



Knowledge Organiser

DESIGN TECHNOLOGY

Design and Technology



Core Technical Principles	
Materials and their working properties	
Question:	Answer:
What does the 'property' of a material mean?	Property means an attribute, quality, or characteristic of something.
What do you think physical properties means?	Physical properties are those that describe how a material behaves under a specific condition, e.g heat or water
What do you think working properties means?	Working or mechanical properties of materials describe how a material behaves when being worked or shaped.
What words are used to describe the physical properties of a material?	Absorbency Density Fusibility Electrical Thermal Conductivity
What words are used to describe the working properties of a material?	Strength Hardness Toughness Malleability Ductility Elasticity
What are the five forces which can be applied to a material to test its strength?	Tension Compression Shear Torsion Bending
Why are most aircrafts are made using aluminium?	Aluminium is a used when making aircraft due to it being a good thermal conductor as well as being lightweight, ductile and malleable. It is also resistant to corrosion.

Timbers	
What type of tree does softwood come from?	Coniferous trees
What type of tree does hardwood come from?	Deciduous trees
How many years does softwood take to mature?	Up to 30 years approx.
How many years does hardwood take to mature?	Up to 100 years approx.
What are 5 key properties of hardwood?	<ul style="list-style-type: none"> Trees tend to grow more slowly and shed their leaves during Autumn and Winter. Hardwood is of high density so this makes the wood hard and tough to cut. The high density of hardwoods means that they burn slowly and are more fire resistant. The high density of hardwoods means it is more resistant to decay Hardwood is usually more expensive than softwood.
What are 5 key properties of softwood?	<ul style="list-style-type: none"> Trees tend to grow relatively quickly compared to hardwood trees. They mostly grow in colder climates and tend to keep their needles throughout the year (evergreen). Softwood is of low density so it is softer and easier to cut. The low density of softwood means it is less resistant to catching fire, burns faster and it has poor resistance to decay. Softwood is usually cheaper than hardwood.
Describe the process of 'seasoning' and explain why it is used?	Seasoning is the process of removing moisture from newly converted planks of wood to prevent timber from being vulnerable to rotting and insect attacks.
What is one method of seasoning and describe the process it goes through?	Air seasoning is when air is allowed to flow around the stacked timber and gradually dries out. The process can take a number of years

Polymers	
What are the 2 categories of polymers?	Thermosetting and Thermoforming polymers
What are the key characteristics of polymers?	<ul style="list-style-type: none"> They are good insulators, thermosetting polymers are excellent insulators. They are self-coloured - their colour is in-built. Pigments are added to polymers when they are being produced, therefore they are available in a variety of colours. They have good resistance to corrosion/degradation. They can be relatively easily moulded into shape. They are impermeable to water (does not allow water or liquid to pass through it.)
What are they key characteristics of thermosetting polymers?	Thermosetting polymers are: <ul style="list-style-type: none"> made of many long chains of polymers which have very strong links between them. The cross links prevent the molecules from moving over one another. They are initially set by heat and moulded into shape. They cannot be remoulded with the use of heat. This makes them excellent insulators.
What are they key characteristics of thermoforming polymers?	Thermoforming polymers are: <ul style="list-style-type: none"> made of many long chains of polymers which don't cross over very often. When heated, the molecules slip easily over one another. They can be softened with the use of heat and moulded into shape. If reheated they can be remoulded. The repeated heating and cooling process causes minimal damage to the properties of the polymer
Describe 3 main differences between thermosetting and thermoforming polymers.	i) Thermosetting polymers are permanently moulded into shape by heat whereas thermoforming can be re-moulded when heat is applied

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	<p>ii) Thermosetting polymers are able to resist high temperatures however thermoforming polymers soften when heat is applied</p> <p>iii) Thermosetting polymers are made of polymer chains with a strong bond between them. Thermoforming are made of polymer chains with only a few cross links.</p>
Sketch and label thermosetting polymers chains?	
Sketch and label thermoforming polymer chains?	

