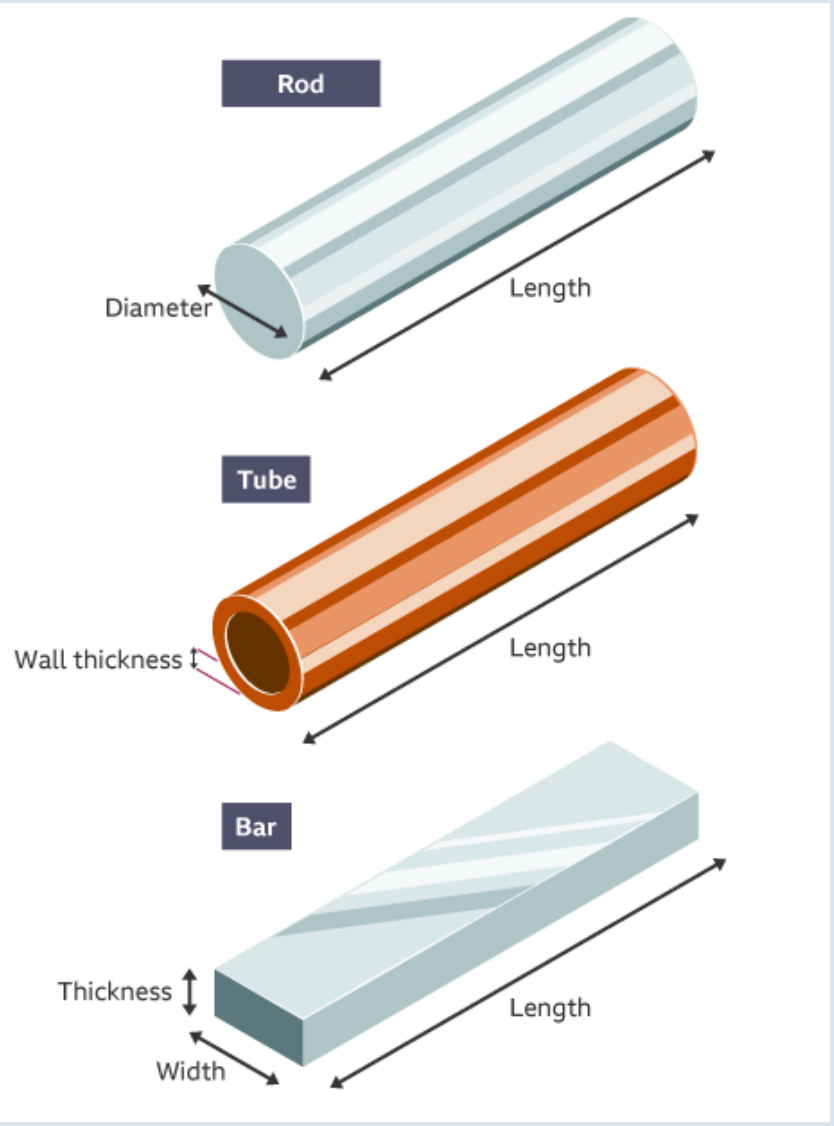




FERROUS & NON-FERROUS METALS

FORMS

Most polymers are formed by processing **crude oil** but they can be made from both natural and synthetic resources. They are sold as **sheets**, films, **bars**, **rods**, **granules** and **tubes**.



FERROUS METALS

Ferrous metals contain iron and are **magnetic**. They are prone to **rust** and therefore require a protective finish, which is sometimes used to improve the aesthetics of the product it is used for as well.

Ferrous metal	Properties	Uses
Cast iron	Brittle if thin, can be cast in a mould, strong compression strength, good electrical and thermal conductivity but poor resistance to corrosion	Manhole covers, pans and gates, vices
High-carbon steel (tool steel)	Hard but brittle, less malleable than mild steel, good electrical and thermal conductivity	Taps and tools, eg screwdrivers and chisels
Low-carbon steel (mild steel)	Ductile and tough, easy to form, braze and weld, good electrical and thermal conductivity but poor resistance to corrosion	Nuts, bolts, screws, bike frames and car bodies

FERROUS METALS

Low-carbon steel (mild steel)	Ductile and tough, easy to form, braze and weld, good electrical and thermal conductivity but poor resistance to corrosion	Nuts, bolts, screws, bike frames and car bodies

NON-FERROUS METALS

Non-ferrous metals do not contain iron and are not magnetic. They do not rust.

Non-ferrous metal	Properties	Uses
Aluminium	Light in weight and malleable but strong, a good conductor of heat and corrosion resistant	Drink cans, saucepans, bike frames
Copper	An excellent electrical conductor of heat and electricity, extremely malleable and can be polished, oxidises to a green colour	Plumbing fittings and electrical wires, professional chef's saucepans
Silver	A precious metal that is soft and malleable when heated, highly resistant to corrosion and an excellent electrical conductor of heat	Jewellery

NON-FERROUS METALS

<u>Non-ferrous</u> metals do not contain iron and are not magnetic. They do not rust.

Non-ferrous metal	Properties	Uses
Aluminium	Light in weight and malleable but strong, a good conductor of heat and corrosion resistant	Drink cans, saucepans, bike frames

ALLOYS

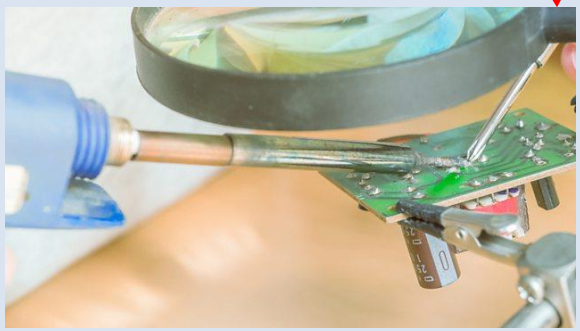
Alloys are mixtures of metal with an element to improve its properties or **aesthetic**. For example brass is a mixture of copper and zinc.

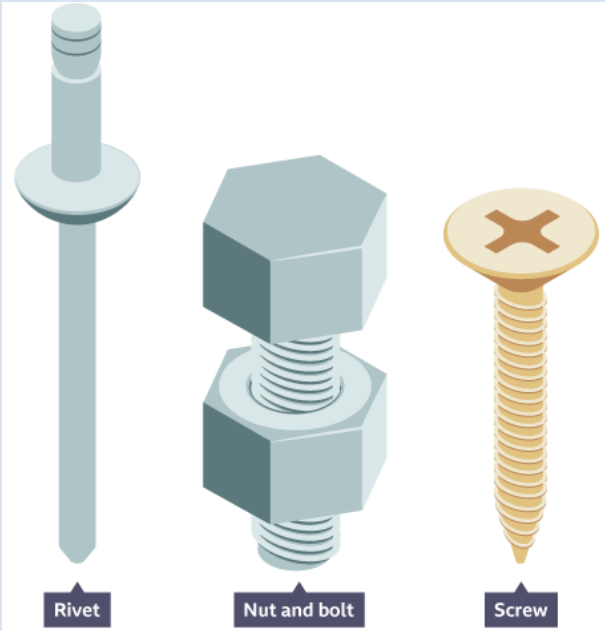
Alloy	Properties	Uses
Brass (alloy of copper and zinc)	Non-ferrous metal that is strong and ductile, casts well and is gold coloured but darkens when oxidised with age, a good conductor of heat	Taps, screws, castings, locks and doorknobs
Bronze (alloy of copper, aluminium and/or nickel)	Non-ferrous alloy, harder than brass and corrosion resistant, reddish/yellow in colour	Castings, bearings
Stainless steel (alloy of steel also with chromium, nickel and magnesium)	Ferrous metal that is silver when polished, hard and tough with excellent resistance to corrosion	Cutlery, sinks, saucepans, surgical equipment

JOINING METALS

There are many different joining methods for fixing metal in place. Non-permanent methods include nuts and bolts, screws and **rivets**. Whilst many would consider a rivet a permanent method of joining, it is possible to drill out an old rivet so that a new one can be used.

