Section 3

WOODS

Wood

Wood is an extremely useful natural material. There are 3 groups of wood to be considered:

- Softwood
- Hardwood
- Manufactured Board

Trees are converted to useable timber by logging, sawing and seasoning. Unseasoned timber twists and splits. When first cut, wood has excess sap and moisture. It is dried out before being sold as rough or planed planks and boards.

Softwoods are mostly produced from evergreen conifers with thin needle-like leaves. These trees are grown in regions in the Northern Hemisphere, in countries with colder climates. Softwood trees grow quickly, with most trees reaching maturity at around 30 years. Numbers are easier to sustain by replanting and therefore are cheaper. Softwoods can be easily identified by their open grain patterns and light colour.

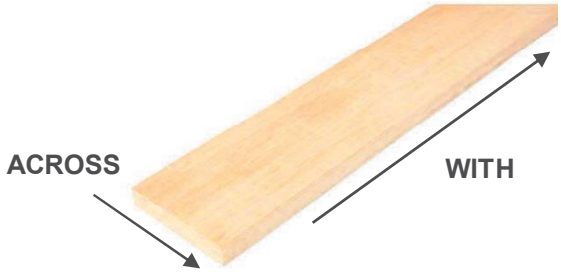
Name	Colour	Properties and working characteristics	Uses
Scots Pine	Cream, pale brown.	Straight grained but knotty, fairly strong, easy to work.	Furniture, joinery, construction work.
Red Cedar	Dark, reddish brown.	Light, soft, weak, natural oils make it weather durable.	Exterior shingles, cladding, sheds.
Parana Pine	Pale yellow with red-brown streaks.	Hard, straight, knot free, strong, durable, smooth finish, tends to warp, expensive.	Quality interior joinery i.e. staircases, built in furniture, lathe work.
Spruce	Creamy white.	Fairly strong, small hard knots, resistant to splitting, not durable.	Construction, general indoor work, furniture.

Hardwoods are produced from deciduous trees (trees that shed their leaves annually) and evergreen broad-leaved trees. These trees are grown in countries with warmer climates. Hardwood trees grow slowly, with most trees reaching maturity at around 100 years. This slow growth makes hardwood more expensive. Hardwoods can be identified by their attractive grain structures, textures and colours. They are more durable than softwoods.

Name	Colour	Properties and working characteristics	Uses
Beech	Whitish pink, pale brown.	Straight grained, even texture, strong.	Furniture, steam bending, turnery.
Oak	Light brown or pinkish brown.	Strong, durable, hard, tough, contains tannic acid which corrodes steel.	Furniture, flooring, boat building, veneers.
Mahogany	Reddish brown.	Fairly strong, medium weight, easy to work, durable, some difficult interlocking grain, prone to warping.	Furniture, shop fittings, panelling, veneers.
Teak	Golden brown.	Hard, strong, durable, natural oils make it resistant to water, acids and alkalis, works well but blunts tools quickly.	Interior/exterior furniture, boat building, laboratory equipment.

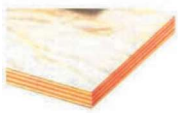
To use timber successfully there are a number of things you need to know about the properties of wood.

Grain is the lines that run along the length of the timber. The way the grain runs effects the strength of the timber. Wood is strong across the grain but will split easily with the grain.

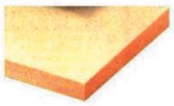


All timber expands as it soaks up moisture from the air and shrinks when it dries out. This change takes place along the width and thickness. The length does not alter.

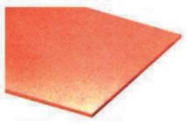
Manufactured boards are now extensively used in industry and in the home. These materials are known as composites. They are generally manufactured using natural timber in thin sheets or particles, which are bonded with resin, compressed and heated. These boards are environmentally friendly because they are often produced from waste products such as sawdust, bark and off-cuts. Manufactured boards can be identified by the colour, texture and end grain.



Plywood



MDF



Hardboard

Chipboard

Blockboard

Name	Colour	Properties and working characteristics	Uses
Plywood	Varies depending on veneers.	Stable, strong, easy to machine.	Furniture, joinery, construction work.
MDF	Brown, compressed wood fibres.	Easily machined, moulded and painted.	General carcass construction/painted work.
Hardboard	Brown, highly compressed wood fibres.	Cardboard-like, weak, brittle.	Cabinet backs, drawer bottoms.
Chipboard	Varies, compressed wood chips.	Strong, stiff.	General carcass construction.
Block board	Wood strips glued, faced with ply.	Stiff, heavy, good load bearing qualities.	Furniture, worktops.

