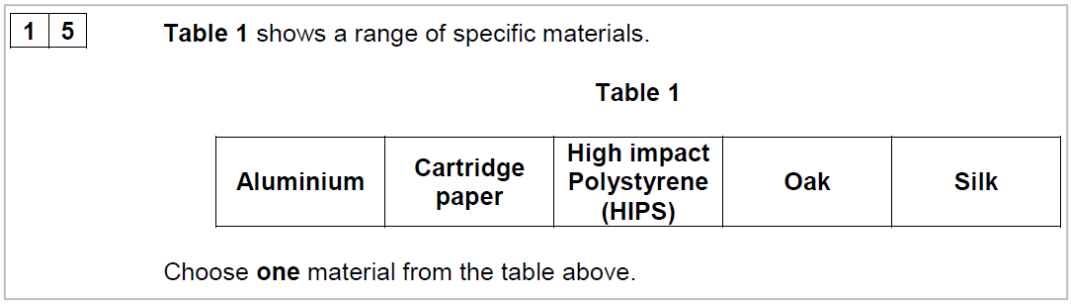
Kibworth Mead Design Technology

Timbers

Timbers are one of the two main materials we focus on for this course. The other being Polymers. Whenever you see a question with multiple material options such as:



1 5 **Table 1** shows a range of specific materials.

Table 1

Aluminium	**Cartridge paper**	**High impact Polystyrene (HIPS)**	**Oak**	**Silk**

Choose **one** material from the table above.

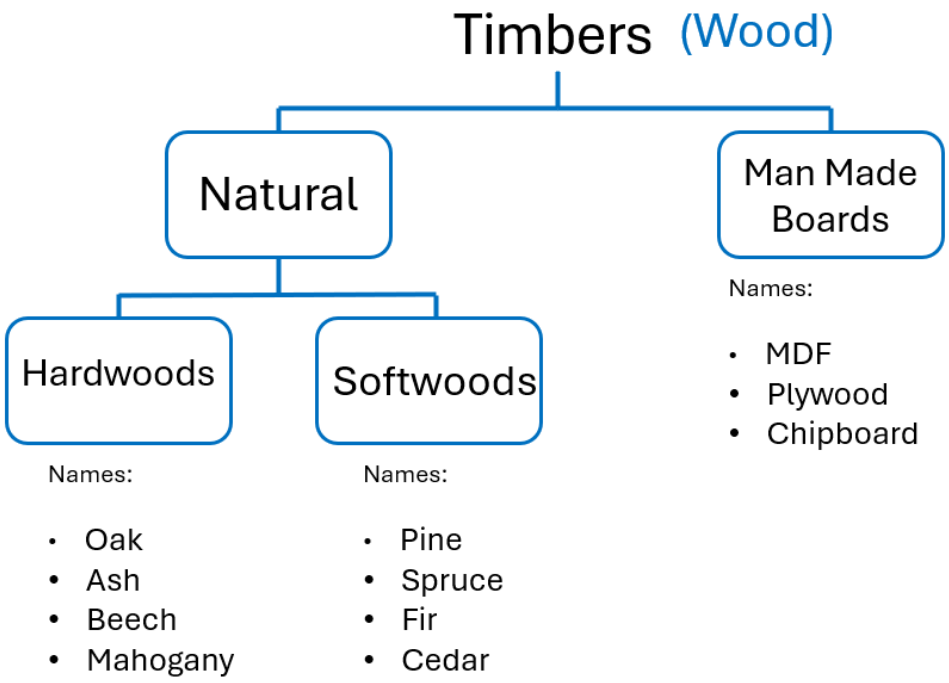
Then you are encouraged to pick Timbers of Polymers depending on how confident you are with the rest of the question.

In this guide it will cover:

- Types, Names and Conversion
- Man Made Boards
- Properties
- Working with timbers
- Joining timbers and Flatpack Furniture
- Finishes

At the back the Do Nows from lessons (with answers) will be included as well as example exam questions. Your teachers will be happy to mark these exam questions for you or you can use the mark schemes on the AQA website to help you.