Soft soldering	Used to solder printed circuit boards (PCBs) and electronic components. Plumbing application where copper pipes are joined together.
Brazing	Used for joining steel by melting a brass rod on the hot steel. As the brass melts, it forms a joint. Brazing is a slow and safe way to learn about joining metal with heat.
Gas welding/Oxyacetylene welding	Oxygen and acetylene are used to produce a flame with a temperature of over 3,000°C. A filler rod is melted so that pieces of metal can be joined together. Gas welding/Oxyacetylene welding is faster than brazing and can also be used to cut metal.
Arc welding	Heat is produced by a high current that is passed down the filler rod. When the filler rod melts, it fuses the pieces of metal together. Arc welding is fast and portable.





FINISHING METALS

As with most materials, surface preparation is important before applying a **finish**. Oil and grease need to be removed before **painting**, and dents and scratches need to be filled and rubbed down with **emery cloth** or silicon carbide paper.

Metals can be:

- Painted
- Dip Coated
- Powder Coated
- Enameled

Painted Playground equipment

Powder Coating a rim

EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

MATERIALS - FERROUS AND NON FERROUS METALS

1) What are the main differences between Ferrous and Non-Ferrous Metals? (2)

- **Non-ferrous** metals do not contain iron
- They are not magnetic.
- They do not rust.

2) Discuss the properties of Aluminium which make it perfect for this coke can: (3)

- **Light in weight**
- **Malleable but strong – Can be formed into the shape**
- **Keeps the drink cool**
- **Corrosion resistant**

4) Mild Steel is used to make bridges and buildings and is used to reinforce concrete. Looking at the pictures below discuss the advantages and disadvantages of using this material: (5)

- **Mild steel is very strong – perfect for buildings**
- **Mild steel is easily weld-able – adds strength and support**
- **Mild steel is very tough – Can withstand shocks**
- **Affordable in the building trade.**

- **Mild steel rusts so must be covered or held in concrete, this can be a downside to using it in general.**

Purple pen time! Swap with a classmate!

MATERIALS - FERROUS AND NON FERROUS METALS

5) This watch is made from Stainless Steel. What type of metal is this? (1)

- **Alloy**

6) Discuss the properties of Stainless Steel which make it perfect for this product: (4)

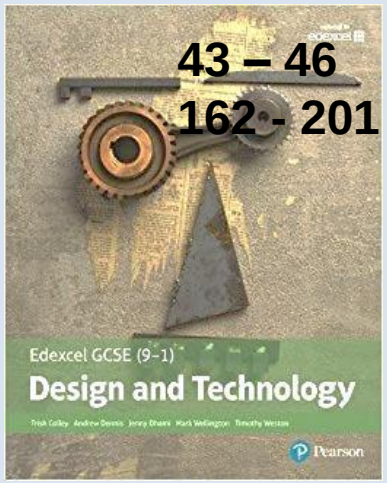
- **Resistant to corrosion which is perfect for a watch which might get wet or come into contact with sweat.**
- **Tough and strong which is perfect for a watch which may be removed several times a day. This will make the watch last longer.**
- **Has an attractive finish which would appeal to people who want a brushed finish.**

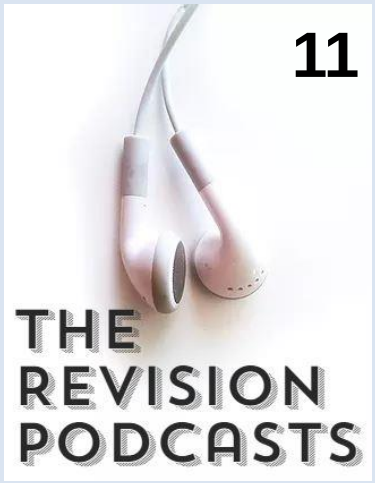
Non-ferrous metal	Properties	Uses
Aluminium	Light in weight and malleable but strong, a good conductor of heat and corrosion resistant	**Airplane / Drinks cans / Saucepans / Bike frames**
Copper	An excellent electrical conductor of heat and electricity, extremely malleable and can be polished, oxidises to a green colour	**Plumbing / Electrical Wires / Chef's saucepans**
Silver	A precious metal that is soft and malleable when heated, highly resistant to corrosion and an excellent electrical conductor of heat	**Jewellery**

Purple pen time! Swap with a classmate!