Questions

Answer in sentences.

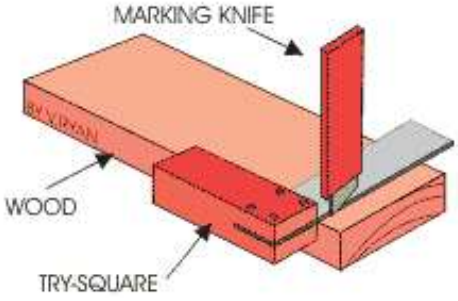
1. What happens to unseasoned timber?
2. Timber can be catogorised into 3 groups, what are they?
3. Why are softwoods generally cheaper than hardwoods?
4. Why is red cedar a suitable wood for a garden shed?
5. Name 2 softwoods, describe their properties/working characteristics and uses.
6. How long does a hardwood tree take to reach full maturity?
7. Name 2 hardwoods, describe their properties/working characteristics and uses.
8. What type of wood is more durable, hardwood or softwood?
9. Why are wide boards of naturally grown timber rare?
10. What makes manufactured boards environmentally friendly?
11. Draw 2 rectangles the same as the ones shown below, sketch the end grain of plywood and blockboard in the rectangles.
12. Name 2 manufactured boards, describe their properties/working characteristics and uses.

Marking Out

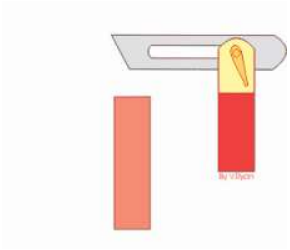
Different materials require different tools, you should be familiar with most of these tools from S1 and S2. These tools are used when measuring and marking out on wood:

- Try Square
- Sliding Bevel
- Marking Guage
- Mortise Gauge

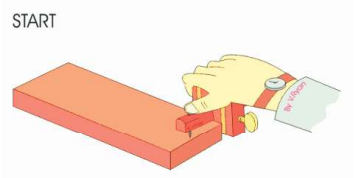
The **woodworkers try-square** is used to measure right angles in wood, either across the breadth or checking something is 'squared up' before gluing. It composes of two main parts the stock and the blade. The blade is made from hardened and tempered steel which makes it resistant to damage. The stock is usually made from rosewood although cheaper versions can be made from plastic or cheap woods. A brass face is added to the stock to ensure a straight edge.



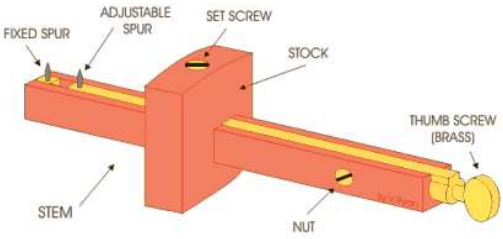
The **sliding bevel** is composed of two parts, the stock and the blade. The stock is usually made from rosewood which is a high quality material. The blade is made from hardened and tempered steel. The blade can be adjusted to a variety of angles and locked in position. This is useful when a line has to be marked at an angle on wood.



A **marking gauge** is used to mark a line parallel to a straight edge. The stem and stock are made from beech and the thumbscrew from clear yellow plastic. The better quality gauges have brass inserts at the front of the stock. These help reduce the wear on the stock as it is pushed against the surface of the wood to be marked. The marking gauge is an extremely important tool for marking parallel lines and preparing for cutting joints.



The **mortise gauge** is a special type of marking gauge and it is used to mark wood so that a mortise can be cut into it. The mortise is marked out using the mortise gauge although it must be set to the correct size of mortise chisel very carefully. A mortise chisel is then used to remove the waste wood. The mortise gauge is normally made from a hardwood such as rose wood with brass being used for the parts that slide along the stem.



Questions

Answer in sentences.

