

Materials Woods

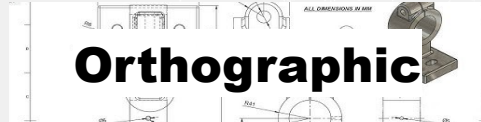
IGCSE Design Technology

Theory Knowledge for Paper 2:

Materials & Processes



Communication



Influences on Design



IGCSE Design Technology



Woods Knowledge

Woods



- **Categories and types of materials**
- **Preparation of materials**
- **Setting, measuring, marking out, testing**
- **Shaping**
- **Joining and Assembly**
- **Finishing**

Categories & Types of Woods.

What are the different categories of woods?

Softwood

What puts types of woods in these categories?

Coniferous trees



- Leaves stay on all year
- Grows fast 20+
- Found in cool temperate

Hardwood

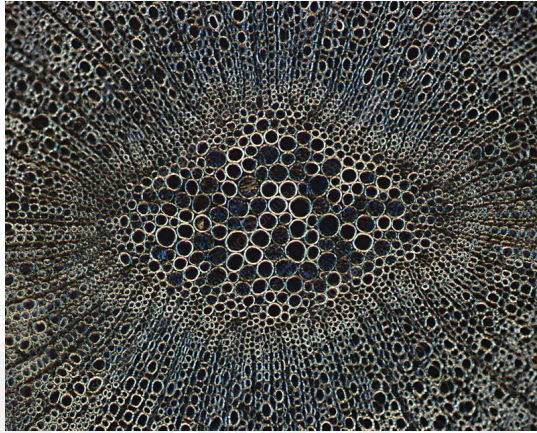
Deciduous trees



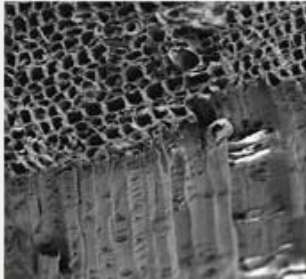
- Leaves fall off in the winter
- Grows slowly 100+

Categories & Types of Woods.

What is the structure of woods?



- Trees use tubes (xylem) to transport water up the tree
- we call these fibres.



You can count the dark rings on a tree to determine its age

- these are called Age Rings

The dark lines are denser and formed from slow growth during the winter

How will this break?



- From the side, dark lines can be seen
- We call this: grain
- Wood is weak along the grain

Categories & Types of Woods.

What types of woods are these and how can you tell them apart?

Name Pine
Category Softwood



Appearance
Yellowish colour
Long thick grain
Property
Low density
Use
Construction
Cheap furniture

Name Cedar
Category Softwood



Appearance
Light red and brown colour, turns silver
Property
Natural preservatives and deters insects
Use
Clothing storage
Outdoor construction

Name Redwood
Category Softwood



Appearance
Rich reddish brown colour
Subtle light age rings
Property
Lightweight but durable
Resists water and decay
Use
Outdoor furniture & decking
Fine Woodworking



Categories & Types of Woods.

What types of woods are these and how can you tell them apart?

Name Spruce

Category Softwood



Appearance

Light yellow grain

Long thick grain

Property

Excellent strength to weight ratio

Use

Construction

Pulp for paper



Categories & Types of Woods.

What types of woods are these and how can you tell them apart?



Name Mahogany
Category Hardwood



Appearance
Light red/brown
Darken by age

Property
Stable - doesn't warp
Highly workable

Use
Fine furniture
Musical instruments

Name Oak
Category Hardwood



Appearance
Swirly grain
Medium darkness

Property
High density
Durable

Use
High quality furniture
Tall ships

Name Beech
Category Hardwood



Appearance
Light colour
Small dashes/freckles

Property
Antiseptic properties
Doesn't splinter

Use
Children's toys
Kitchenware and handles

Categories & Types of Woods.

What types of woods are these and how can you tell them apart?

Name Jelutong
Category Hardwood



Appearance
Uniform pale white
Straight grain

Property
Lightweight,
non-durable

Use
Wood carving
Stationary, matchsticks

Name Meranti
Category Hardwood



Appearance
Rich colour
Ribbon stripe grain

Property
Low warping
Easy to work

Use
Budget furniture
Doors and windows

Name Balsa
Category Hardwood



Appearance
Swirly grain
Medium darkness

Property
High density
Durable

Use
High quality furniture
Tall ships



Categories & Types of Woods.

What is manufactured board?

Manufactured board is a composite material made from wood particles, fibers, and veneers that are bound together with adhesives to create a wood-like panel.



Advantages

Improved properties, such as directional strength, dimensions, cost, uniformity and stability

Disadvantages

Some are easily damaged or soak up water.
Some weigh more or cost more.

Categories & Types of Woods.

Name MDF **Manufactured board**



Description

Wood particles and glue compressed together

Also...

Can't get wet
Very Dense
Will flake apart

Name Plywood **Manufactured board**



Description

Layers of ply with the grain glued together at 90 degrees each time to remove its weakness

Also...

Different quality materials can be used

Name Blockboard **Manufactured board**



Description

Strips of softwood in the core with a layer of ply on the top and bottom

Also...

Useful when you need thicker material



Categories & Types of Woods.



Name Chipboard
Manufactured



Description

Large wood particles and glue compressed together

Also...

Cheapest wood you can buy.

Normally covered with laminate.