Section 11

THERMOPLASTICS & THERMOSETTING POLYMERS





THERMOPLASTICS & THERMOSETTING POLYMERS

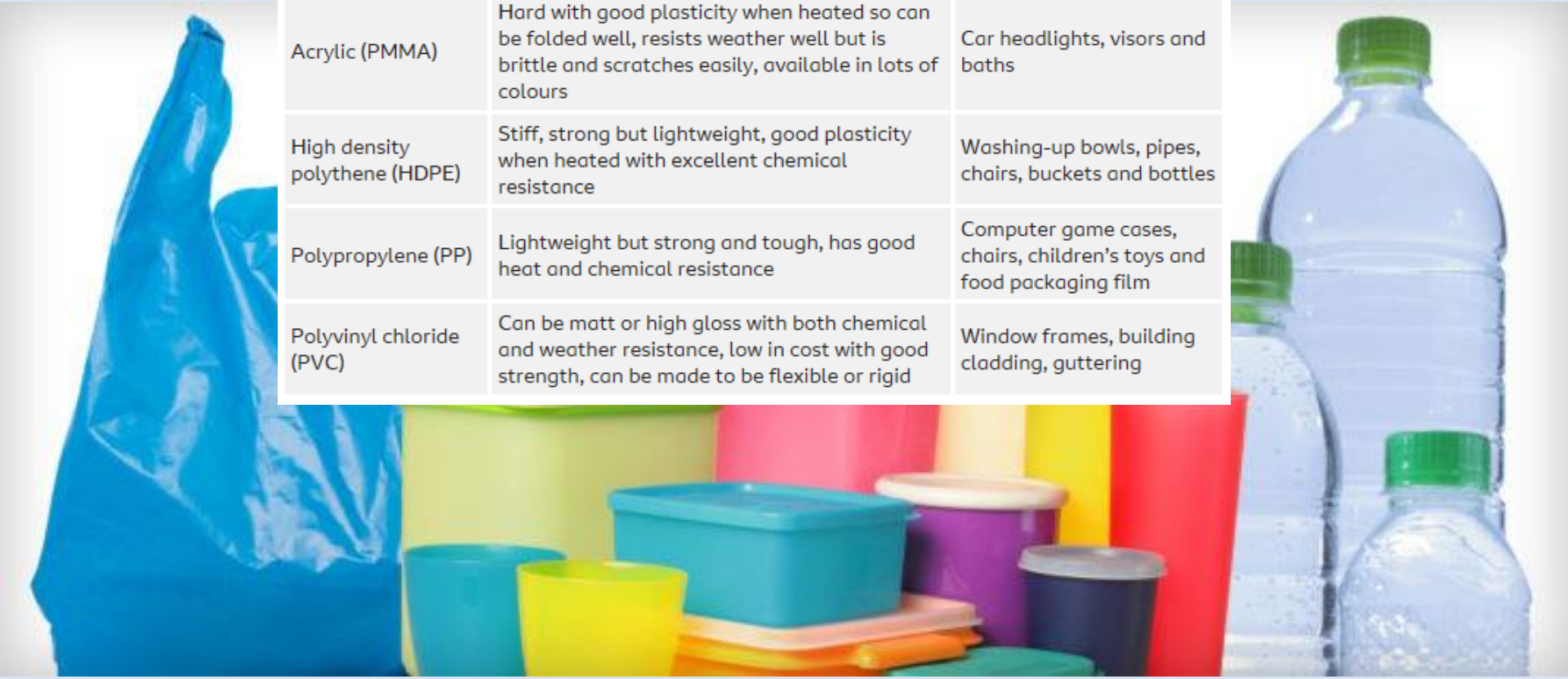
FORMS POLYMERS COME IN

They are sold as **sheets**, films, **bars**, **rods**, **granules** and **tubes**.

THERMOFORMING POLYMERS

Thermoforming polymers can be heated and formed repeatedly. They are **pliable** and **recyclable**.

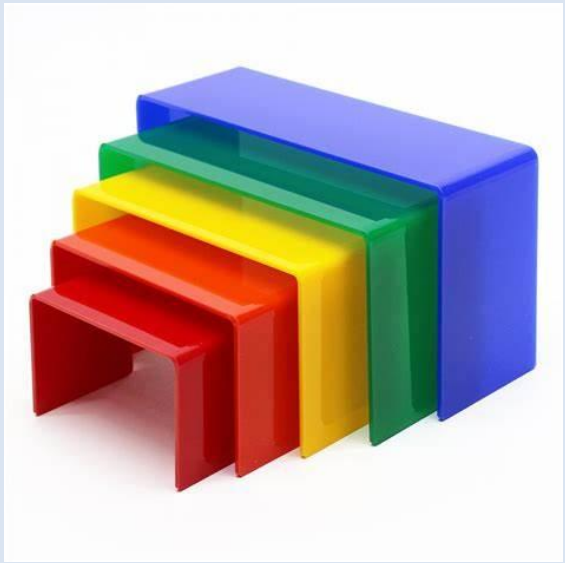
Thermoforming polymer	Properties	Uses
Acrylic (PMMA)	Hard with good plasticity when heated so can be folded well, resists weather well but is brittle and scratches easily, available in lots of colours	Car headlights, visors and baths
High density polythene (HDPE)	Stiff, strong but lightweight, good plasticity when heated with excellent chemical resistance	Washing-up bowls, pipes, chairs, buckets and bottles
Polypropylene (PP)	Lightweight but strong and tough, has good heat and chemical resistance	Computer game cases, chairs, children's toys and food packaging film
Polyvinyl chloride (PVC)	Can be matt or high gloss with both chemical and weather resistance, low in cost with good strength, can be made to be flexible or rigid	Window frames, building cladding, guttering



THERMOFORMING POLYMERS - ACRYLIC

Thermoforming polymer	Properties	Uses
Acrylic (PMMA)	Hard with good plasticity when heated so can be folded well, resists weather well but is brittle and scratches easily, available in lots of colours	Car headlights, visors and baths

- **Acrylic is available in a range of colours**
- **Acrylic can be heated and formed / shaped**
- **Acrylic can be laser cut into complex shapes**
- **Acrylic is relatively easy to work with**
- **Weather resistant**



THERMOSETTING POLYMERS

Thermosetting polymers are **brittle** and can only be formed once. They are hard to recycle. They are good **insulators** and are resistant to heat and chemicals.

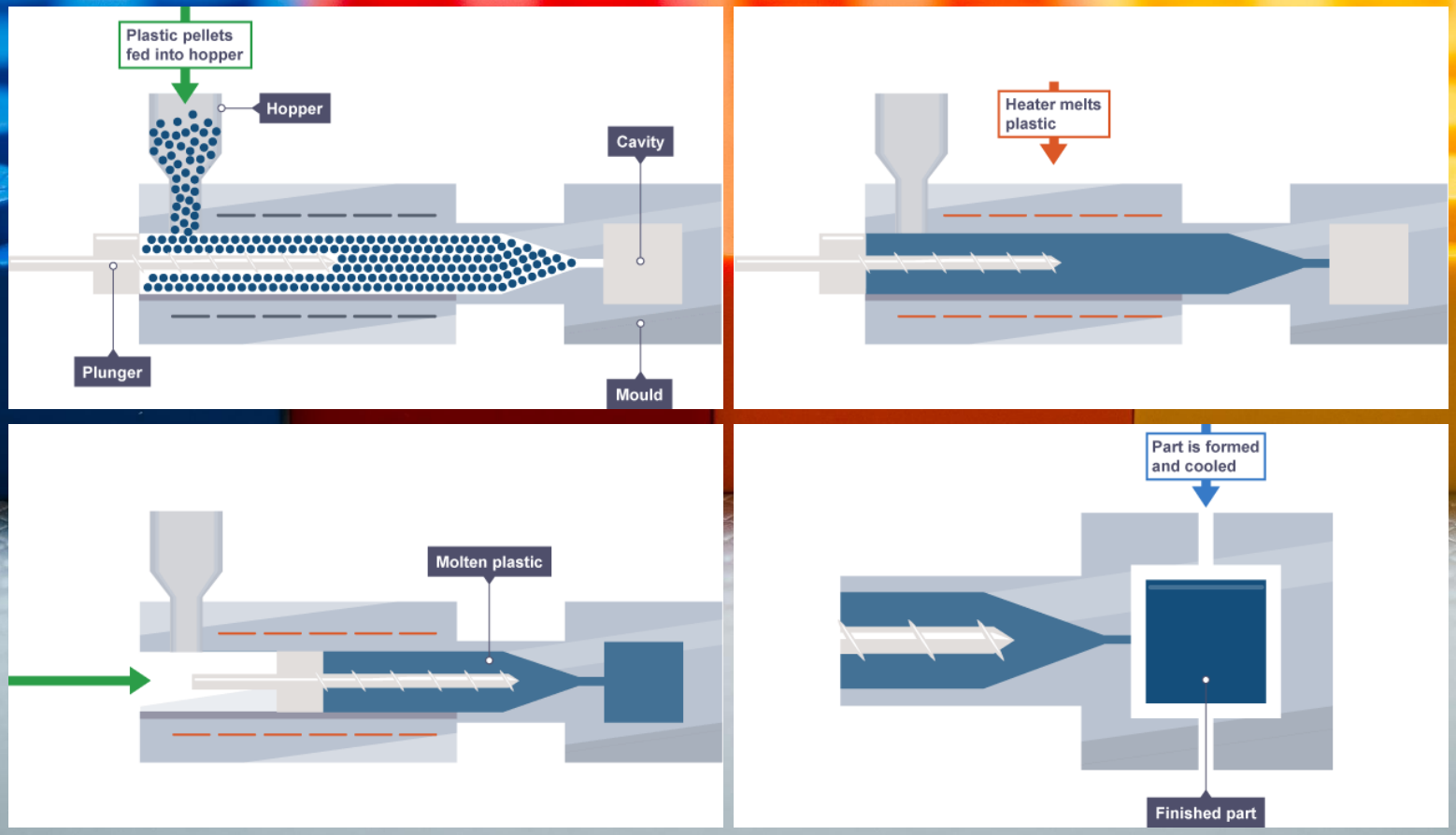
Thermosetting polymer	Properties	Uses
Epoxy resin (ER)	Supplied as two parts, one resin and one hardener (see image) - the resin and hardener combine to create an extra-strong adhesive, good chemical and heat resistance and an excellent thermal insulator, can be brittle	Bonds materials and can be used for waterproof coatings and lamination
Melamine formaldehyde (MF)	Excellent heat resistance as well as being resistant to scratching and staining, hard and strong	Laminates for worktops, food safe so used for picnic tableware
Urea formaldehyde (UF)	A hard and stiff polymer with excellent thermal insulation	Electrical fittings, toilet seats, holding the wood chips together in the making of medium-density fibreboard (MDF)