Metals and Alloys	
What are the properties of Non-ferrous metals?	<ul style="list-style-type: none"> - found in the Earth's crust in rock known as ore - does not contain iron - is not magnetic (good for electronic devices and wiring) - will not rust (resistant to corrosion due to lack of iron) - is malleable (due to lack of iron)
Give examples of non-ferrous metals	Aluminium, Copper, Zinc, Tin
What are the properties of ferrous metals?	<ul style="list-style-type: none"> - is found in the Earth's crust in rock known as haematite (iron ore) - contains iron - is usually magnetic (useful property for sorting out metals when recycling) - will rust when exposed to moisture and oxygen
Give examples of ferrous metals	Cast Iron, Low carbon steel, High carbon steel
What are 2 ways of permanently joining metals together?	Soldering and welding
What are 2 ways metal can be joined in a non-permanent way?	Self-tapping screws and nuts and bolts.

Paper & Boards	
What is paper made from?	Cellulose fibres from wood, rags or grasses
At what angle are the diagonal lines on isometric grid paper?	30°
What are the 2 paper sizes above A3 and what are the 2 paper sizes below A3?	A5 A4 <u>A3</u> A2 A1
Explain what properties that make corrugated card a good choice for pizza boxes?	It is strong but lightweight with good insulation properties
Draw and label a piece of corrugated card highlighting the use of triangulation to increase strength?	

Textiles	
What are all fabrics made from (the building blocks of fabrics)?	Fabrics are made from fibres, through a process of spinning, weaving and finishing.
What are the 2 main categories of fibres?	Natural and synthetic
What are the 3 main types of fabric construction?	Woven, Knitted, Bonded
How are woven fabrics constructed?	Woven fabrics are produced by interlacing two sets of yarns at right angles to each other on a machine called a loom.
How are knitted fabrics constructed?	Knitted fabrics are made from interlocking yarns. This can be done by machine or by hand.
How are non-woven fabrics constructed?	Non-woven fabrics are made from staple fibre (short) and long fibres (continuous long), bonded together by chemical, mechanical, heat or solvent treatment.

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Design and Making Principles	
Investigation, primary and secondary data	
What is market research?	Is research carried out to gain an understanding of the target market for a product.
Explain the difference between primary and secondary research?	Primary research is information you find yourself from interviews, questionnaires et from interviews, questionnaires, etc Secondary research is where you use someone else's information from books, internet, magazines, etc
Describe what anthropometrics is?	The study of the human body and its movements, and often involves research into measurements of body parts.
Describe what ergonomics is?	Is the relationship between people and products, and how they use them and interact with them.
Describe what a design brief?	It describes the problem or situation that needs a design solution.
Describe what a design specification is?	It is a list of points (a list of criteria) which are used as a checklist to determine the success of your product idea.
Describe a manufacturing specification?	It contains all the information necessary to make the product.

Environmental, social and economic challenge	
Describe deforestation?	When humans remove or clear large areas of forest lands and related ecosystems for non-forest use.
What are 2 main causes for deforestation?	- Trees cut down for timber and paper based end products - Trees cut down to create space for cattle, crop and urbanization (new buildings and homes)
What is global warming?	An increase in the overall temperature of the earth's atmosphere due to the greenhouse effect caused by increased levels of carbon dioxide and other pollutants.
What is the main cause of global warming?	Burning of fossil fuels releases pollutants: <ul style="list-style-type: none"> • <u>Smoke</u> causes soot deposits and can cause breathing difficulties. • <u>Carbon monoxide</u> is a poisonous gas. • <u>Carbon dioxide</u> is a greenhouse gas that accumulates in the atmosphere and contributes to global warming.
What is fair trade?	A trading partnership that works towards fair prices and better conditions for farmers and workers who produce goods all around the world.
What does the fair trade mark or logo on products indicate?	That the ingredients and materials in the product have been approved and meet Fairtrade's social, economic and environmental standards.

The work of others	
What is a design movement?	It is a particular styles from a specific period in time or when certain trends, social/political happenings influence the work of artists and designers living in that period.

What were the following design movements and when did they happen?	
Arts and Crafts movement?	Arts and Crafts – 1853 – 1907 an international movement in the decorative and fine arts that stood for traditional craftsmanship using simple forms, and often used medieval, romantic, or folk styles of decoration.
Art Nouveau?	Art Nouveau – 1880-1910 An ornamental style of art that flourished throughout Europe and the United States which was characterized by its use of a long, sinuous, organic lines.
Art Deco?	Art Deco – 1908-1935 A design movement characterized by the use of geometric shapes and patterns which were strongly symmetrical.
Modernism – De Stijl?	Modernism – De Stijl – 1917-1931 De Stijl movement embraced an abstract, pared-down aesthetic centered in basic visual elements such as geometric forms and primary colours.
Post-modernism?	Post-modernism – 1970-1990 A style or styles of architecture and the decorative arts that were a reaction to Modernism. It shattered preconceived ideas of what design should look like and was often amusing, contradicting, controversial and complex.
Memphis?	Memphis – 1981-1988 A group designers who designed colourful, eccentric and vibrant furniture and homeware products. Their design philosophy was form over function and 'radical design'.

