

MY GCSE PRODUCT DESIGN REVISION



@moretondt

MATERIALS

MATERIALS REVISION

Materials are either **RENEWABLE** or **NON-RENEWABLE**.

RENEWABLE

Can be grown or cropped from plants, trees and animals. Sometimes known as non-finite as there is no end to this resource and we can source more, through planting more plants and trees, and breeding more animals. They materials, if used responsibly are sustainable.

NON-RENEWABLE

Dug out of the ground as ores, minerals and oil, before being processed. Once consumed, they are gone forever, this is called a finite resource. It is really important that we recycle as many of these materials as possible.

WOODS
METALS
PLASTICS
SMART

MATERIALS REVISION CHECKLIST

- FERROUS METAL
- NON-FERROUS METAL
- HARDWOOD
- SOFTWOOD
- MANUFACTURED BOARD
- THERMOPLASTIC
- THERMOSETTING PLASTIC

TOP TIPS

Memory tip: Remember Pincers!

- P - Pine
- I - Indicates
- N - Needles
- C - Cedar
- E - Evergreen
- R - Redwood
- S - Softwood

Ferrous Metals

Ferrous metals contain Iron and are prone to rusting if exposed to moisture. Due to the iron within them they can also be picked up by a magnet.

Name	Properties	Uses
Cast Iron	•Hard skin but softer underneath, but brittle and it corrodes by rusting	•Metalwork vices, manhole covers and car brake discs etc.
Mild Steel	•Tough, ductile, malleable, good tensile strength •It will rust if in constant contact with water.	•Nuts and bolts, car bodies, building girders
High Carbon Steel	•Very tough and very hard, resistant to abrasion	•Used for most tools - chisels, screwdrivers, saws etc.
Stainless Steel	•Hard and tough resistant to wear and corrosion	•Cutlery and kitchen equipment
High Speed Steel	•Brittle but resistant to wear	•Milling cutters and lathe tools

Non-Ferrous Metals

Non-Ferrous metals do not contain iron.

Name	Properties	Uses
Aluminium	•Light in colour although it can be polished to a mirror like appearance •It is very light in weight	•Cooking foil, window frames, ladders etc.
Copper	•A ductile and malleable metal •It is often red/brown in colour •It is a very good conductor of heat and electricity	•Plumbing and electrical components such as telephone wire
Tin	•Very ductile and very malleable •It is resistant to corrosion from moisture •It is bright silver in appearance.	•Coating on food cans, tin foil and soldering
Zinc	•Very resistant to corrosion from moisture •However zinc is a very weak material	•Coating on screws, steel buckets •It is also used to galvanise steel
Brass	•An alloy of copper and zinc •Brass is resistant to corrosion, fairly hard, good conductor of heat and electricity	•Decorative metal works such, such as door handles and musical instruments

Smart Materials

Smart materials have properties that react to changes in their environment. This means that one of **their properties can be changed by an external condition**, such as temperature, light, pressure or electricity. This change is reversible and can be repeated many times.

There are a wide range of different smart materials. Each offer different properties that can be changed.

Shape-memory alloys	For most materials, if they are bent out of shape, they stay that way. However, if a part made from a shape-memory alloy (SMA) is bent out of shape, when it is heated above a certain temperature it will return to its original shape. This property makes it useful for making spectacle frames - they return to their original shape if they are put in hot water after bending them. SMAs are used as triggers to start the sprinklers in fire alarm systems, controllers for hot water valves in showers or coffee machines and for spectacle frames.
Piezoelectric materials	When a piezoelectric material is squeezed rapidly, it produces a small electrical voltage for a moment. If a voltage is put across the material it makes a tiny change in shape. Piezoelectric materials are being used for contact sensors for alarm systems and in microphones and headphones.
Quantum-tunnelling composite	Quantum-tunnelling composite (QTC) is a flexible polymer which contains tiny metal particles . It is normally an insulator but if it is squeezed it becomes a conductor. QTC can be used to make membrane switches like those used on mobile phones, pressure sensors and speed controllers
Electroluminescent materials	Electroluminescent materials give out light when an electric current is applied to them. Among many possible applications are safety signs and clothing for use at night.
Colour-change materials	Thermochromic materials change colour as the temperature changes. These are used on contact thermometers made from plastic strips and test strips on the side of batteries (where the heat comes from a resistor under the thermochromic film). They are also used as food packaging materials that show you when the product they contain is cooked to the right temperature. Photochromic materials change colour according to different lighting conditions. They are used for security markers that can only be seen in ultraviolet light.