Materials Woods

Woods **Preparation of Woods**

Environmental Impacts

Softwoods

- **Fast Growth Rates:** Softwood trees grow much faster than hardwoods, allowing forests to be replenished and harvested on a shorter, more sustainable rotation.
- **Carbon Sequestration:** Growing trees absorb carbon dioxide, locking it into the wood fiber throughout the product's lifecycle.
- **Lower Energy Processing:** Sawmills processing softwoods often burn leftover green wood residues (bark and sawdust) onsite to power kiln-drying and machinery, lowering fossil fuel reliance

Hardwoods

- **Slow Growth Cycles:** Hardwood trees take decades or centuries to mature, meaning overharvesting leads rapidly to permanent deforestation and localized habitat loss.
- **High Carbon Storage:** Mature hardwood logs store high volumes of carbon per cubic meter—often significantly outstripping their initial cradle-to-gate production emissions.
- **Sourcing Sensitivity:** Hardwoods require strict certifications (such as those from the Forest Stewardship Council) to ensure they do not originate from fragile, unmanaged old-growth forests.

Manufactured Boards

- **Resource Efficiency:** They utilize scrap wood, sawdust, and fast-growing small-diameter trees, maximizing raw material yields and reducing waste.
- **Chemical Binders:** The primary environmental concern is the use of synthetic resins and glues (such as urea-formaldehyde), which can release volatile organic compounds (VOCs) during production and end-of-life breakdown.
- **Higher Embodied Energy:** Gluing, pressing, and transporting engineered panels requires significantly more industrial processing and non-renewable energy than cutting solid softwood or hardwood lumber.

Preparation of woods

Preparing wood from trees

Why do we need to dry wood?



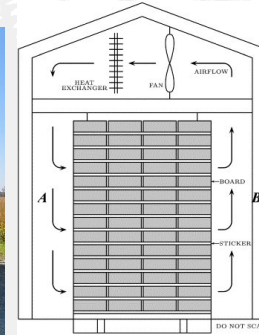
Reduces the water content to 10-20%
Stabilizes the wood
Kills fungus and insects

Air drying



- Reduces cracking and twisting
- 8-16 months

Kiln drying



- Quick and cost effective
- 6-8 weeks

Preparation of woods

Stock Form - Standard material profiles



Plank



Strip



Square



Veneer



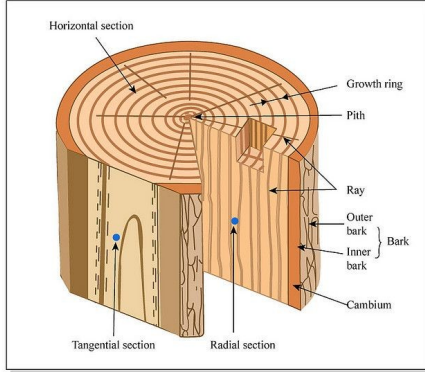
Dowel



Groves to allow glue
to fit into the hole

Preparation of woods

Creating boards



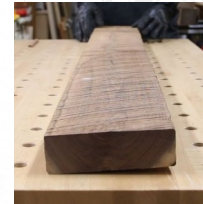
Planks can only be as big as the tree allows, so you need to glue multiple planks together to make a board



Sash Clamps, used to glue large pieces together

Natural woods bend and twist, when you glue into a board, this could multiply.