THERMOSETTING POLYMERS - EPOXY RESIN

Supplied as two parts, one resin and one hardener (see image) - the resin and hardener combine to create an extra-strong adhesive, good chemical and heat resistance and an excellent thermal insulator, can be brittle.

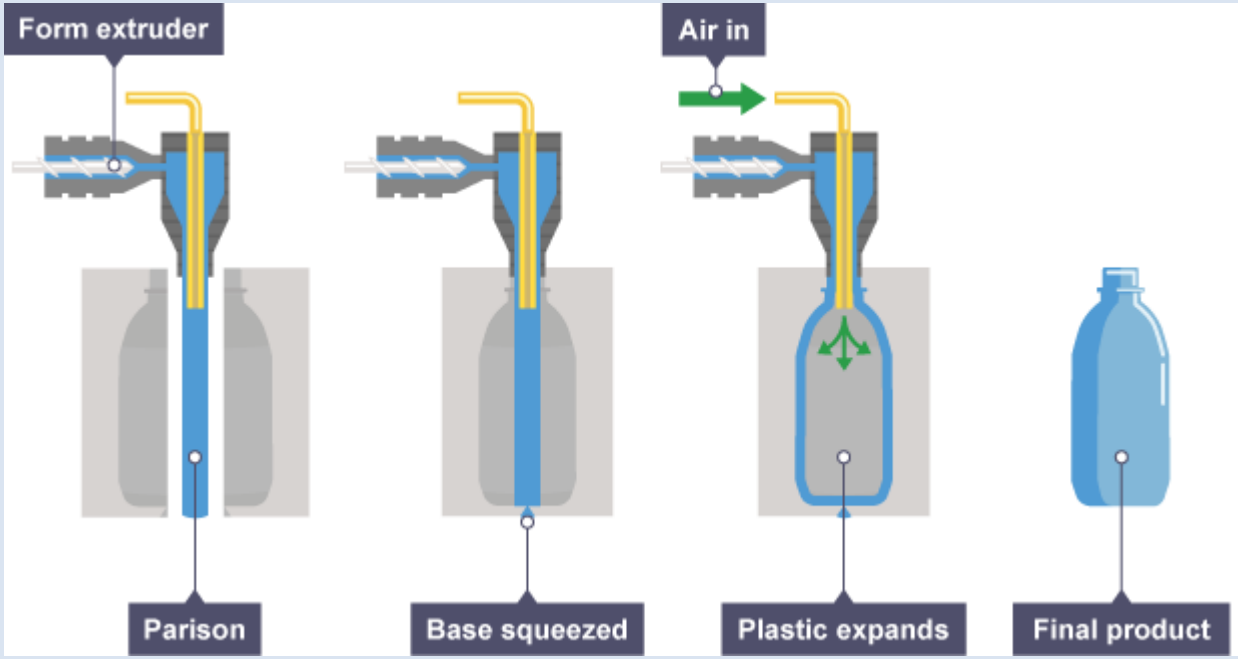
MANUFACTURING PROCESSES – INJECTION MOULDING

Injection moulding is used in industry to produce most **mass-produced** polymer parts. Liquid polymer is injected into a mould and left to cool. Lego bricks are made using this process.



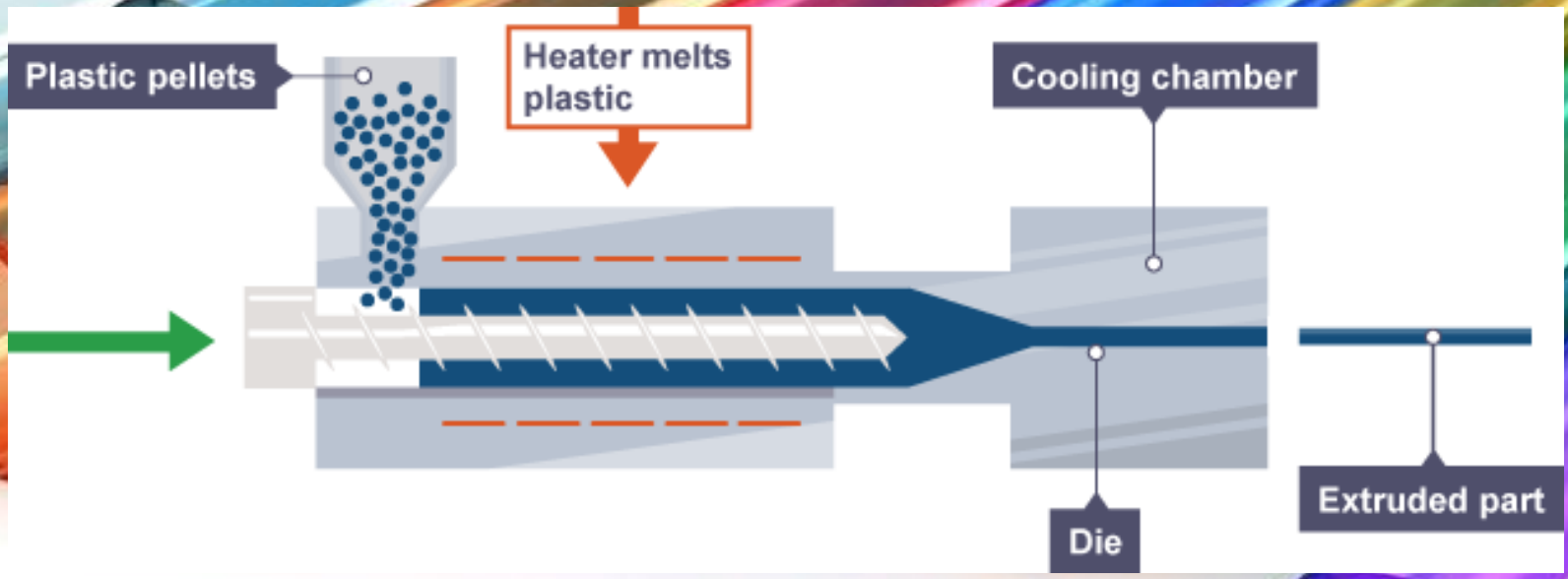
MANUFACTURING PROCESSES – BLOW MOULDING

Blow moulding is used to shape plastics, eg bottles, plastic barrels and similar shapes.
A tube of softened plastic called a **parison** is **extruded** into a mould.