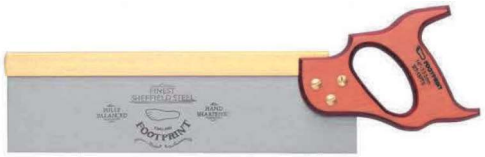
1. What unit of measurement is used in Design and Manufacture?
2. Name the tool used to measure dimensions.
3. What is the function of a try square?
4. What is a try squares blade made from?
5. When would a sliding bevel be used?
6. Name the tool used to mark parallel lines to an edge.
7. Name the 3 parts of a marking guage.
8. What type of frame joint would you be manufacturing if you needed a mortise gauge?

Cutting and Shaping

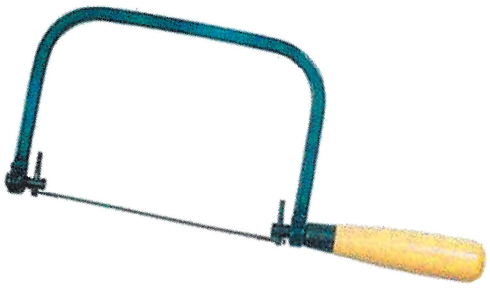
Different materials require different tools, you should be familiar with most of these tools from S1 and S2. These tools are used when cutting and shaping wood:

- Tenon saw
- Coping saw
- Mallet
- Chisels
- Files
- Plane

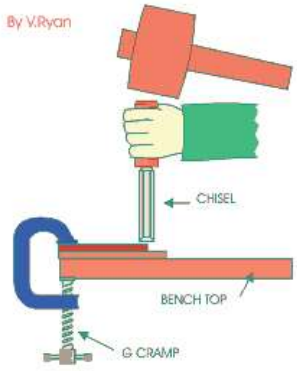
The **tenon saw** is used for general sawing and cutting mortise and tenon joints. The heavy back gives the saw its weight which is useful when sawing wood. The weight of the saw along with the forward sawing motion allows the saw to cut through woods relatively easily and accurately.



Coping saws are used for cutting a range of woods and plastics and are very useful for cutting unusual shapes or curves. In a modern workshop these shapes are normally cut using machine fretsaws. However, there are times when these machines are not available . Using a coping saw is a test of skill as it can be difficult to control and requires practice.

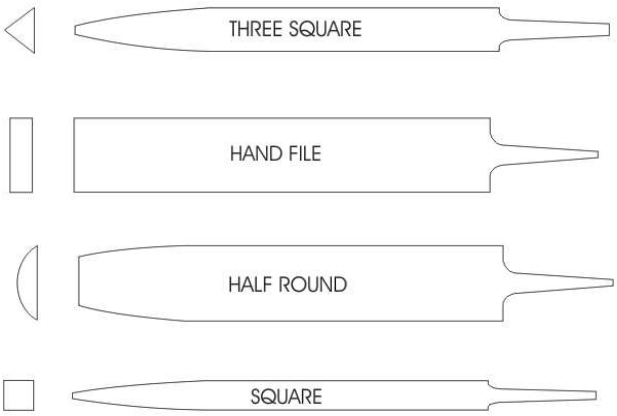


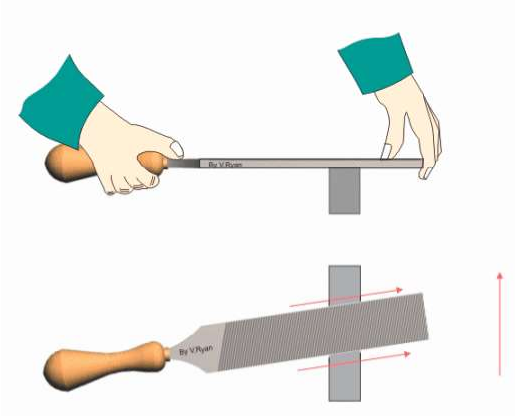
There are many different types of chisels and each has a particular use. **Bevel edged chisels** are slightly undercut making them easy to push into corners. They are normally used for finishing dovetail joints. The handles of most chisels are made from ash, beech, box wood or plastic and a mallet (not a hammer) is normally used to apply force.



Mortise chisels are used for 'chopping out' joints. They are particularly useful for cutting mortise joints as they are strong enough to withstand heavy blows with a mallet. The handle is normally made of ash or beech with a steel hoop at the top to stop it splitting. It also has a strengthening piece called a ferrule which prevents the handle from splitting at the bottom when it is hit repeatedly by a mallet.