You need to glue the curve of the grain in alternative directions



Materials Woods

Woods **Marking Out**

Marking out

Types of marking out equipment



Metal Rule



Trisquare



Marking Gauge



Mortise Gauge



Marking Knife



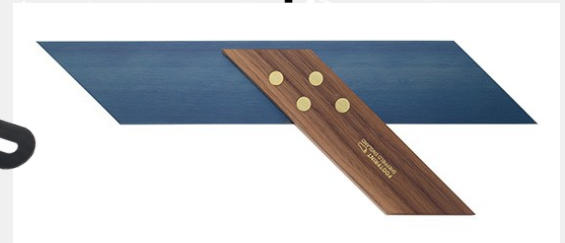
Bradawl



Sliding bevel



Mitre Square

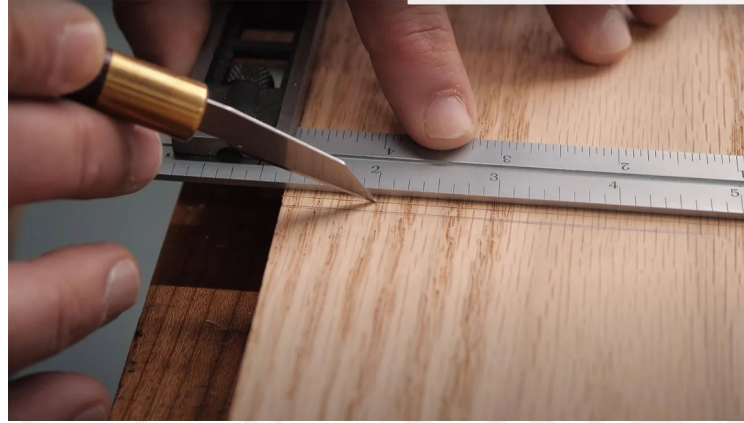


Marking out

Marking out methods



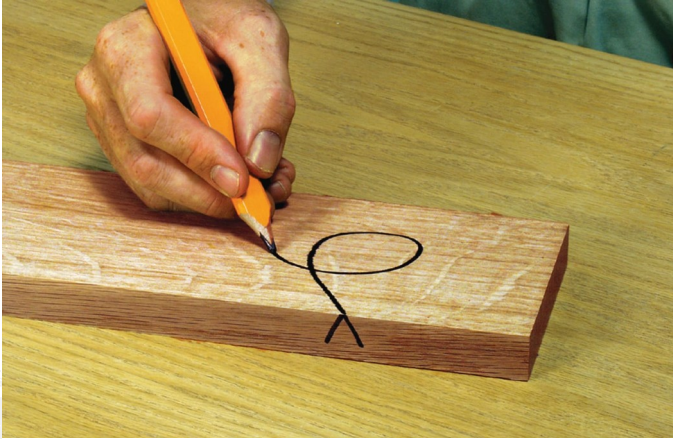
Marking out on all sides to keep cutting accurate and square. Shading out waste material to help indicate where to cut.



Marking knives are used for precision but also creates a track for saws and chisels. This also preventing wood splitting beyond the line.

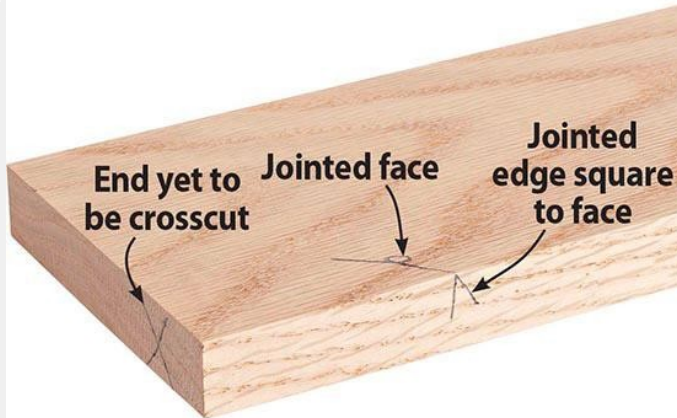
Marking out

Marking out methods



A board's working face and edge are the surfaces that all measurements are taken from.

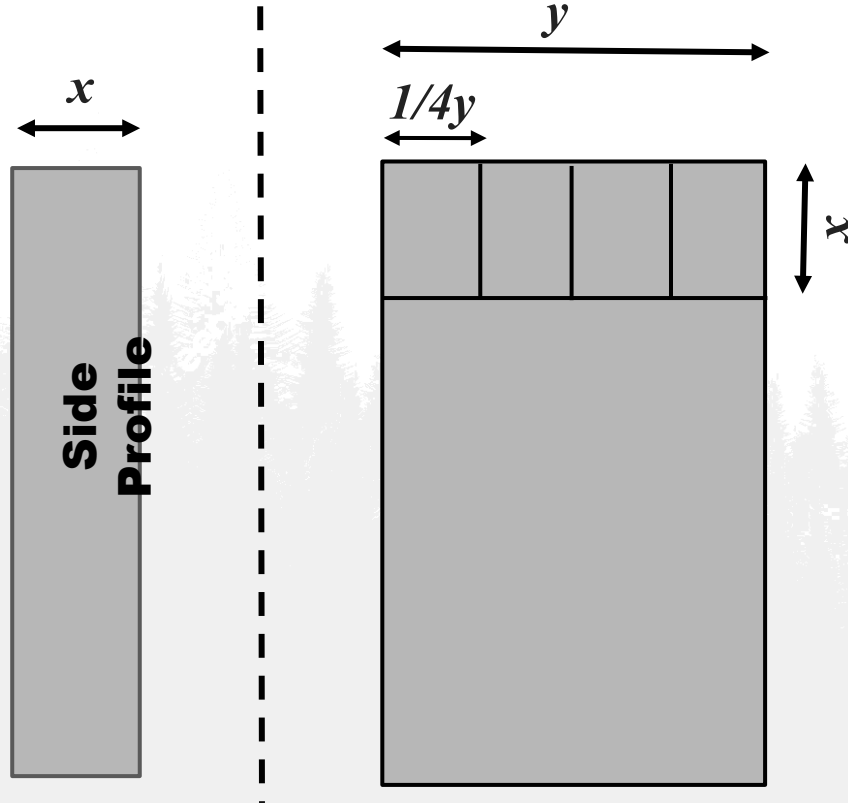
This dates back to when boards were planed by hand. You couldn't count on every side to be strictly parallel, so two were designated as reference surfaces.



It's still a good idea. These marks can mean front and top, too.