Types and Names



Timbers come from trees and are a renewable material source. This means that we can get more of it again and again as we plant more trees.

See the Sustainability Revision Guide for more information about how timbers are sustainable.

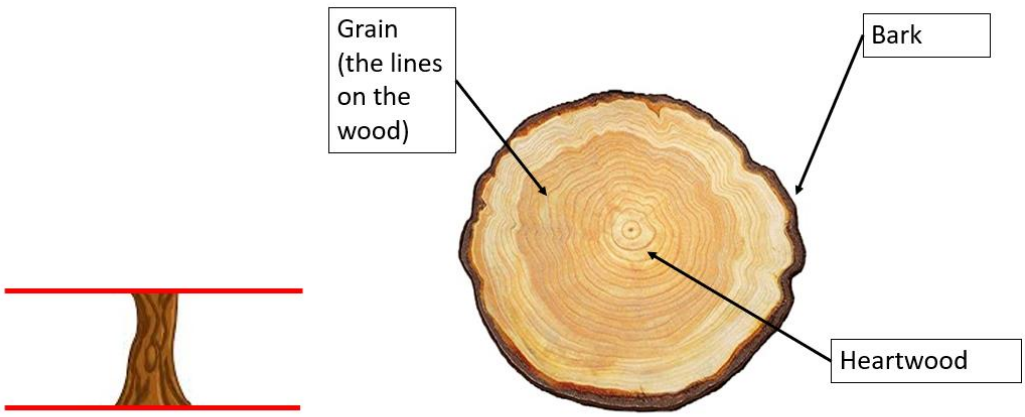
The two main categories of timbers are Natural and Man-Made Boards. Natural timbers can then be split into two subcategories Hardwoods and Softwoods. We will explore man-made boards in the next section of this guide.

First, let's look at how trees are made into usable natural timber.

<u>Felling, Conversion</u>

Trees need to be felled (cut down). The branches are cut off and the trunk of the tree cut into manageable lengths for processing.

The bark is then stripped from the outside of the trunk as this isn't very useful (paths and outdoor play areas) leaving the exposed timber. There is a layer of sapwood under the bark before we get to the usable timber inside called the heart wood.



With the heartwood now ready, we need to turn the timber into usable stock forms.

Stock forms are standard shapes and sizes of a material that manufacturers can buy, ready to turn them into products. Stock forms make transportation of the material easier but also make the material easy to cost and sell as well as making it easier for designers to know what shape the material is available in.

Stock forms of timber are:

- Planks
- Sheets
- Dowels
- Sections ('L' shape for example)

Planks and sheets are the most common stock form.

<u>Cuts of Timber</u>

When the timber is cut from the tree it is done so in one of two ways:

1. Rough sawn
2. PAR (Planed all round)

Rough sawn is exactly as the name suggests. The cuts are done quickly so won't leave a neat edge and the piece may have lots of splinters on the outside.

Rough sawn is used for timbers that will be used outside mainly – sheds, fences etc.

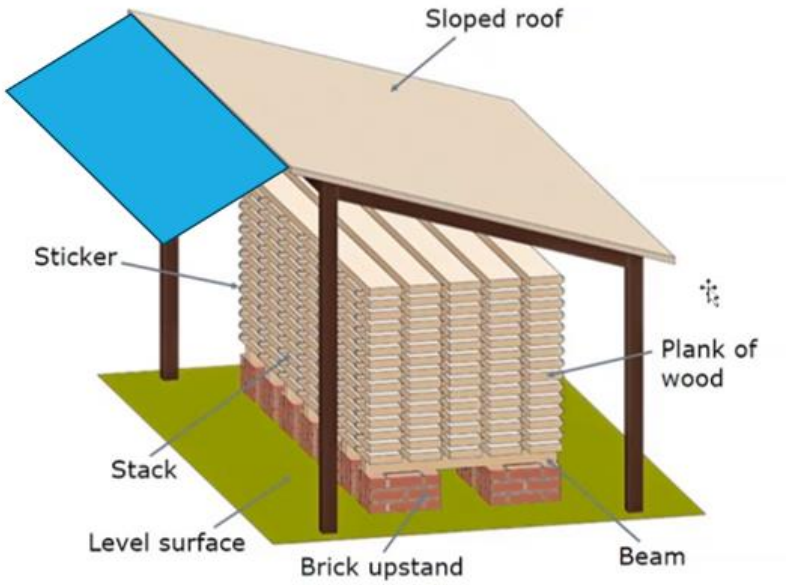
PAR cuts are for the internal timber use such as tables, chairs, cabinets etc. This is when a thinner and more delicate saw blade is used to give a nice, smooth finish to the timber.