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Past and Present designers:	
Which designer is famous for the design of the London underground map?	Harry Beck
Which British fashion designer pushed the boundaries of fashion, worked for Givenchy and Gucci and was known for his theatrical fashion shows?	Alexander McQueen
Which present day product designer worked for Alessi design group and is famous for the Juicy Salif lemon juicer?	Philippe Starck
Which successful architect is known for his great attention to detail, consideration for the environment and innovative use of materials and technology?	Norman Foster
Which famous Scottish designer was inspired by Art Nouveau and produces a wide range of products from posters, lighting to furniture?	Charles Rennie Mackintosh

Past and Present companies:	
What are the Italian design company is known for designing 'products with personality' which are often brightly coloured and metal?	Alessi
Who are 3 designers who worked for the Alessi design group?	Ettore Sottsass, Philippe Starck and Alessandro Mendini
What type of product is the company Dyson known for? And what type of technology did they develop for this product?	A bagless vacuum clear with 'cyclone technology'
What is the name of the Germany company that are known for designing and manufacturing small appliances such as radios, electric shavers, coffee makers etc.	Braun

Design Strategies	
What is collaborative design?	When designers work in teams to solve problems, analyse tasks and share their understanding of design problems to come up with workable solutions together rather than alone.
Explain the meaning of user-centred design?	A design process which pays particular attention to the needs of potential users of a product. The involvement of users at all stages of the design process is important.
Explain iterative design?	A process of designing a product in which the product is tested and evaluated repeatedly at different stages of design. This is to eliminate usability flaws before the product is designed and launched.
What is biomimicry?	Is an innovative approach to design which strives to copy patterns and structures in nature or imitate models, systems, and elements of nature for the purpose of solving complex human problems
What is the acronym ACCESS FM?	Aesthetics Customer Cost Environment Safety Size Function Materials
What is the acronym CAFEQUE?	Cost Aesthetics Function Ergonomics Quality User Environment
What is design fixation?	Is when a designer becomes fixed on their first idea or an idea they like but it is not the best one or they haven't explored other possibilities.

Mechanical Devices	
What is a mechanism?	A simple device that changes an input motion into a different output motion.
What are the 4 types of movement or motion in a mechanical system?	Linear motion Reciprocating motion Rotary motion Oscillating motion
What is a mechanism which moves around a fixed point (a pivot)?	Lever
What is a first order lever?	A first order lever has the fulcrum in the middle between the load and the effort. e.g a seesaw
What is a second order lever?	A second order lever has the load and effort on one side and the fulcrum on the other side. e.g a wheelbarrow

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What is a third order lever?	A third order lever has the load and effort on one side and the fulcrum on the other side, but the load is further away from the fulcrum and therefore the effort needed is greater than the load. e.g barbeque tongs
What is a fulcrum or pivot?	A fixed point around which the mechanism moves.
What is a cam and follower?	A mechanism that converts rotary motion into reciprocating motion when the cam rotates, and the follower moves up and down.
What is a gear train?	A mechanism with two wheels with teeth around the edge that interlock and transmit rotary motion or torque.
What is a linkage?	A mechanism that transfers force and changes the direction of movement.
What are 2 types of linkages?	Bell crank linkage Push/pull linkage
What are pulleys and belts?	A mechanism of two small wheels connected by a belt that transmit rotary motion to rotary motion.