Marking out

FPT - Mark out a finger joint



Mark all the way around the wood

- this helps when you cut it out

Scribble the waste materials

- Helps prevent cutting the wrong piece



Materials Woods

Woods **Shaping**

Shaping woods

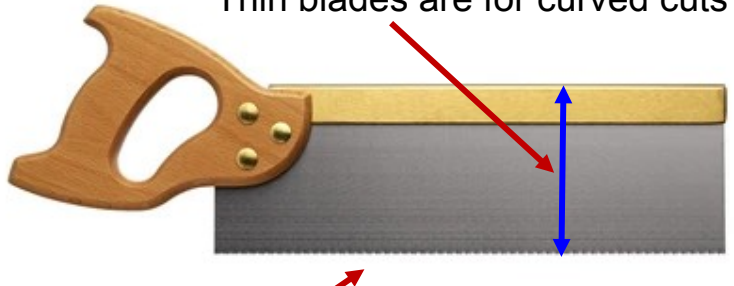


Cutting - Saws

Saws are used to remove the bulk of the material close to shape before using a metal file, sandpaper or planes to give the final shape and finish

Blade

Thick blades are for straight cuts
Thin blades are for curved cuts



Teeth

Smaller teeth are for harder materials
Large teeth remove more material quickly



Tenon Saw

For cutting straight lines



Panel Saw

For cutting large sheets



Coping Saw

For cutting curved lines



Bench hook

To hold the work



Shaping woods

Types of Chisels



Bevel Chisel



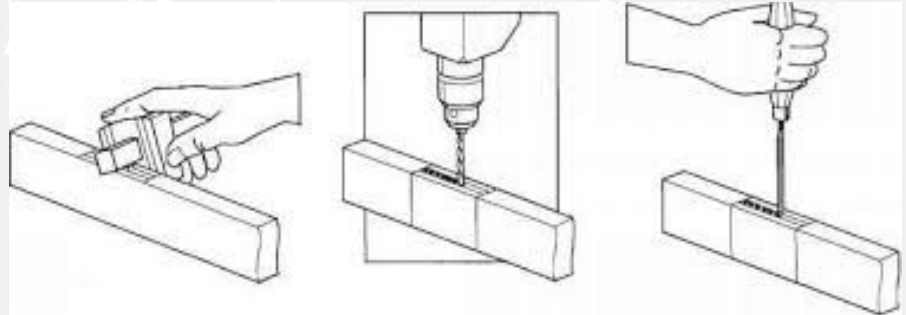
Mortise Chisel



Gouges



**Keep both
hands
on/behind
the chisel**



Shaping woods

Types of wood planes



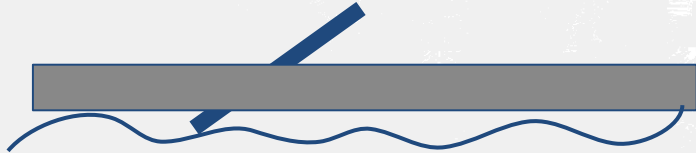
Jack plane



Spoke Shave



Smoothing plane Jointer plane



The base of the plane sits on the high spots, the plane blade cuts any of the high spots off until its flat