Seasoning

Once the timber has been cut, it needs to be seasoned to remove all of the moisture inside it. The trunk of the tree carries water up to the leaves so is full of moisture. This needs to be dried out before it can be used and there are two methods of drying out timber (seasoning):

- Air dried
- Kiln dried

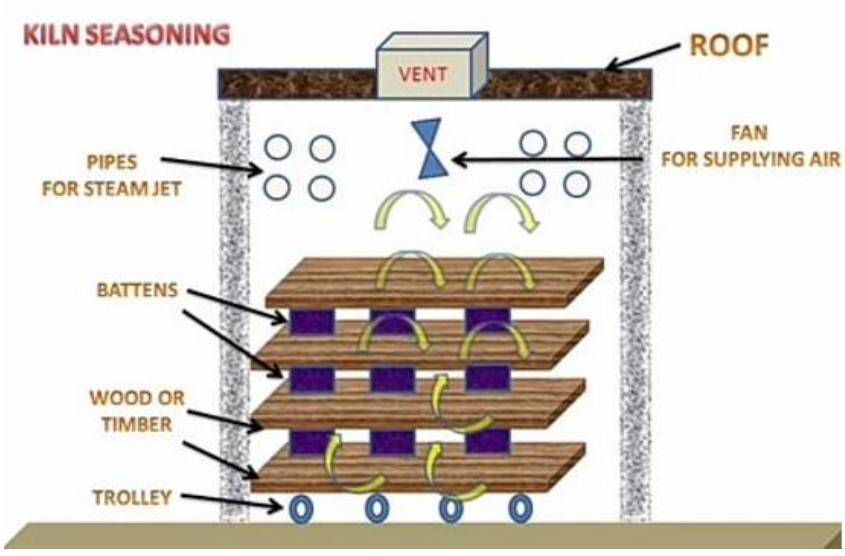
Air drying can be seen below:



The timber planks are stacked together with ‘stickers’ or ‘spacers’ between each plank. This is because the air needs to get around each plank which it couldn’t do if they were stacked on top of one another.

The stack of planks is raised off the ground to protect them from surface level moisture and from being eaten by bugs while a roof provides shelter from the rain. All four sides of the shelter are open to allow wind to pass through it and get to the planks (think of hanging washing out to dry on a washing line!)

Kiln drying is faster and produces better quality timber (less prone to faults and kills bacteria) but is much more expensive and any products made this way will be more expensive. It can be seen below:



Kiln drying works in a similar way to air drying except heaters are used and the room is sealed (no open sides). A fan then blows the hot air around the planks which are stacked in a similar way to air drying. Kiln drying is similar to how an oven works – sealed space, heater inside and a fan to blow the hot air around to evenly dry what's inside.

Now the timber has been cut and seasoned, let's look at the differences we see in natural timbers.

Hardwoods

These take 80 years to grow! Compared to softwoods they are usually wider but smaller in size and will drop their leaves in winter.

Taking 80 years to grow means they aren't as readily available making them more expensive to buy.

We can often identify hardwoods from their appearance. They are usually darker in colour compared to softwoods with the grain pattern much closer together because of how slowly they grow.

The darker timber means the grain pattern doesn't stand out as much either as it does on softwoods.

Softwoods

Softwoods take 30 years to grow to a fully grown tree. With the tree taking less time to grow, the grain pattern is much more spaced out, showing this quicker growth between grain lines.