Hand files are used in the workshop to smooth rough edges. They can be used to smooth a range of materials including metals, wood and plastics. They are made from high carbon steel and they are heat treated so that they are tougher than the steel or other materials that they are to be applied to.

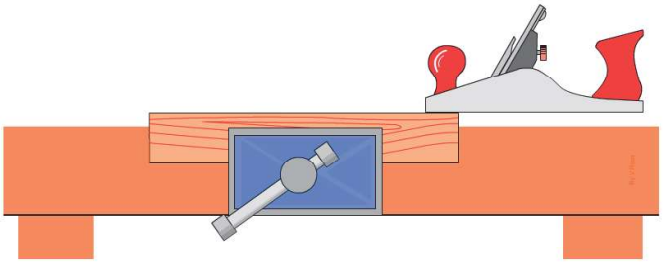




A large range of planes are available and they are used for different purposes. The body of a plane is made from high grade cast iron with the cutters being tungsten made from vanadium steel. **Smoothing planes and Jack planes** are used to smooth rough surfaces or plane down the thickness of a piece of wood to the required size.

JACK

SMOOTHING



Questions

Answer in sentences.

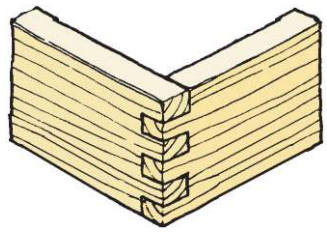
1. What direction does a tenon saw cut?
2. Name the type of saw used to cut curved shapes from wood.
3. Why do bevel-edged chisels have tapered edges?
4. Where should your hands be when using a chisel?
5. What tool is used to hit a chisel when additional force is needed?
6. Name the wood joint cut with a mortise chisel.
7. What stops the wooden handle on a mortise chisel from splitting?
8. Name 4 types of file.
9. Name the 3 cuts of file.
10. What are the 2 functions of a smoothing plane.

Assembly

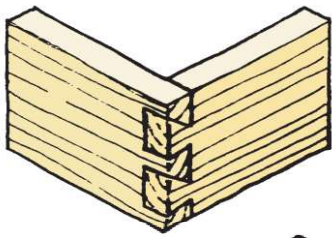
Different materials require different tools. These tools and joints are used when joining wood:

- Finger
- Dovetail
- Housing
- Dowel
- Cross halving
- Corner Lap
- Mortise and Tenon
- Knock down fittings
- Screws
- Nails/Pins
- Glue
- Cramps

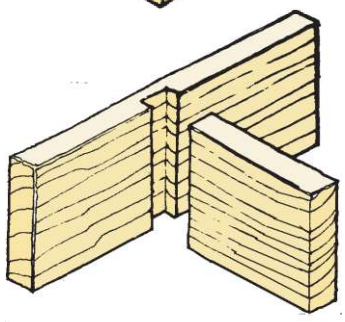
Finger Joint
This is an interlocking corner joint. It must be made accurately or the strength and appearance of the joint will be severely limited.



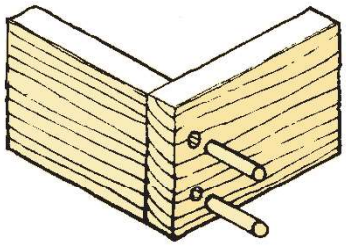
Dovetail
This is a very strong joint but is also a very difficult joint to cut. It has very good mechanical strength which is increased if it is glued.



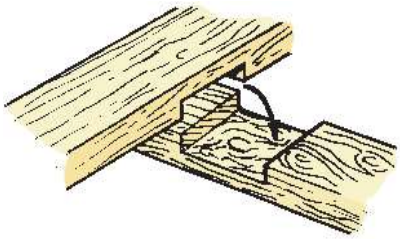
Housing
Is stronger than as simple butt joint. It is usually used for shelves or partitions but it is difficult to cut accurately. It is usually glued but can also be nailed.



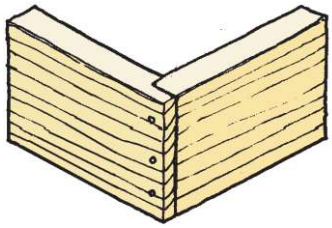
Dowel
This corner joint is essentially a butt joint which is strengthened by wooden pegs called dowels which are pushed into both pieces of wood as they are glued. Dowel joints can also be used to make partitions. If the dowel holes are 'blind' (they do not go all the way through) the dowels are completely hidden.