Shaping woods

Types of wood working machines

Belt Sander



Disc Sander



Scroll Saw



Pillar Drill



Bandsaw



Mortise Cutter



Wood Lathe



Shaping woods

Types of woodworking hand machines

Hand drill



Hand power Drill



Router



Jigsaw



Hand power planer

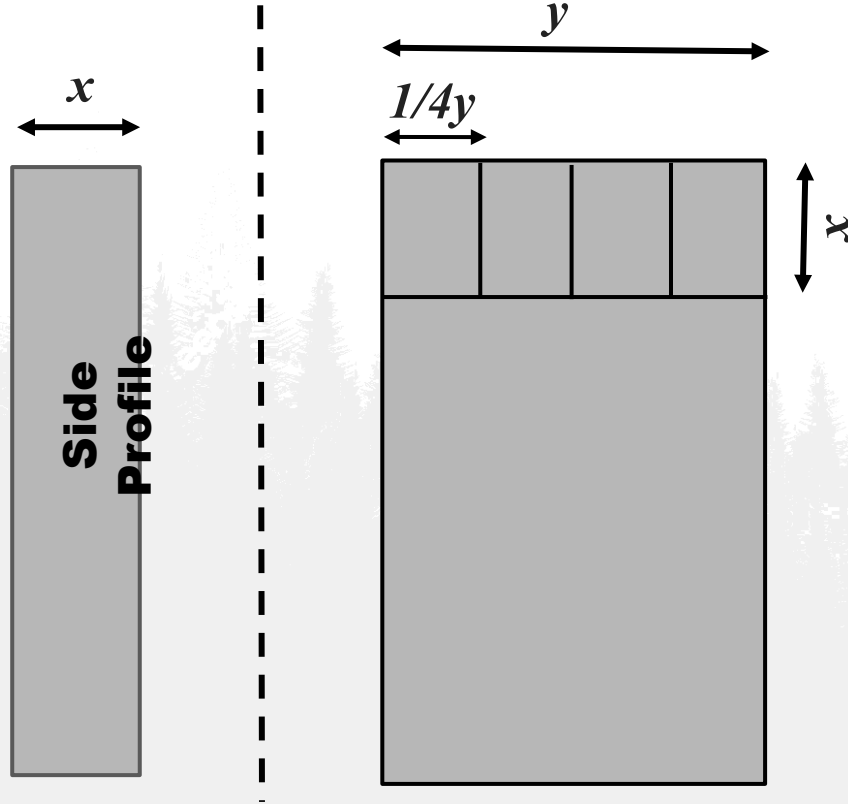


Hand circular saw



Marking out

FPT - Cut out the finger joint



Mark all the way around the wood

- this helps when you cut it out

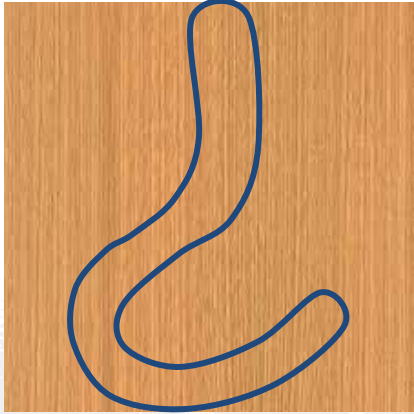
Scribble the waste materials

- Helps prevent cutting the wrong piece



Shaping woods

Laminating and **Steaming**



Steaming



Steam chamber
- Wood is left in
hot steam to
make the resin
soft

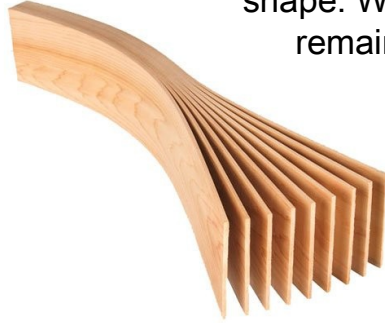


Steaming softens the resin in
wood, which allows it to be
bent whilst its soft

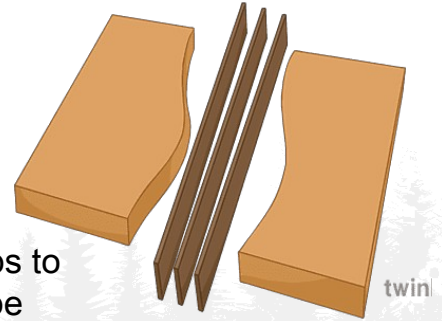
What's wrong with cutting this
out from a solid board

Shaping woods

Laminating and Steaming



Thin/flexible pieces of wood are glued together and held in shape. When the glue sets, it remains in that shape.



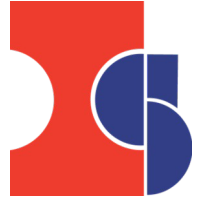
A jig uses clamps to hold it in shape

Vacuum bag - uses air pressure to hold it in shape



Shaping woods

FPT - Laminated Organiser



Choose one of these products.

Create a blue foam former and laminate using the bagpress

Flexible plywood will only bend to a maximum of ... before breaking

Finish the edge of the product using a jack plane.



Materials Woods

Woods **Joining and Assembly**

Joining woods

Types of adhesives



PVA GLUE

- General purpose wood glue
- 2 hours gluing time
- Needs to soak into the wood fibres
- Sets clear



Cascamite GLUE

- Waterproof glue
- 3 hours gluing time
- Strong wood glue



Epoxy Resin

- General purpose glue
- 10 minute gluing time
- 2 part adhesive
- Type of thermoset plastic



Acrylic Cement

- Plastic glue
- 1 minute gluing time
- Solvent - will evaporate
- Use capillary action



Contact Adhesive

- General purpose glue
- 15 minute gluing time
- Allow to go tacky on individual surfacers before joining

Types of Joints

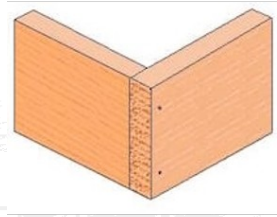
Score each joint for the following

Aesthetics /10

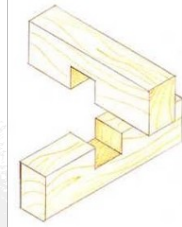
Surface Area /10

Mechanical strength /10

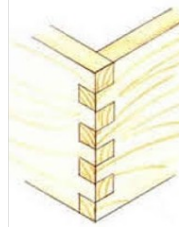
**Difficulty to construct
/10**



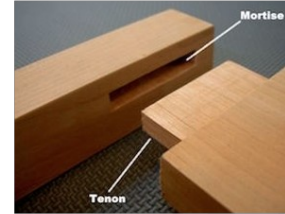
Butt Joint



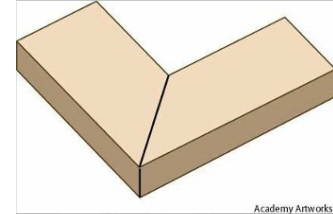
Cross halving



Finger joint



Mortise & tenon



Mitre joint

	/10	/10	/10	/10	/10
Aesthetics					
Surface Area					
Mechanical strength					
Difficulty to construct					

Types of Joints

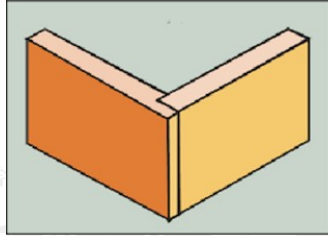
Score each joint for the following

Aesthetics /10

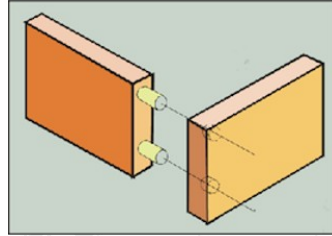
Surface Area /10

Mechanical strength /10

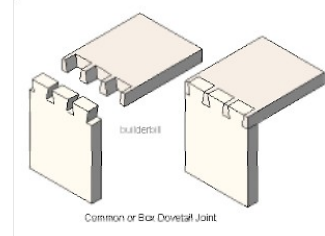
**Difficulty to construct
/10**



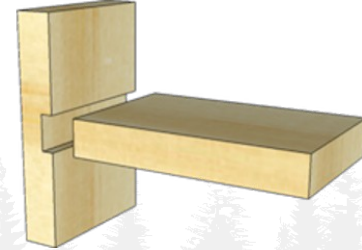
Lap Joint



Dowel joint



Dovetail joint



Housing joint

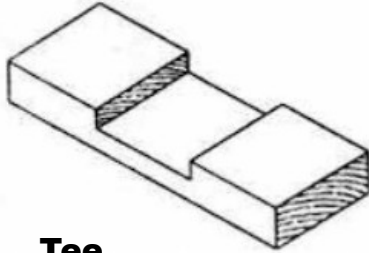
	/10	/10	/10	/10
Aesthetics				
Surface Area				
Mechanical strength				
Difficulty to construct				