Softwoods are also lighter than hardwoods, so the grain pattern stands out more, something that some people find more appealing to look at.

Softwoods are considered slightly less hard than hardwoods, but all timber can be scratched and dented easily.

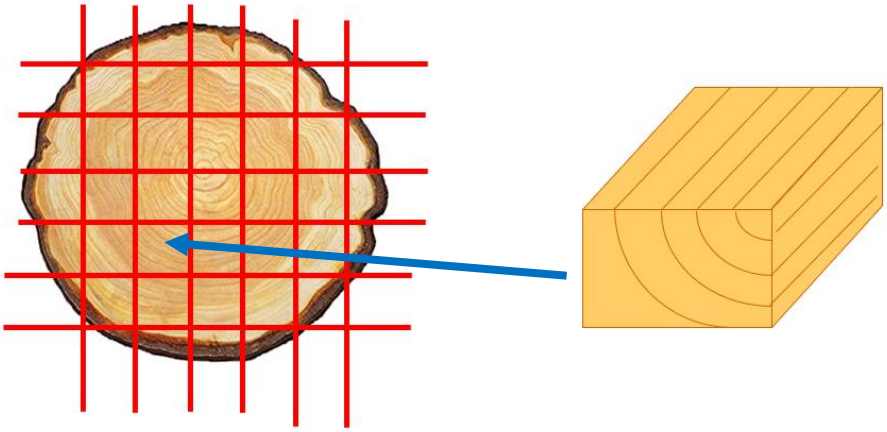
Hardness is a working property of materials. If a material is hard, this means it has a resistance to being scratched or dented (surface damage).

Softwoods also come from evergreen trees meaning they don't lose their leaves in winter. Softwood trees often grow taller and thinner than hardwoods which tend to be smaller but wider.

The lighter colour means the grain pattern is much easier to see and with the grain more spaced out compared to hardwoods, softwoods are considered to be an attractive timber to use.

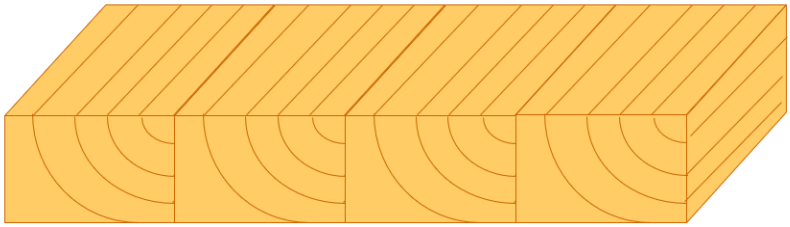
Identifying Natural Timbers

When we cut a tree trunk into planks, we cut the circular grain pattern into segments.



We can see these circular segments on the end of a plank. To tell if a timber is natural or not, we should be able to follow the lines of the grain up, over and down a plank of timber. This is because the grain runs through the tree.

Planks cut can only be as wide as the tree they are cut from, so if we need a bigger size for a product like a table, then we need to stick two or more planks together:



We can still follow some of the grain lines around each plank though so still tell if the timber is natural or not.

Man Made Boards

Natural timers have their problems so man-made boards were created to solve some of these issues. Just like with natural timbers, you need to learn the names of some man-made boards:

- MDF (Medium Density Fibreboard)
- Plywood
- Chipboard (also called Hardboard)

Let's now look at each of these boards in a little more detail:

Plywood

Plywood is made using thin layers of natural timber. It is made in a few simple steps:

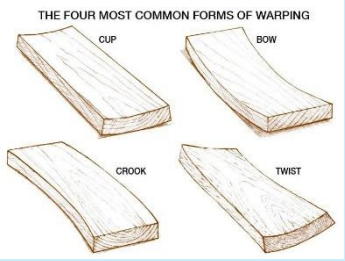
1) A tree is felled, bark removed and cut into manageable sizes (just like we learned last lesson).
2) Next the tree trunk is spun around, and a cutter is placed into the tree trunk at an angle so it can peal thin layers off the trunk very carefully. This means that grain lines will still be seen on each layer.
3) Each layer is then cut to a specific size.
4) The layers are then placed on top of each other and turned so the grain is at a perpendicular angle to the previous layer.
5) Glue is used to join each layer together

Plywood is created to because natural timber can crack down the grain pattern (this is where it is weakest) and can warp (bend).