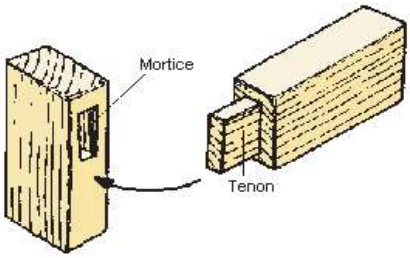
Cross Halving Joint
This type of wood joint is used where two pieces of a framework cross. It is similar to the corner and tee halving joints, and can also be strengthened with dowels or screws if necessary.



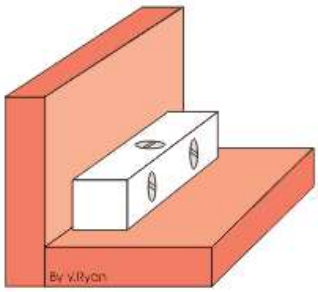
Corner Lap
This corner joint is stronger and more rigid than a butt joint, but some end grain shows. You will need a saw, chisel and mallet to cut this joint by hand.

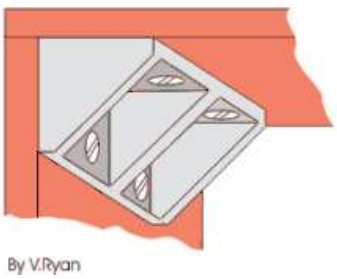


Mortise and Tenon
The Plain Mortise and Tenon joint is very common and is widely used for the joints of tables. Although it is quite strong, if enough force is placed on the joint it will eventually break or come lose.



Knock-down fittings are those that can be put together easily, normally using only a screw driver, a drill, a mallet/hammer and other basic tools. They are temporary joints although many are used to permanently join together items such as cabinets and other pieces of furniture that are purchased in a flat pack. Flat packed furniture benefits the customer in many ways, they are able to transport it home themselves and build it with the aid of instructions, this saves money because they don't need to pay for delivery.





Countersunk/slot-head: This can be used for general woodworking for example fitting hinges to doors. Because the screw is countersunk it can be tightened 'flush' to the surface of the material.

Pozidrive head: Used with special screw drivers which will not slip when pressure is applied. This is ideal when using screws in corners or confined spaces.

Round head: These are used for fixing pieces of material together where countersunk holes are not being used. Round head screws can look quite decorative especially if they are made of brass.

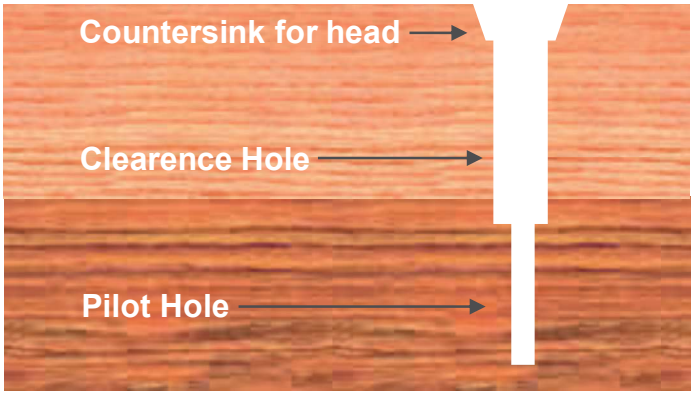
Steps to carry out when fixing woodscrews:

1. Make a pilot hole using a bradawl.

2. Drill a clearence hole.

3. Countersink the hole.

4. Fix screw with screwdriver.



BRADAWL

Using **nails** is an effective way of fixing or joining pieces of softwood together. Hardwoods can be difficult to join with nails as they tend to bend under the impact of the hammer.

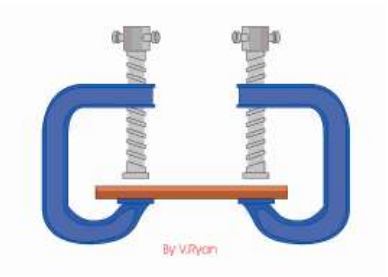
Round wire nail: This is used for general work. It is not attractive in shape and it can split wood when hammered in position.

Lost head nail: This is ideal if it is necessary to hide the head of the nail as a punch can be used to hammer the head beneath the surface level.