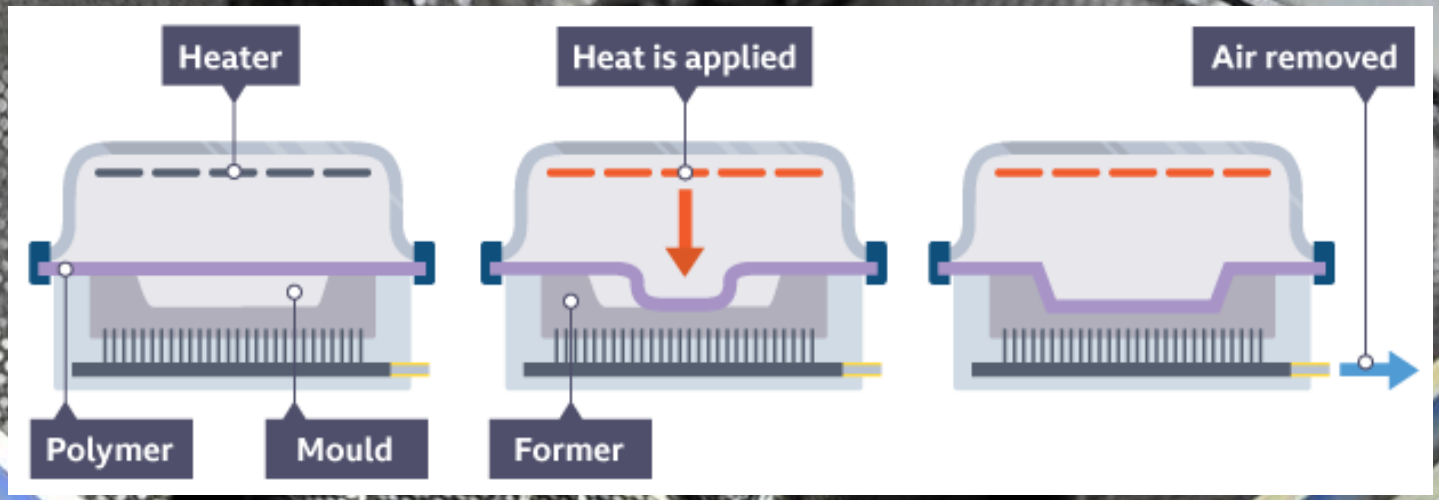
MANUFACTURING PROCESSES – EXTRUSION

Extrusion works in a very similar way to injection moulding. Instead, the hot polymer is fed through a shaped die continuously.



MANUFACTURING PROCESSES – VACUUM FORMING

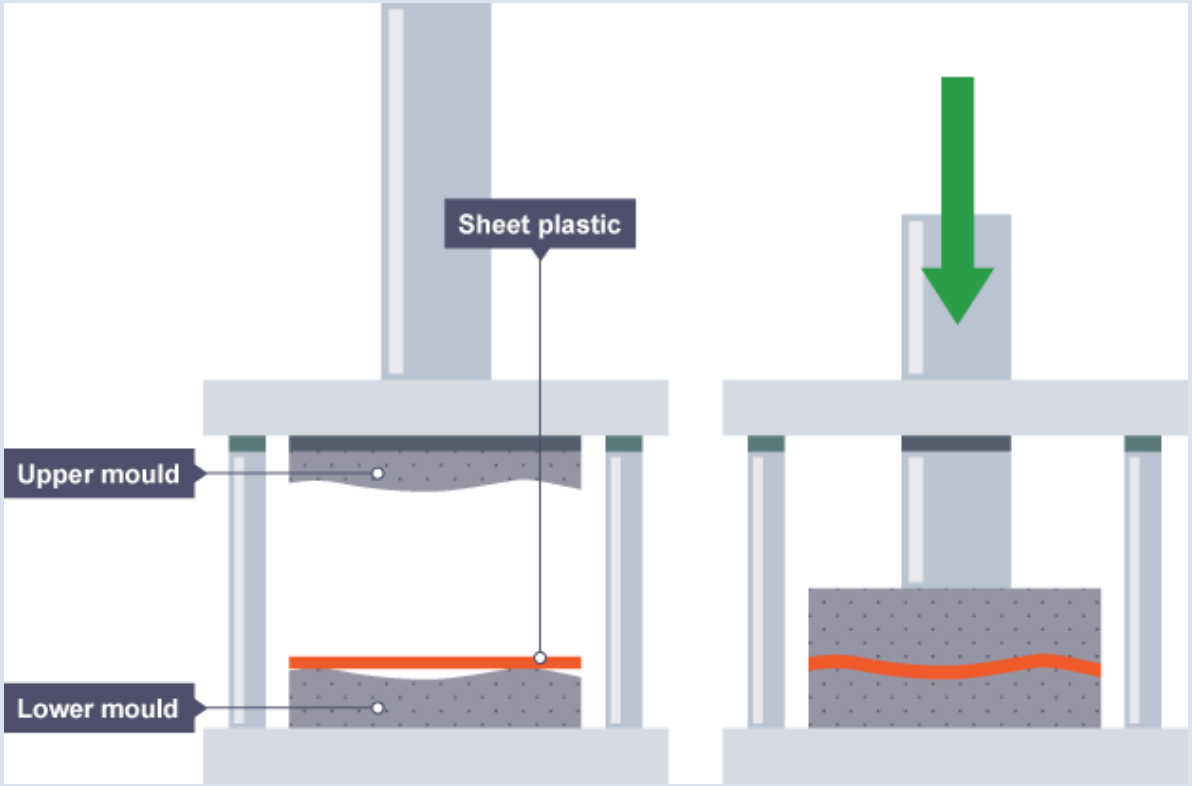
Vacuum formers can be used for making **moulds** and **housings** for electronic products. **High impact polystyrene (HIPS)** is often the material used in a vacuum former, as it heats up quickly depending on thickness.



The solid shape that goes in the vacuum former is called a former; the hollow part that has been vacuum formed is called a mould.

MANUFACTURING PROCESSES – PRESS MOULDING

Press moulding is used to make electrical fittings, handles, and many other products but can only be used with thermosetting plastics. A mould is made in two halves and sheet plastic is placed between them. They are then heated and pressure applied, forcing the plastics to assume the new shape.



EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

MATERIALS - THERMOPLASTICS AND THERMOSETTING PLASTICS

1) What are the two groups of plastics / polymers? (2)

- **Thermo**
- **Thermosetting**

2) How have these plastics been manufactured: (3)

Injection Molding **Blow Molding**

3) Why is Acrylic (Thermoplastic) used for school projects? (4)

- **Acrylic is available in a range of colours**
- **Acrylic can be heated and formed / shaped**
- **Acrylic can be laser cut into complex shapes**
- **Acrylic is relatively easy to work with**
- **Weather resistant**

4) Discuss the environmental impact of using Thermosetting plastics for making products such as Epoxy Resin and the toilet seat seen below: (5)

- **Thermosetting plastics can't be re-formed / re-heated so are very hard to be recycled.**
- **A lot of the Thermosetting product end up in landfill and take years to bio-degrade.**
- **Products could be re-used though to make other product to save them from going into landfill.**
- **Some Thermosetting plastics can be toxic to the environment when put into landfill or disposed of.**

Purple pen time! Swap with a classmate!

MATERIALS - THERMOPLASTICS AND THERMOSETTING PLASTICS

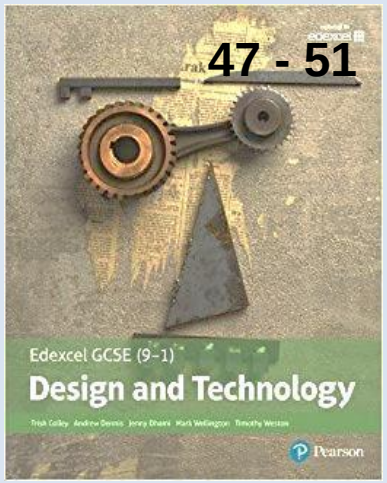
5) This toy plane is made out of recycled milk jugs (Thermoplastic). Discuss why you think it has been made out of this material and the benefits? (4)

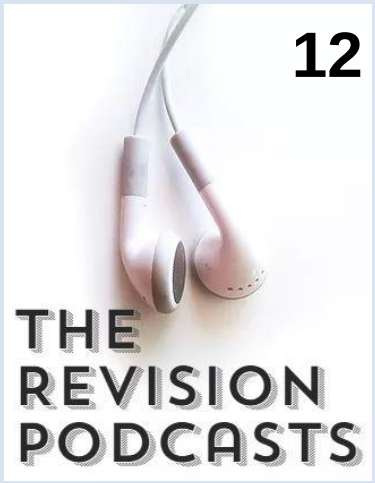
- **The milk jugs are being re-used which is great for the environment because they aren't having to be recycled or thrown away.**
- **Thermoplastics can be recycled and re-formed using heat so they can be made into the shape of the plane.**
- **Using re-used products is great for a company as it shows they care about the environment.**
- **The plane will be light which is perfect for a child's toy.**
- **The plane will still be strong so will be able to withstand abuse.**
- **The plane can be coloured green / yellow.**

Purple pen time! Swap with a classmate!

Section 12

NATURAL & SYNTHETIC TEXTILES

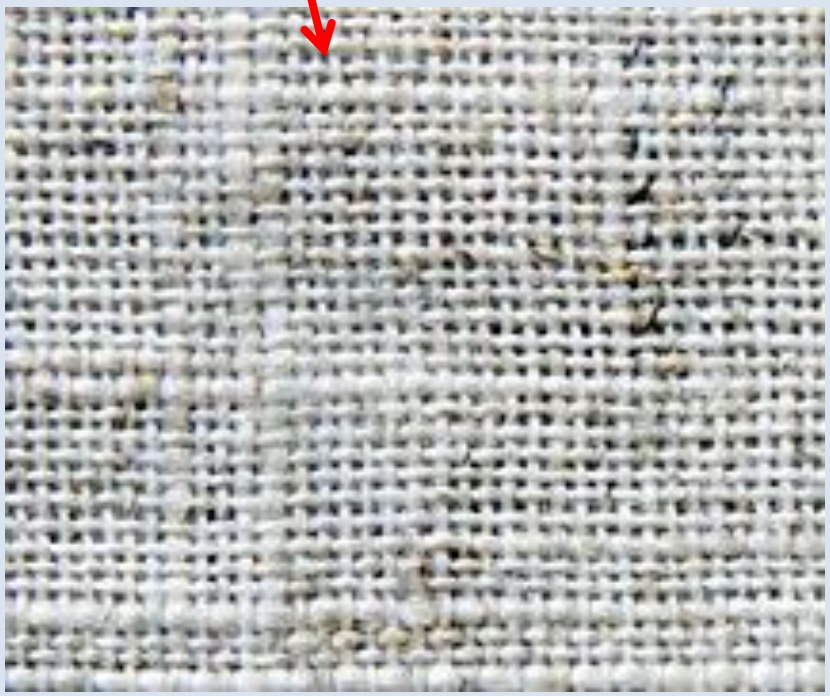




NATURAL & SYNTHETIC TEXTILES

FORMS TEXTILES COME IN

The most common fabrics used in clothing manufacture are either **woven** or **knitted**, and have noticeable differences.



NATURAL TEXTILES

Natural fibres come from plants, animals or insects. They are easily **renewable** and **biodegradable**.

Natural fibre	Properties	Uses
Cotton (plant)	Highly absorbent so is comfortable to wear, strong and durable, easy to care for but can shrink and has poor elasticity so creases	Most clothing, bed linen, upholstery fabric and in the medical industry (because it can be boiled)
Linen (plant)	Highly absorbent and cool to wear, very strong and durable, poor elasticity so creases easily	Summer clothing, upholstery fabric, table clothes and napkins
Hemp (plant)	Absorbent, strong and naturally antibacterial	Carpets, rugs and ropes
Jute (plant)	Absorbent and very strong but coarse	Bags, sacks for vegetables, carpets and twine
Wool (animal)	Absorbent with good insulating properties due to the fibre's natural crimp (curl), has good elasticity so doesn't crease much, relatively strong but can shrink on washing	Jumpers, suits, carpets and blankets
Silk (insect)	Drapes well and has good lustre (sheen), absorbent but difficult to wash and creases	Luxury clothing, eg dresses, underwear and bedding

NATURAL - WOOL

Perfect for a warm jumper! Good insulating properties and it has good elasticity / doesn't crease.

SYNTHETIC TEXTILES

Synthetic fibres are made mainly from **non-renewable** coal and oil **refined** into monomers, which join together in a process called **polymerisation**. The do not **degrade** easily but they can be made into any length (continuous filament) and thickness and for any purpose.

Manufactured fibre	Properties	Uses
Acrylic	Like all synthetic fibres, has good strength with good elastic properties so doesn't crease, has poor absorbency but can be a good insulator if crimp is added to replicate wool fibres	Jumpers and other knitted clothing that looks like wool, fake fur jackets
Polyester	Hardwearing with good tensile strength, good elasticity but poor absorbency, a highly versatile fibre	Clothing and sportswear
Nylon (polyamide)	A hardwearing fibre with good tensile strength, has good elasticity so doesn't crease and is resistant to chemicals, not absorbent and melts easily	Parachutes, tents, rucksacks, sports clothing, rope and carpets
Elastane	Highly elastic and stretchy, strong and hardwearing	Clothing such as leotards, swimming costumes and gym clothing, mixed with cotton in T-shirts for a better fit

SYNTHETIC - POLYESTER / ELASTANE

Perfect for gym wear!

- Hardwearing and strong so it can take some abuse.
- Elastic / stretchy so it can stretch with the body.

Product Details

- Tight fit for a body-hugging feel
- Fabric: Body: 83% polyester/17% elastane. Gusset lining: 100% polyester.