Key Word – Warp

Definition – where timber bends/curls.

Timber can warp in different ways as shown here:



With the grain pattern in a perpendicular direction for each layer, this stops the timber from cracking all the way through and each layer will push against the other to stop it from warping (bending)

MDF (Medium Density Fibreboard)

MDF is made using small fibres of natural timber. It is made in a few simple steps:

1) A tree is felled, bark removed and cut into manageable sizes (just like we learned last lesson).
2) The waste from the heartwood is then put into a chipper and cut into small fibres. This means that grain patter is lost and can no longer be seen.
3) The fibres can be mixed with fibres from other trees.
4) The fibres are then mixed with a resin and pressed into a sheet.
5) Heat is applied to help the resin set and the MDF sheet is created.

MDF is created to because natural timber can only be made into planks as big as the tree they were cut from. If we want a cheaper, bigger board, we can use MDF because it is just made from lots of little fibres that can come from any type of tree.

Chipboard (also called Hardboard)

Chipboard is made in exactly the same way as MDF; however, it uses larger chunks of natural timber. This This means that when the mixture is pressed together, there will be air pockets in the board to help make it lighter.

It does make the board weaker against fracture (break into two pieces).

MDF and chipboard boards can be made into really large boards because they don't rely on the size of the tree, simply the size of the machine making them.

Veneer

A veneer is a thin layer of natural timber (or other material) that is layered onto another material.

Plywood is technically made from a series of veneers!

Veneers can be added onto timbers like MDF or chipboard to make them look nicer and improve their aesthetic properties.

When veneers are made, the sheet will only have the straight (ish) lines of the wood grain, and the circular segments can't be seen because the top and bottom are so thin.

This means that when veneers are put on a product, the grain pattern won't line up like it does with natural timber and you won't be able to follow the pattern around the timber plank or sheet.

Timber Properties

Firstly, let's look at working properties. These aren't just for timbers. The other materials revision guides (Polymers, Metals etc) will have this list too. Working properties are about how a material performs under a force. We analyse the working properties to see if a material would be suitable for the product and what the product needs to do.

Toughness	A materials ability to withstand fracture when a force is applied to it.
Hardness	A materials ability to withstand surface damage (dent or scratch) when a force is applied to it.
Malleability	A materials ability to be deformed under a force without fracture.
Ductility	A materials ability to be stretched without fracturing.
Elasticity	A materials ability to be stretched or compressed and then return back to its original shape.
Flexibility	A materials ability to be bent without fracture.

Timbers are used for their toughness. They are a strong material they are also lightweight compared with a material like metal and are warm to touch!

Timber is a porous material meaning that air and water can travel into and through it (think about how timber absorbs water). This means that timber is suitable for insulation (why it is used for roofs).

So, when we are selecting timbers, we need to consider:

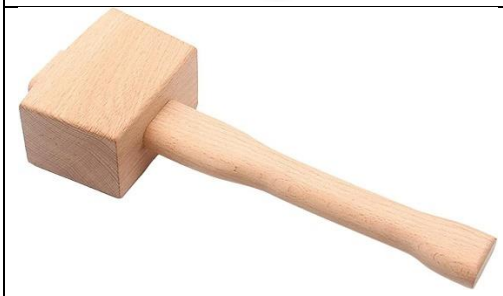
- Aesthetics – how they look
- Availability – MDF, Plywood and Chipboard are only available in sheets
- Working properties
- Cost

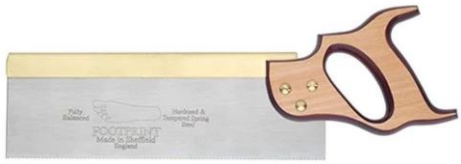
Look at the table on the next page to see how we can select the appropriate timber.