Energy Generation and Storage

Describe what fossil fuels are?	A natural fuel such as coal, gas or oil formed from the remains of living organisms.
What does Britain rely on fossil fuels to provide?	Energy
What is produced when any kind of fuel is burnt?	Heat
How is electricity generated by burning fuels?	Heat is used to convert water to steam, which then drives turbines connected to generators.
What are turbines?	A wheel inside a machine which is rotated by a flow of water or other fluid, or steam or gas.
What are generators?	A machine for converting mechanical energy into electricity.
Carbon dioxide is also produced when fossil fuels are burnt. How does the release of carbon dioxide affect the planet?	It adds to the greenhouse effect and possible global warming
What does greenhouse effect mean?	Pollution in the atmosphere causes the sun's heat to get trapped in the lower atmosphere and warm up the planet.
What is nuclear power?	It is the use of nuclear reactions that release nuclear energy to generate heat.
Nuclear power is obtained from nuclear fission. What is fission?	It is a process used in nuclear reactors which involves the splitting of uranium atoms to produce heat.
What is the advantage of fission?	Huge amounts of energy can be produced from a small quantity of uranium.
What is renewable energy?	Energy from a source which will not run out.
What are 6 examples of renewable energy sources.	Wind Solar Tidal Hydroelectricity Waves Biomass
What is hydroelectricity?	The process which uses a dam to block a river in a valley and channels water through turbines that are used to turn generators for producing electricity.
What is biomass?	Growing plants so that they can be burnt or using decaying plant or animal materials to produce heat.
What are 3 main types of energy storage systems?	Kinetic pumped storage Mechanical energy storage Electrical energy storage
What is kinetic pumped storage?	A method of storing energy which can deal with a sudden high demand for electricity. It can be used as an additional fast-acting electricity top-up system.
What are 2 types of electrical storage systems?	Capacitors Batteries

Prototype Development

What is the purpose of a prototype?	Test out and modify design ideas To check the functionality To innovative designs Check viability of a product
What are the two types of prototypes?	Physical prototype Virtual prototype
What is rapid prototyping?	It is a way of making a prototype using CNC machines
Why is rapid prototyping used?	It enables a model of a product or part to be made very quickly. It allows small numbers of specialised parts to be made economically. It can be used to customise mass produced good to meet client's requirements.

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Tolerances	
What are tolerances?	Tolerances are the acceptable range of size a product or part can be
Why do we use tolerances?	Tolerances are used to make product more accurately
What is a disadvantage of tolerances?	Materials may be wasted if tolerances are not calculated correctly It may increase the manufacturing cost
Why is it difficult to maintain an accurate tolerance with timber?	Timber is a natural material, therefore it is less stable than other materials. It can move, split, bow or warp.

Material Management	
What is material management?	It is the careful planning of how material will be cut and shaped.
Why is effective material management important?	It is important because it helps to minimise waste and reduce the environmental impact of a product.
What is nesting?	When shapes in a material are laid out as close as possible without reducing the quality of the cut.
What is a datum point?	It is a data point at which the x, y and z coordinates are set at zero or a reference point from which an accurate measurement can take place.
Why is a datum point important when using a CNC machine to cut out material?	A CNC machine uses the datum point as a fixed reference point to start from when calculating the paths to take to cut out the design from the material. Laser cutters need a datum point

Specialist Technical Principles	
Specials tools and Equipment	
What is a laser cutter?	Laser cutting is a technology that uses a powerful laser beam to cut materials. It is typically used for industrial manufacturing applications, but is also starting to be used by schools, small businesses, and hobbyists.
What is a 3D router?	A 3D router can convert 2 dimensional and 3 dimensional CAD drawings into 3D products made from timber or polymer based materials.
What is a CNC machine?	A CNC, or computer numerical control machine is a high precision tool that is computer-controlled and makes repeated, accurate movements. A CNC machine works from CAD drawings
What is a CNC milling?	CNC milling is a certain type of CNC machining. Milling is a process that is quite similar to drilling or cutting, and milling can perform these processes for a variety of production needs. CNC mills are often grouped by the number of axes on which they can operate.
What is a vacuum forming machine?	The machine is used for vacuum forming shapes. The vacuum forming process works by heating a plastic sheet, forming it into a dome shape or the shape of the mould used. The plastic is then cooled until it sets hard, then removed from the mould and machine.
What is a sewing machine?	Sewing machines are used to join fabrics together and produce decorative effects. There are many 3 main types of sewing machines: Basic sewing machine Automatic sewing machine Computerised sewing machine
What is 3D printing?	<ul style="list-style-type: none"> 3D printing or additive manufacturing is a process of making three dimensional solid objects from a digital file. The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object. 3D printing is the opposite of subtractive manufacturing which is cutting out / hollowing out a piece of metal or plastic with for instance a milling machine. 3D printing enables you to produce complex shapes using less material than traditional manufacturing methods.