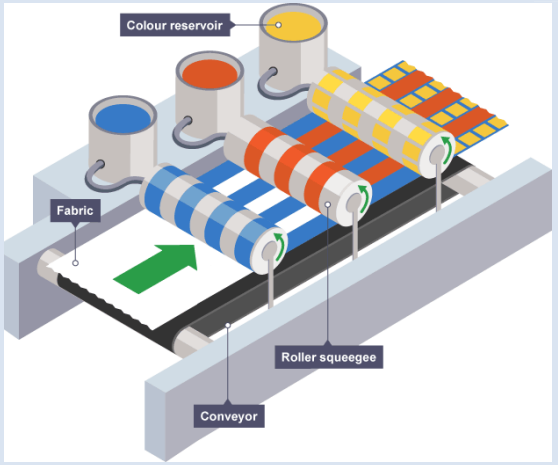
COMPONENTS

Components refer to any resource that is used to complete the construction of a textile product.

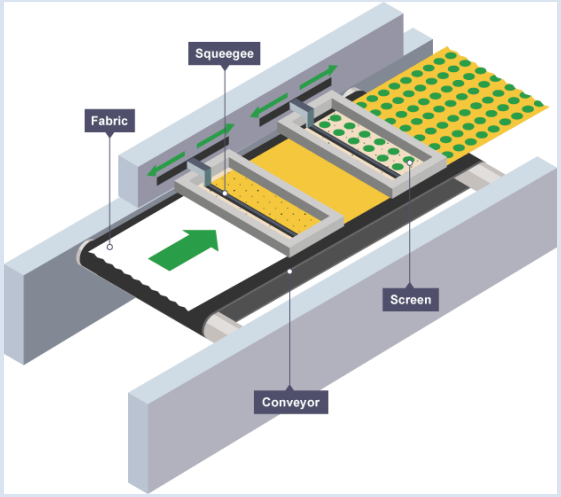
Buttons - available in a range of sizes, colours and materials, such as plastic, wood and metal
zips - fabric sides with plastic or metal teeth, sold in a variety of standardised lengths with open (for coats) or closed (for trousers) ends
Hook and eye - a two-piece fastening usually made of metal for either side of a join, such as at the top of a zip
Velcro - hook and loop fastening that is usually made from nylon and can be repeatedly ripped open and closed and is useful for children's clothes and shoes for ease of use
Press fasteners - metal or plastic discs that clip together when pressed, found on duvet covers and baby grows

FINISHES

Dying



Roller Printing



Screen Printing

Sublimation Printing

EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

MATERIALS - NATURAL, SYNTHETIC AND MIXED TEXTILES

1) Write down two natural and two synthetic fibres? (2)

Cotton / Wool / Linen / Hemp / Silk / Jute
Acrylic / Polyester / Nylon / Elastane

2) Give one reason and explain why fibres are mixed in the production of textile materials: (3)

- **To get the best properties from both materials:**

If a particular fibre needs to be more elastic you could add elastane to it for example.

- **The material will be improved:**

If a fibre was not waterproof it could be mixed with a waterproof fibre.

3) You are to design a new type of clothing to be worn in the gym for exercising and lifting weights what fibres would you combine and why? (4)

- **Polyester / Nylon / Elastane**
- **They are all perfect for gym wear as they are all elastic**
- **They are all strong (Tensile strength)**
- **Elastane is the most hardwearing so might be the best.**
- **Any mix of these three would be suitable.**

4) These Adidas trainers are made from recycled fishing ropes. Evaluate the environmental impact of starting to make products in this way: (5)

- **This is great as fishing ropes are left in the ocean or thrown away after use.**
- **A product is being recycled and re-used to make another product.**
- **Making products from fishing ropes is good as it will helping get rid of some of the plastics in the oceans.**

- **The trainers might not be a strong as using conventional materials.**
- **The trainers might be more expensive because it is more difficult to make trainers using this material**
- **The trainers still use plastic that is not re-used.**

Purple pen time! Swap with a classmate!

MATERIALS - NATURAL, SYNTHETIC AND MIXED TEXTILES

5) Choose a product write whether it is natural or synthetic and discuss why it has been made from this particular material? (4)

- **Polyester cycling top – Synthetic: Versatile material / Strong so won't tear / Elastic so it can fit to the shape of the cyclist**
- **Nylon Tent – Synthetic: Hardwearing / Non absorbent so keep the rain out / Elastic so it can be stretched over the frame**
- **Cotton Top – Natural: Comfortable to wear which is good for clothing / Durable / Easy to care for**

Polyester

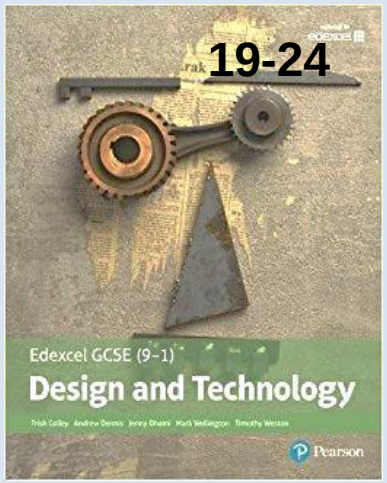
Nylon

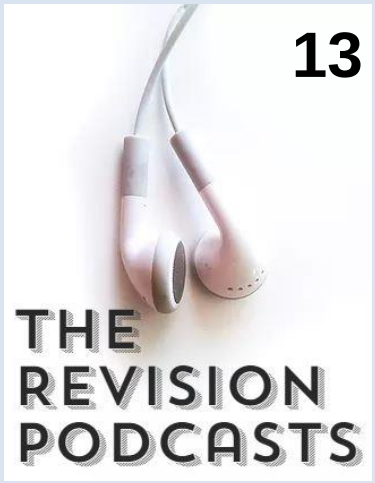
Cotton

Purple pen time! Swap with a classmate!

Section 13

SMART & MODERN MATERIALS





SMART AND MODERN MATERIALS

SMART AND MODERN MATERIALS

A modern material is a material that has been developed through the invention of new or improved processes to improve the properties of the material, eg to make them stronger, faster, lighter and tougher.

Many modern materials are developed for specialist applications; however, some have become available for general use.
Concrete, aluminium and **steel** are all commonly used modern materials, but more recent additions include materials that have changed the way we manufacture and use products.

To be classed as a 'smart material' they need to exhibit a physical change in response to some external stimuli.

While smart materials are modern materials, modern materials are not necessarily smart.
To be classed as a 'smart material' they need to exhibit a physical change in response to some external stimuli.
In other words, they change when you do something to them, and when you remove what is causing that change they return to their original form.

SMART MATERIALS

To be classed as a ‘smart material’ they need to exhibit a physical change in response to some external stimuli such as:

HEAT / LIGHT / SOUND

- This cat mug changes appearance when hot liquid is poured into it. **(HEAT)**
- These glasses change depending on the amount of light. **(LIGHT)**

THERMOCHROMIC PIGMENT

Thermochromic pigments change colour when their temperature changes. The term ‘thermo’ relates to heat, and chroma means colour - so thermochromic pigments change colour when they are heated up. These pigments can be mixed with paint or polymers to give the materials the same colour-changing properties as the pigment. You may have seen this technology on colour-changing mugs or bath items for children.