Property	Hardwoods	Softwoods	Plywood	MDF	Chipboard
Cost	£££££	£££	££	£	£
Toughness	Tough	Tough but weaker than hardwoods	Toughest but easily chipped	Least Tough	Tougher than MDF but not as touch as softwoods
Easy to cut and shape	Fairly easy	Easy	Can chip very easily so doesn't often give a neat finish	Very easy	Easy
Looks	Darker colour and lighter grain pattern – considered very attractive	Lighter colour and with a darker grain pattern – considered very attractive	Lighter with grain pattern on two sides, however layers visible all the way around	No pattern, very dull but looks smooth – not considered attractive	No pattern, looks very rough – not considered attractive

Working with Timbers

In this section we will look at the tools we use to cut and shape timbers. In our workshop you have used a range of hand tools:

	**Chisel** This tool is used to carve fine detail into timber products. They can also be used to hollow out timber shapes. They can be used with or without a mallet, but a mallet provides more force to push the chisel through the timber.
	**Mallet** This tool is like a hammer but is made from either wood, plastic or rubber. This is so it can be used on materials that aren't as strong as metal. A mallet also has a large surface area, so it doesn't apply too much force.

	**Tenon Saw** This tool is used to cut straight lines in timber. The thick blade means that only straight lines can be cut because the blade won't allow a curved cut like a Coping Saw with a thin blade did.
	**Coping Saw** This hand saw is used to cut curves/corners out of timbers. The thin blade and space between the blade and frame make it perfect for this job. The thin blade can snap easily if twisted or pulled too much.
	**Sandpaper** This comes in different sizes (Grit). The smaller the number, the bigger the grains of sand, the more material it removes. Sandpaper (also called glasspaper) is used to smooth down timber after cutting but can also be used to shape/round timbers.
	**File/Rasp** A length of metal with rough teeth. This works in exactly the same way as sandpaper – rubbing it back and forth over the material will remove any excess material. Files are often used when sandpaper can't be used and for a more delicate finish.

We can also use power tools to work with timber:

	**Belt Sander** Usually has a belt of 60 grit sandpaper. The belt moves around so when a material is pressed against it the material can be smoothed down or even rounded. This is used before hand sanding to remove a larger amount of material.
	**Scroll/Table Saw** This is an electronic version of the coping saw. It has a thin blade so can be used to cut curves and complex shapes.
	**Lathe** We don't have one of these in school! A piece of timber (usually natural) is put into this machine and turned. As it turns different shaped cutters are used to craft different shape cylindrical objects: 

	**Power Drill** Used to cut holes in timber or other materials. Different drill bits can be added depending on the job needed. In school we use general purpose twist drill bits, however special timber drill bits, countersink bits, flat bits etc can all be used.

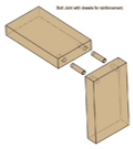
You might be asked questions about this in the exam. If you are it will either, be in Section A and multiple choice which would just be to identify the name of the tool, or it will be in Section B.

If the question is in Section B then you might need to explain using annotated diagrams HOW the tools are used (including health and safety steps)

Joining Timbers & Flatpack Furniture

Timbers are unique as they have their own special methods for joining them together. They could be joined with components such as screws, nails etc, however timbers have a number of different joints that can hold them together and, in some cases, give a nice aesthetic look!

Below is a table of the different timbers joints we can use and their properties:

Joint	Looks	Strength	Easy to Make	Repairable ?	Can be used without glue?
Butt Joint		Weak unless a large surface area is used.	Easiest	No	No
Dowel Joint		Strong but not as strong as mortise and tenon.	Difficult to make as needs to be very accurate.	Yes	Yes
Housing Joint		Strongest	Easier than dowel or mortise and tenon joints	No	Yes, but not very strong without
Mortise and Tenon Joint		Strong.	Slightly easier than dowel joints.	No	Yes

Timbers can also be joined using other general joining methods such as:

- Nails
- Screws
- Knock-down Fittings

These joining methods (fixings) are often used in flatpack furniture because they are much easier to use.