Types of Joints

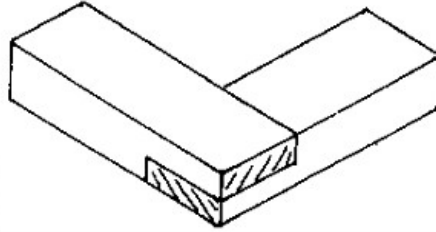
Joint Terminology – Random questions found in exams



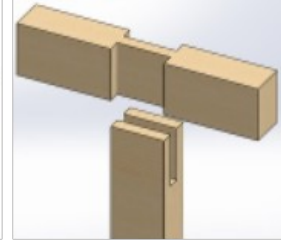
Halving



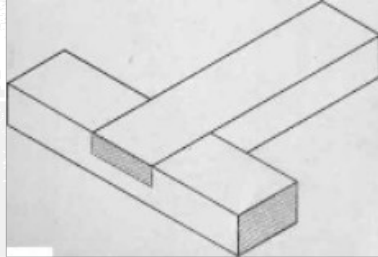
Corner



Bridle



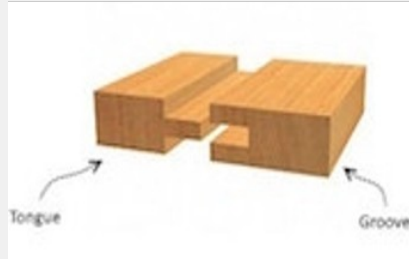
Tee



Through Vs Blind



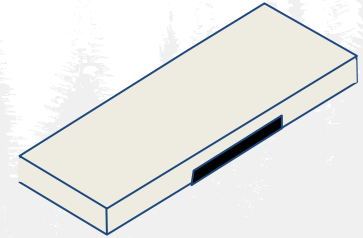
Tongue and Groove



Biscuit Joint



Rebate

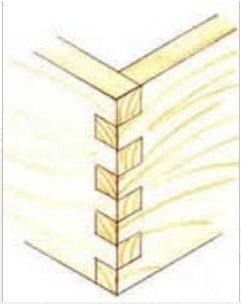


Types of Joints

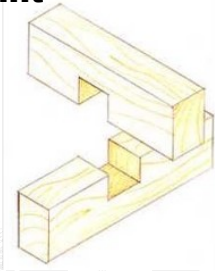
Using a range of materials, by hand,
create as many joints as possible



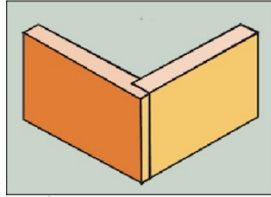
Finger joint



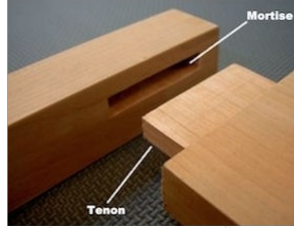
Cross halving joint



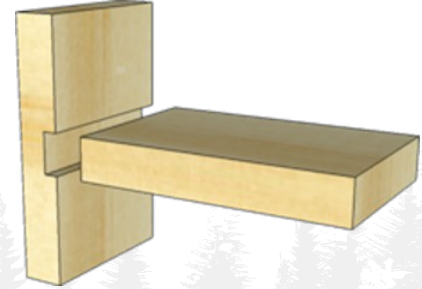
Lap Joint



Mortise & tenon joint



Housing Joint



How do you create them?

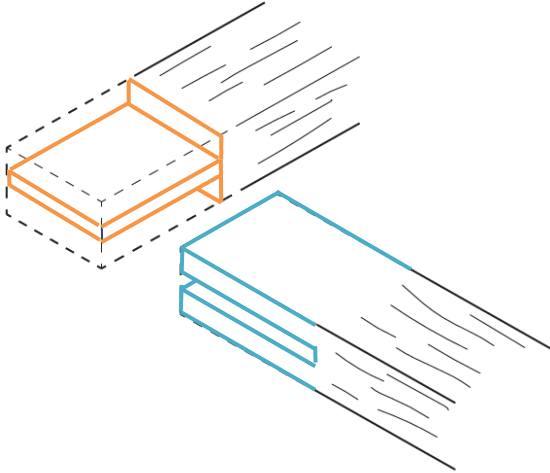
Types of Joints

Joint Terminology – Random questions found in exams

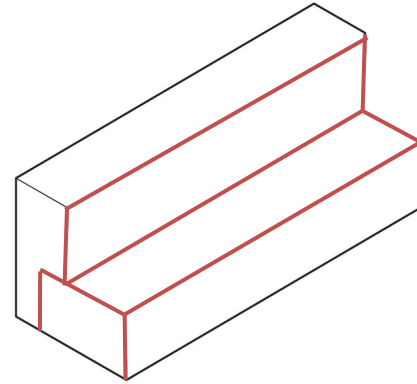


6

- 9 Complete the drawing below to show an exploded view of a corner **bridle** joint.