WOODS






Softwoods

Softwoods come from coniferous trees which are evergreen, needle-leaved, cone-bearing trees, such as cedar, spruce, fir and pine.

Name	Properties	Principle Uses
Pine 	<ul style="list-style-type: none"> •Very light brown colour •Straight grained and sometimes knotty, fairly tough. 	<ul style="list-style-type: none"> •Cheap quality furniture, simple joinery.
Spruce 	<ul style="list-style-type: none"> •Creamy white colour •Not very tough 	<ul style="list-style-type: none"> •Indoor work including bedroom and bathroom furniture.

Hardwood

Hardwoods come from broad-leaved, deciduous trees. The main hardwood timbers include ash, beech, birch, cherry, elm, mahogany, oak and teak.

Name	Properties	Principle Uses
Ash 	<ul style="list-style-type: none"> •Light brown colour •Open grained, tough and flexible 	<ul style="list-style-type: none"> •Tool handles, some sports equipment
Beech 	<ul style="list-style-type: none"> •White to pinkish brown colour •Close grained, hard, tough but warps easily 	<ul style="list-style-type: none"> •Tool handles, children's toys, furniture
Elm 	<ul style="list-style-type: none"> •Light to medium brown colour •Open and sometimes interlocking grain, durable in water, tough, resists splitting. 	<ul style="list-style-type: none"> •Outdoor and indoor furniture
Mahogany 	<ul style="list-style-type: none"> •Pink to reddish brown colour •Fairly strong, durable, some interlocking grain 	<ul style="list-style-type: none"> •High end furniture
Oak 	<ul style="list-style-type: none"> •Light brown colour, strong, hard tough, open grained, corrodes steel screws and fittings 	<ul style="list-style-type: none"> •High end furniture, interior wood work

WOODS

Manmade Boards

Name	Properties	Principle Uses
Ply	<p>Plywood is a composite material. Composed of individual plies / veneers of wood. The plies are glued together with synthetic resin.</p> <p>Plywood is less likely to warp or split, due to this construction. Supplied in a range of sizes and thicknesses..</p>	<p>Cheap quality furniture, simple joinery. Softwood ply tends to be used in the construction industry for walls, roofs and floors.</p> <p>Hardwood ply often used for quality laminate flooring, kitchen units and some furniture.</p>
Blockboard	<ul style="list-style-type: none"> •A type of plywood. Built up with a core of softwood strips bonded together with adhesive and covered with a sheet of plywood on either side. 	<ul style="list-style-type: none"> •Used as a building material and for furniture manufacture including fitted kitchens / bedrooms. <p>A strong and heavy board, unlikely to warp and twist. The plywood faces are normally beech or other natural woods</p>
Chipboard	<ul style="list-style-type: none"> •This is made up of small chips of wood bonded together with resin and formed into sheets by compression. 	<ul style="list-style-type: none"> •It is not as strong as plywood or block board, but it is not expensive. Chipboard is often covered with a plastic laminate or wood veneer and used in cheap furniture.
MDF	<ul style="list-style-type: none"> •A quality board, relatively cheap. Composed of fine wood dust and resin pressed into a board. <p>Can be worked, shaped and machined easily. Paint can be applied to it, without the need for an undercoat or primer (although finishes better with an MDF primer)</p>	<ul style="list-style-type: none"> •Used widely in the building, shop fitting and furniture trades

PLASTICS

Thermoplastics

Can be heated and reshaped many times.