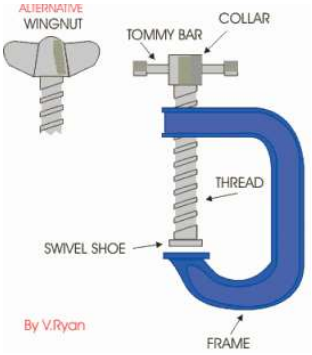
Panel pin: A very popular way of joining woods although glue is usually included as part of the join.

A nail punch can be used to drive the nail heads below the surface.

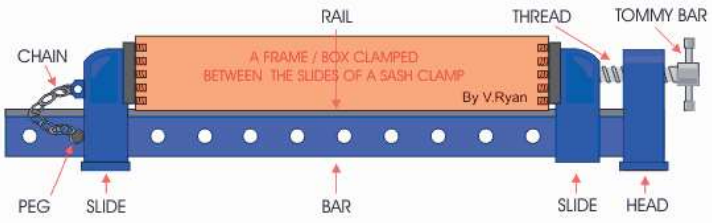
When you manufacture a product using woods it will soon be necessary to join parts together. P.V.A. (Polyvinyl Acetate) **Glues** are very popular as they do not need preparation. These glues are supplied in a plastic container and can be used straight away. A good example of this is 'Evo-stik Woodworkers Resin'.



G Cramps are an essential tool in the workshop and they come in a range of sizes and are generally used for clamping work securely to a surface/workbench top. They can also be used to hold parts together whilst glue is drying.



Sash clamps are used to clamp work together when it is glued. They vary in size and are normally used in pairs. The bar is made from cold drawn mild steel and the head and slides made from malleable iron.



Questions

Answer in sentences.

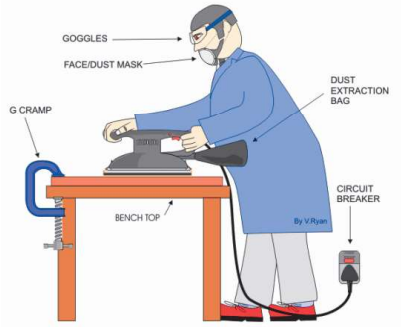
1. Name a suitable wood joint to build a box.
2. Name a suitable wood joint to support a shelf in a cabinet.
3. Name a suitable wood joint for joining table legs and rails.
4. Sketch and label a finger joint.
5. Why is most modern furniture flat packed?
6. What benefits does flat packed furniture give to the customer?
7. Why would you use a countersunk scew?
8. List the steps to fix a countersunk screw.
9. When would you use a nail punch?
10. Name the glue used to join wood.
11. Explain the difference between a G-cramp and a sash cramp. When they would be used?

Finishing

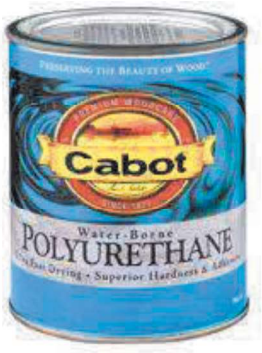
Different materials require different tools, you should be familiar with most of these tools from S1 and S2. These tools and processes are used when finishing wood:

- Sanding
- Varnish
- Stain
- Wax
- Paint

Glass/sand paper is used to smooth wood surfaces. When sanding wood, glass paper can be used with a cork block or is 'clipped' into the sheet sander. If the surface requires a lot of sanding then start with 'coarse' glass paper rather than fine - as this will reduce the amount of time required.



Varnish



- **Appearance**: Creates a very shiny , transparent surface on the finished wood.
- **Protection**: Gives good protection against marking and scratching.
- **Durability**: Good durability.
- **Application**: Can be applied using brush or spray. Brushing it on needs good technique or you will get bubbles and streaks.
- **Extra information**: Can be removed using paint removers. Brushes can be washed using hot soapy water.

Stain

- **Appearance**: Matt finish, similar to original surface of wood. Available in a large variety of colours. Stain soaks into the wood and so the wood grain is still visible.
- **Protection**: Gives minimum protection, wood will still mark easily.
- **Durability**: Poor durability.
- **Application**: Can be applied using a rag, brush or spray gun, then rubber into the grain in circular motions.
- **Extra information:** Gloves should be worn when using wood stain. Cannot be removed form wood.