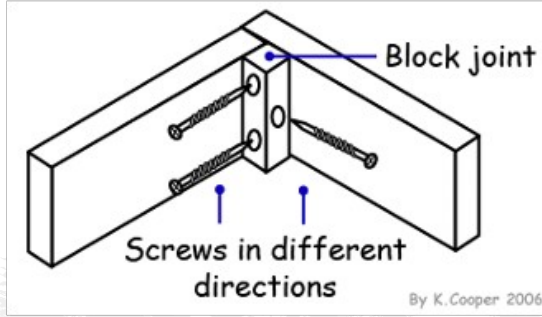
- 4 Complete the drawing below to show a rebate.



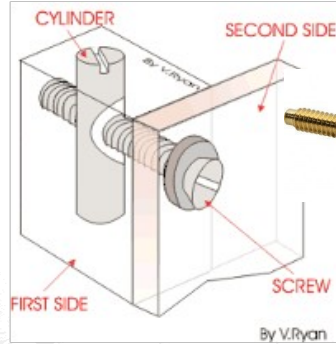
Types of Joints

Knock Down Fittings

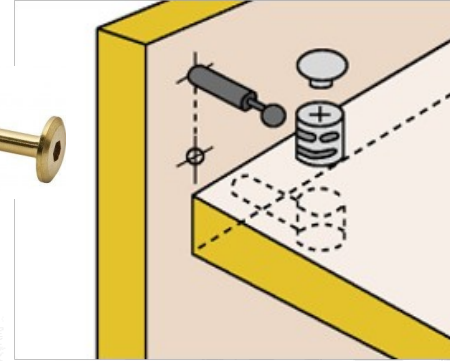
Corner Blocks



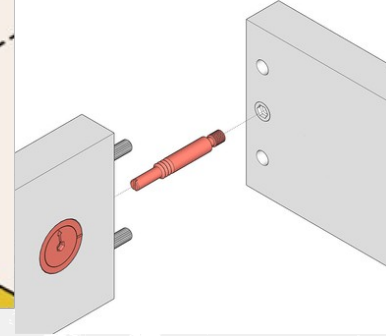
Scan Fitting



Cam Lock

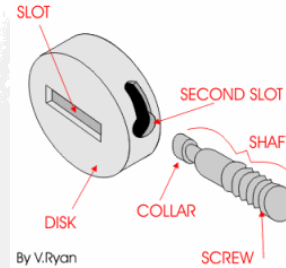


How to Attach

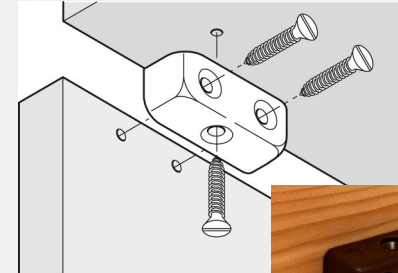


Knock-down fittings are hardware components designed to join panels together temporarily or permanently without the use of traditional wood glue and clamps.

They are heavily used in flat-pack or furniture like IKEA products, allowing items to be manufactured quickly, shipped flat, and assembled at home using basic tools like a screwdriver or an Allen key.

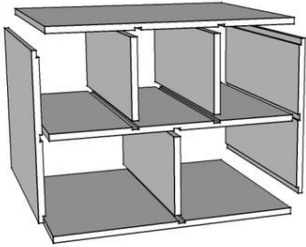


Modesty Block



Joining Metals **Types of Construction**

Carcase Construction



Frame construction uses interconnected narrow boards joined by profiles like mortise and tenon, while carcass construction builds a solid box using panels joined end-to-end like lap joints



Frame Construction



Joining Metals **Types of Production**

In manufacturing, the **level of production** depends on the **volume needed**, **cost of setup** and how much **customization** the customer requires.



One-Off Production

1 Product made at a time
Expensive to produce
Highly Skilled
Non specific tools & machines

Batch Production

4-50 Product made at a time
Medium Skilled
Non specific tools & machines
use of Jigs
Multiple same machines

Mass Production

1000+ Products manufactured
Low Skilled
Specific machines
Use of production lines

Continuous

Production continuously produced
Low Skilled
Specific machines
Use of production lines

Joining Woods **Jigs, formers, moulds**



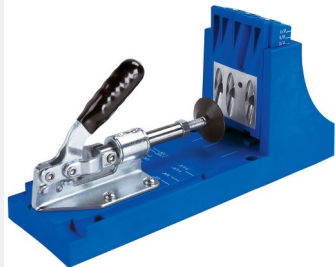
Mould - Material flows into the cavity



Former - Soft material is pulled over the shape



Drilling Jigs - Helps locate the hole accurately and quickly



Holding device - Holds and lines up material

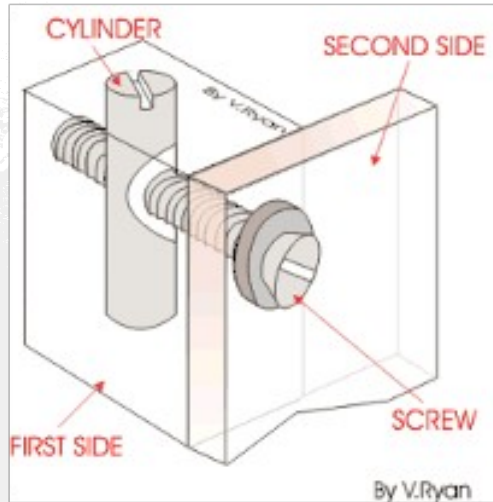
Joining woods

FPT - Knock Down Fittings



How would you make a drilling jig to drill these holes?