Name	Properties	Principle Uses
Polyamide (Nylon)	<ul style="list-style-type: none"> •Tough, fairly hard, self-lubricating, resists wear, good resistance to chemicals and machines 	<ul style="list-style-type: none"> •Casing for power tools, curtain rail fittings and clothing
Polymethyl methacrylate (Acrylic)	<ul style="list-style-type: none"> •Stiff, hard but scratches easily, durable, brittle in small sections, good electrical insulator, machines and polishes well 	<ul style="list-style-type: none"> •Signs, aircraft canopies and windows, covers for car lights, wash basins and baths
High impact polystyrene (HIPS)	<ul style="list-style-type: none"> •Light but hard plastic •Available in sheets but softens at high temperatures 	<ul style="list-style-type: none"> •Common for school projects which include products' outer casings or packaging.
Polypropylene (PP)	<ul style="list-style-type: none"> •Light plastic, hard but can scratch easily, tough, resistance to chemicals, resists work fatigue 	<ul style="list-style-type: none"> •Used for medical and laboratory equipment, seating, rope, some kitchen equipment
Polythene: - low density (LDPE)	<ul style="list-style-type: none"> •Tough, resistance to chemicals, flexible, fairly soft, good electrical insulator 	<ul style="list-style-type: none"> •Plastic bottles, toys, packaging film and bags
Polythene: - high density (HDPE)	<ul style="list-style-type: none"> •Stiff, hard, able to be sterilised 	<ul style="list-style-type: none"> •Plastic bottles, tubing and milk crate
PVC	<ul style="list-style-type: none"> •Stiff and hard wearing 	<ul style="list-style-type: none"> •Air and water pipes and medical devices

Thermoset Plastics

Can be heated and shaped one, cannot be reshaped.

Name	Properties	Principle Uses
Epoxy resin (Epoxide, ER)	<ul style="list-style-type: none"> •Good electrical insulator, hard, brittle unless reinforced, resists chemicals 	<ul style="list-style-type: none"> •Used for printed circuit boards (PCBs) and surface coatings and adhesives
Polyester resin (PR)	<ul style="list-style-type: none"> •Stiff, hard, brittle unless laminated, good electrical insulator, resists chemicals 	<ul style="list-style-type: none"> •Used for car bodies and boats
Urea formaldehyde (UF)	<ul style="list-style-type: none"> •Stiff, hard, strong, brittle, good electrical insulator 	<ul style="list-style-type: none"> •Used for electrical fittings and adhesives
Phenol formaldehyde (PF, Bakelite)	<ul style="list-style-type: none"> •Hard and brittle 	<ul style="list-style-type: none"> •Board and table top games and billiard ball

PAPER & CARDS

Paper

Paper weight and thickness is measured in **grams per square metre (gsm)**.

Most paper is now manufactured from recycled paper sources. Virgin paper is made from 100% wood pulp and contains no recycled material.

Different types of paper and board have different uses, as shown in the table below:

Type	Description and Usage
Layout Paper	<ul style="list-style-type: none"> •Lightweight, inexpensive, thin white paper •Used for sketches and initial ideas, takes colour well
Tracing Paper	<ul style="list-style-type: none"> •Thin and translucent, expensive •Used for making manual copies of drawings
Cartridge Paper	<ul style="list-style-type: none"> •Quality white paper, available in multiple weights •Can be used for simple model work
Bleedproof Paper	<ul style="list-style-type: none"> •Smooth and hard, medium cost •Used for water or spirit based felt tip pens
Coloured Paper	<ul style="list-style-type: none"> •Available in multiple colours and thicknesses •Used to mount finished work and to apply colour surfaces to models
Grid Paper	<ul style="list-style-type: none"> •Printed square and isometric grids in multiple sizes, low cost •Used as a guide for model making

Card & Board

The thickness of cardboard (sometimes called just Board or Card) is measured in microns; one micron is one thousandth of one millimetre. Sometimes the thickness of cardboard is given in sheets. This refers to the numbers of sheets of paper that have been glued together to

Type	Description and Usage
Board	<ul style="list-style-type: none"> •Thickness (between 300 and 650 microns) •Range of colours •Use to create models •Thickness depends on usage
Corrugated Card	<ul style="list-style-type: none"> •Strong and Lightweight •Used for packaging protection •Available in different thicknesses
Mounting Board	<ul style="list-style-type: none"> •High quality thick card •Coloured surfaces •Used for final models and mounting work
Spiral Wound Tubing	<ul style="list-style-type: none"> •Strong •3D printable surface •Used for Packaging
Duplex	<ul style="list-style-type: none"> •Foam based board •Multiple finishes available •Used for food packaging