Wax

• **Appearance**: Creates a very shiny, transparent surface on the finished wood.

• **Protection**: Gives great protection against marking and scratching.

• **Durability**: Can last forever when applied correctly.

• **Application**: Wax is very easy to apply. Applied using steel wool, rubbed down, with a soft cloth, then repeat process until you get a perfect finish.

• **Extra information**: Can be removed using solvents. Buffing the surface will bring back a dulling shine.

Paint

• **Appearance**: Matt or gloss finish, put layer over surface of wood, grain of wood is no longer visible. Paint comes in a large variety of colours.

• **Protection**: Gives some protection to woods surface.

• **Durability**: Medium durability. Can be scratched or chipped easily.

• **Application**: Applied using a brush. Thin layers brushed on to avoid running and drips

• **Extra information**: Can be removed by sanding down surfaces.

Brushes can be washed with hot soapy water**.**

Questions

Answer in sentences.

1. What is the function of glasspaper?
2. How is varnish applied?
3. How is wood stain applied?
4. How is wax applied?
5. How is paint applied?
6. Name a suitable finish for a child's chair, it must be:

- Coloured.
- Shiny.

7. Name a suitable finish for an oak coffee table, it must be:

- Shiny.
- Clear.

8. Name a suitable finish for a pine picture frame, it must:

- Be coloured.
- Allow the wood grain to be seen.

Processes

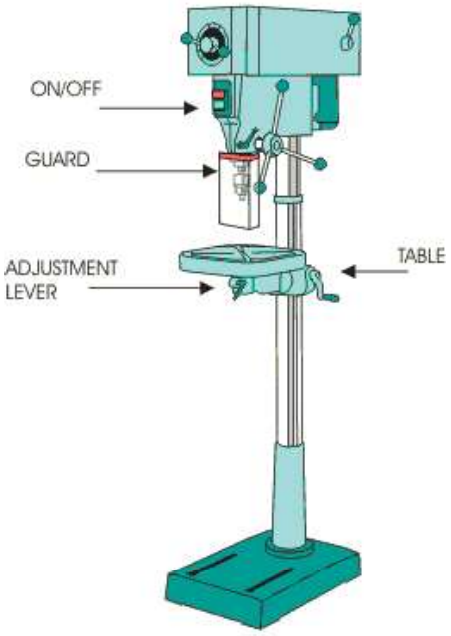
Different materials require different processes and machines. These machines are used when working with wood:

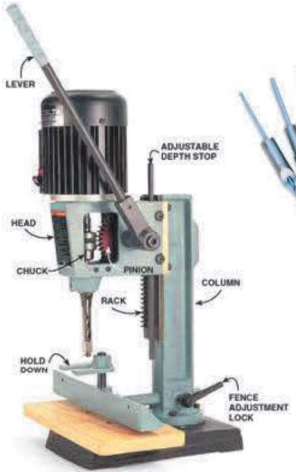
- Drill Press
- Mortise Machine
- Belt/disk Sander
- Sheet sander
- Jigsaw
- Lathe

The **drill press (pillar drill**) has a long column which stands on the floor. It is used for drilling holes through materials including a range of woods, plastics and metals. It's larger size means it is capable of being used to drill larger/longer pieces of material and produce larger holes.

SAFETY

1. Always use the guard.
2. Wear goggles when drilling materials.
3. Clamp the materials down or use a machine vice.
4. Never hold materials by hand while drilling.
5. Always allow the 'chippings' to clear the drill by drilling a small amount at a time.
6. Follow all teacher instructions carefully.

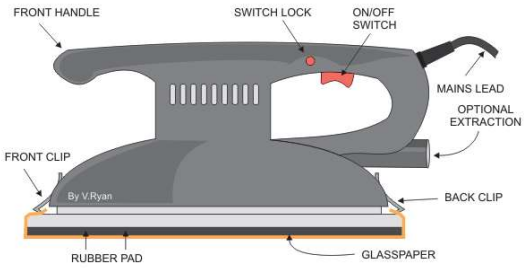




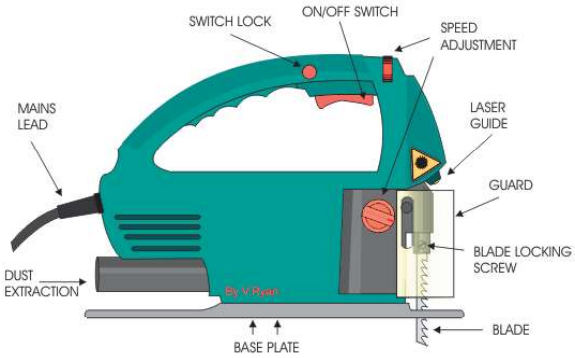
A **mortise drill/machine** is a specialised woodworking machine used to cut square or rectangular holes in a piece of wood, such as a mortise in a mortise and tenon joint. The hollow chisel mortiser combines the cutting of a four-sided chisel with the action of a drill bit in the centre.