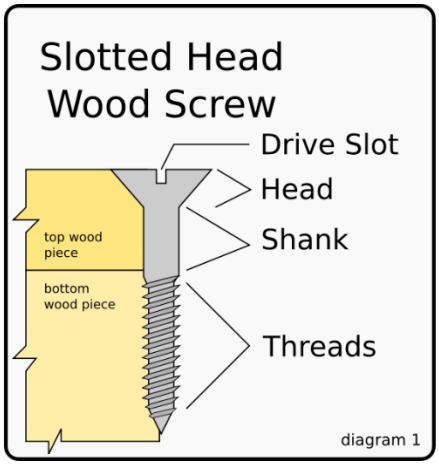
Nails

Nails are threadless and are hammered into position. They use compression to hold the materials together as they are forced into the material.

Nails are considered permanent because once they are taken out the hole they were put in won't be as tight and the nail will likely come out again.

Screws

A screw needs a pilot hole the size of the core diameter drilling. This is to not put too much pressure on the timber and crack it. The screw itself then



works by the thread cutting into the timber, keeping it between the thread that prevents the screw from being pulled out.

A countersink hole needs to be drilled to make sure the head sits flush with the timber.

Flat Pack Furniture & Knock-down Fittings

These are used for flat pack furniture. Flat pack furniture is often sold in shops like IKEA and it is furniture that the customer needs to build and assemble themselves.

This helps companies make furniture cheaper as they save on assembly costs. However they need to make sure the furniture is designed to be as easy to put together as possible given that the customer might not have a high level of confidence or competency.

Knock-down fittings can easily be assembled with a simple screwdriver or Allen key.

They aren't as strong or rigid as the timber joints we looked at last lesson but can be taken apart and reassembled easily.

They are also very easy for the company to make – they only drill the holes and then buy the cheap components to sell with the product.

Timber Finishes

Timber has two problems:

1. The looks! Even the colour of natural timber will fade over time and some man-made boards like MDF doesn't look attractive to start with.

2. Damage. Timber isn't very hard so can be scratched and dented very easily... plus it can rot and weather away if left outside.

We can add finishes to timber to help with this as some timber will need both the aesthetics protecting and its physical state protecting from damage.

Remember, Timber is absorbent, however if it takes on water regularly it will begin to rot away.

We learned in this revision guide that timber can be cut two ways, one being rough sawn. This timber is often used outside where it will be exposed to lots of water. However to prevent rot it can be pressure treated where a treatment is forced through the timber with pressure to help make the timber last longer... but this doesn't last forever.

Other timber finishes can be seen below:

Finish	Aesthetics	Protection	Function	Reapplication Needed?
Wood Preservative	No	Yes	Painted on to protect timber against fungal or insect attack as well as preventing rot and decay.	Yes
Varnish	Yes	Yes	Varnish adds a thick, clear layer on top of the timber. This protects it from moisture, surface damage and enhances the grain pattern.	No – unless chipped off
Oil	Yes	Yes – from moisture only	Protects from moisture but soaks into the timber so doesn't protect from surface damage.	Yes – regularly!
Paint	Yes - not used on natural timber as the grain pattern is lost.	Yes – from moisture only	Protects from moisture but soaks into the timber so doesn't protect from surface damage.	No
Stain	Yes	No	Permanently colours the timber – transparent so the grain pattern shows through.	Yes
Wax	Yes	Yes – from moisture only	Protects from moisture but soaks into the timber so doesn't protect from surface damage.	Yes – regularly!

Do Now Questions

What does PAR stand for when talking about how timbers are sawn?

Planed All Round – when all the sides of the timber are made smooth and cut with precision.

What is 'felling'?

Cutting down a tree. Often stripping the branches and cutting the trunk into usable lengths.

Why would IKEA use chipboard and MDF for their furniture?

They are much cheaper. IKEA specialise in cheap, fashionable furniture so using these materials helps them keep costs low.

Name 4 softwoods

Pine, Spruce, Fir and Cedar

What is the difference between a Coping Saw and a Tenon Saw?