KEVLAR

Kevlar is a tightly woven fabric that has great impact resistance. It is used in racing tyres, racing sails, gardening gloves and bulletproof vests.

PHOSPHORESCENT WIRE

A thin copper wire that is coated in **phosphor**, which glows brightly when a current is applied to it. It is commonly used in fancy dress and decorative luminescent clothing, nightlights, waterproof displays, medical tool display screens and car's speed dials.

REFLECTIVE FABRICS

Reflective fabricschange colour when the light changes. When bright light is focused on them they glow or light up. Very useful for safety jackets or cyclists clothing that may be illuminated by the headlights of a car!

POLYMORPH

Polymorph is a **polymer** that becomes **malleable** when heated to about 62°C. When it cools down it becomes hard enough to drill and cut. This makes it perfect for modelling as it can be reheated and formed again. It is also excellent for creating ergonomic handles.

CONCRETE

Concrete is an engineering material that simulates the properties of rock and is a combination of particles closely bound together. It is used in construction a lot!

It is relatively cheap.
It has a long life.
It is strong under compression.
It is fire-resistant.
Can be easily shaped before it sets.
A warm material which holds heat well.

Did you know…

- Concrete is the second most used material on earth after water

CARBON-FIBRE

- **Fantastic strength and stiffness:**

The road bike / F1 car will absorb bumps in the road and will feel very solid to the rider or driver.

- **Lightweight:**

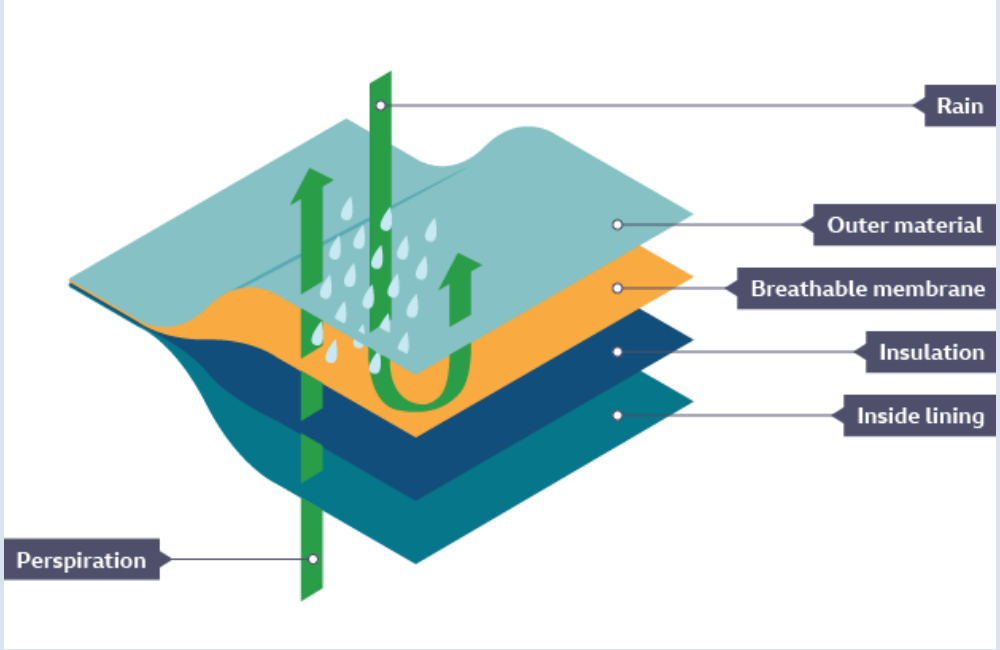
The lighter a road bike or F1 car the better so that it can get up hills quicker or accelerate quicker.

- **Can be moulded into complex shapes:**

Perfect for bike frames or F1 cars as they can be quite complex shapes with tricky angles.

GORE-TEX

Gore-Tex is designed to allow body moisture to evaporate away from the body.
It does this whilst still remaining waterproof.
It is made up of several layers which all have different jobs.
The membrane has microscopic holes, big enough to let body moisture through but too small for rain.



EXAM PRACTICE TIME!

20 MINS TO ANSWER THE QUESTIONS IN YOUR BOOKLET

SMART AND MODERN MATERIALS

1) Why is Polymorph perfect for modelling ideas for design for elderly people with Arthritis?: (3)

- **It can be made up really easily.**
- **It is malleable and easy to form into different shapes.**
- **Can be re-heated and formed again.**
- **Can be drilled cut and sanded once it has cooled down.**

2) The house to the right is made from Concrete. Discuss the benefits of making a house from this material? (4)

- **It is relatively cheap.**
- **It has a long life.**
- **It is strong under compression.**
- **It is fire-resistant.**
- **Can be easily shaped before it sets.**
- **A warm material which holds heat well.**

3) Mr Mason's road bike is made from Carbon Fibre which is a Fibre based composite material. Give three advantages to using this material and explain? (5)

- **Fantastic strength and stiffness:**

The road bike will absorb bumps in the road and will feel very solid to the rider.

- **Lightweight:**

The lighter a road bike the better so that it can get up hills quicker!

- **Can be moulded into complex shapes:**

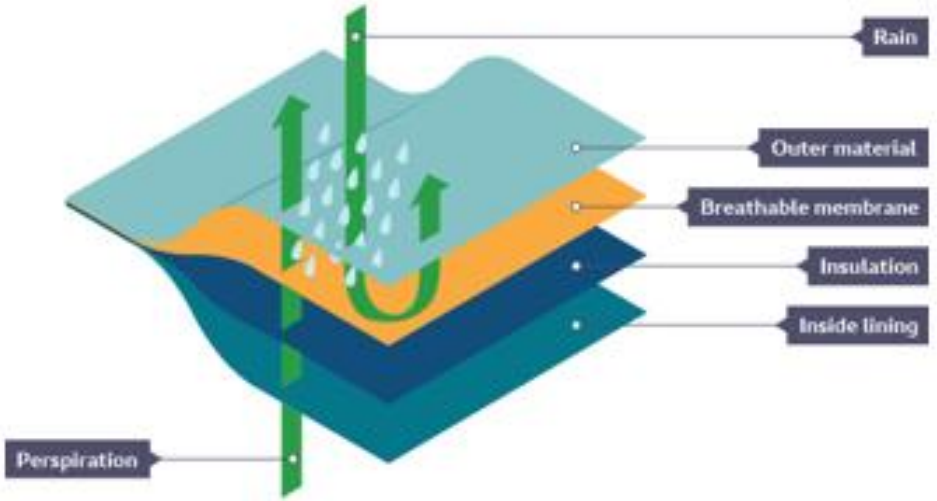
Perfect for bike frames as they can be quite complex shapes with tricky angles.

Purple pen time! Swap with a classmate!

SMART AND MODERN MATERIALS

4) This North Face jacket is made from a smart breathable fabric call Gore-Tex Using the diagram below to help you evaluate why this material has been developed and discuss the advantages: (4)

- Gore-Tex is designed to allow body moisture to evaporate away from the body.
- It does this whilst still remaining waterproof.
- It is made up of several layers which all have different jobs.
- The membrane has microscopic holes, big enough to let body moisture through but too small for rain.



Purple pen time! Swap with a classmate!