Scan Fitting



In pairs, using scrap wood, make the drilling jigs and construct a scan fitting.

Joining woods

Using screws

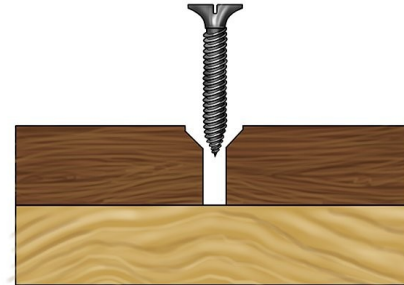


Countersink Bit



1. Drill a pilot hole through outer and inner panels.
 - > Diameter of the core of the screw
 - > Prevents the wood splitting
1. Drill a clearance hole
 - .> Diameter of the threads
 - > Prevents screw gripping outer panel so it pulls both panels together
1. Drill a countersink
 - > Makes an angles hole for the head to lay flush
1. Insert screw using a manual screwdriver

Countersink screw



Round head screw



Joining woods

Types of nails

Round Wire Nail



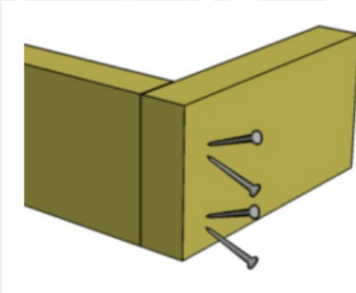
Panel Pin



Oval Wire Nail

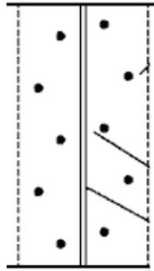


Dovetail Nailing



Angling the nails so they don't pull out

Staggered Nailing



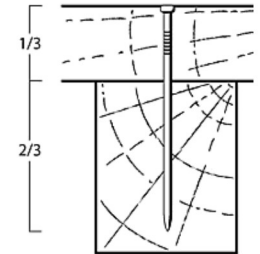
Prevents nails splitting the wood down the grain

Clinch Nailing



Bending the end of the nail to prevent it falling out

Length of nail



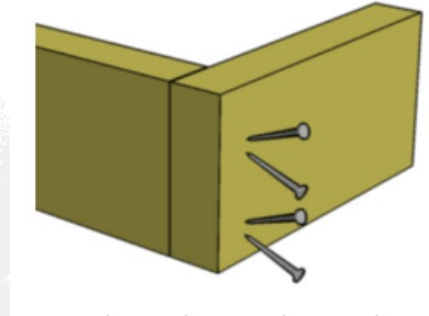
Joining woods

FPT - Screws and Nails - PAIRED activity

1. Follow the steps to create a countersunk screw joint

2. nailing

Using 4 nails, try dovetail



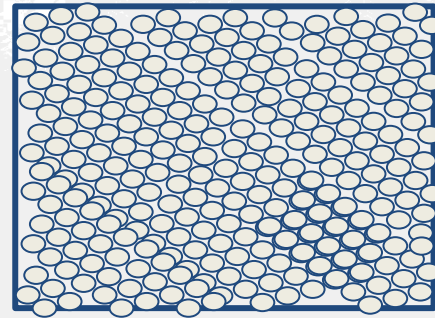
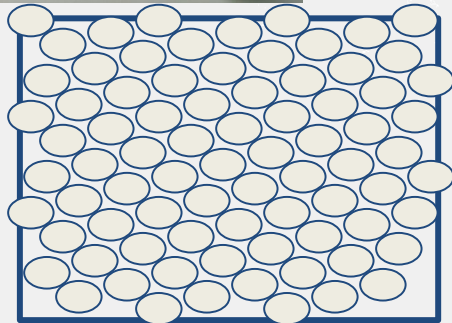
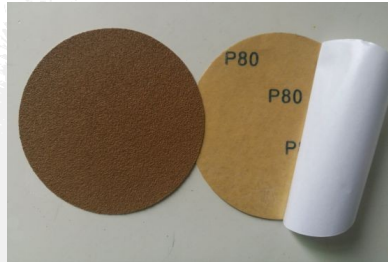
Materials Woods

Woods **Finishing**

Finishing woods

Finishing woods - Abrasive Papers

Glass Paper/aluminium oxide paper
Used to finish woods
Multiple grades



Finishing woods

Finishing woods - Finishes

Paint

Covers wood completely, so shouldn't be used on natural woods. Comes in oil or water based paint.



Wood Stain

Push on like varnish, but dyes the wood a different colour - works by soaking into the wood so glue will leave a non-stained patch



Varnish

Seals the material, can be different colours, can be oil or water based.



Wax

Spread on using a cloth, natural finish