A coping saw has a thin blade so can cut curves. A tenon saw has a thick blade so can only cut curves.

Why do we need to sand timber after cutting?

To make it safe. Timber splinters when cut so needs smoothing to make it safe to use.

Why is natural timber expensive?

The trees take either 30 or 80 years to grow.

Why is MDF cheaper than natural timber?

MDF is made from waste timber and doesn't need to all come from one tree like a plank so is much cheaper.

Why is glue not the strongest method of joining timber together?

Glue has flexible properties allowing for the parts to move slightly. This movement means that eventually the glue will break, and the parts will separate.

Why does glue not work on polymers?

Polymers aren't POROUS so the glue doesn't form the same bond with the material.

What finish would timber used for a garden shed have, PAR or rough sawn?

Rough sawn

What are the two reasons we add a finish to timber for?

Enhance and protect the aesthetics

Protect the timber from damage

Which timber joint is the strongest when used with glue?

Housing joint

Which timber joint can't be used without glue?

Butt joint

What are the two main categories of timbers?

Natural timbers & Man-Made Boards

Name two softwoods

Pine, Spruce, Fir and Cedar

What are the two types of seasoning?

Air dry & Kiln

Which is the most expensive seasoning method?

Kiln – it requires a heat source to be paid for as well as a containment structure to be built

How is Plywood made?

Layers of natural timber are glued together with the grain pattern in perpendicular directions and pressed into a sheet.

GCSE Exam Questions

June 2023 Paper (Mark scheme - Mark scheme: Paper 1 - June 2023 (sanity.io))

1 1 . 1 Name **one** manufactured board.

[1 mark]

1 1 . 2 Explain **one** advantage of using manufactured boards.

[2 marks]

1 8 Choose **one** commercial process from the table below.

Paper and board die cutting	Wood turning	Metal casting	Polymer extrusion	Textile weaving	Electronic pick and place assembly

My chosen process is _____

1 8 . 1 Name a **specific** main material used with this process.

[1 mark]

_____

1 8 . 2 Name a stock form of the material used in your chosen process.

[1 mark]

_____

1 8 . 3 Give **two** reasons that make your chosen process suitable for commercial manufacture.

[4 marks]

1 9 Five tools are shown below.

1 9 . 1 Name **one** of the tools shown.

[1 mark]

_____

1 9 . 2 Explain what the tool you have named in Question **19.1** is used for.

[2 marks]

_____

_____

_____

June 2022 Paper (Mark scheme - Mark scheme: Paper 1 - June 2022 (sanity.io))

0 3 A malleable material is one that

A can be pressed into a shape or form. ⬭

B is able to withstand scratches and indents. ⬭

C is hard to break or snap. ⬭

D rusts with exposure to air and moisture. ⬭

[1 mark]

0 7 Identify the material shown in **Figure 1**.

Figure 1

A Balsa ⬭

B Chipboard ⬭

C Medium density fibreboard (MDF) ⬭

D Plywood ⬭

[1 mark]

0 9 A tough material is described as one that can

A bend and then return to its original shape. ⬭

B be pulled or stretched along its length. ⬭

C be shaped by pressing. ⬭

D withstand impacts without breaking. ⬭

[1 mark]

November 2021 Paper (Mark scheme - Mark scheme: Paper 1 - November 2021 (sanity.io))

1 0 Which **one** of the following is a manufactured board?

A Ash ⬭

B Balsa ⬭

C Plywood ⬭

D Spruce ⬭

[1 mark]

		
Mail packaging	**Baseball bat**	**Screwdriver blade**
		
Baby's drinking cup	**Gym wear**	**Electronic device with display**

1 4 . 1 Name the specific main material/component of your chosen product.

[1 mark]

_____

1 4 . 2 Name **one** property of the material of your chosen product.

[1 mark]

_____

_____

1 4 . 3 Describe why the property is needed for the product to function properly.

[2 marks]

_____

2 6 Use notes and/or sketches to describe how a material of your choice would need to be prepared/processed for a surface treatment or finish.

Name any equipment you would use and describe how it is set up.

[6 marks]