The **Sander** is used to smooth materials such as woods and plastics. It is also used to remove small amounts of waste material. The disc sander is the round piece of sand paper on the front of the machine that spins around at high speed. The belt sander is the length of sand paper that rotates around like a very fast conveyer belt. Hand held and fixed belt sanders are available.

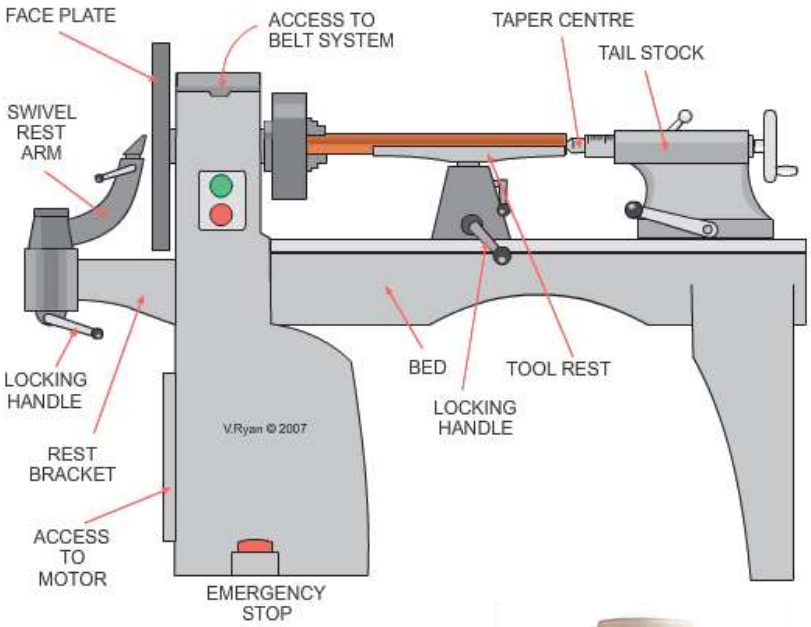
Sheet sanders are used to smooth wood surfaces. When sanding wood, glass paper is 'clipped' into the sheet sander.

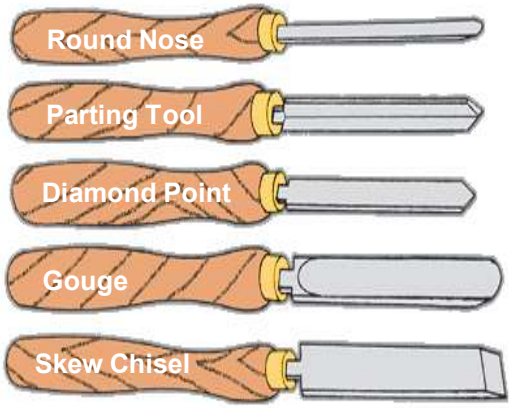


Jigsaws are general cutting and shaping tools. They are provided with a selection of blades suitable for cutting and shaping a range of materials. They are ideal for cutting thin manmade boards such as plywood and MDF and they are capable of cutting detailed curves.



Woodturning is a form of woodworking that is used to create round wooden objects on a lathe. Woodturning differs from most other forms of woodworking in that the wood is moving while a stationary tool is used to cut and shape it. Many intricate shapes and designs can be made by turning wood.





The Live Centre is in the shape of a fork (butterfly) and is used to drive the timber round.

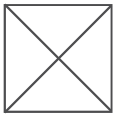
The dead centre fits in the tailstock and supports the end of the wood. It does not rotate the cone and so it is greased to stop the wood from burning.

FORK

CENTRE

Preparing wood for turning:

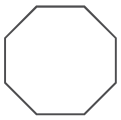
1. Find the centre on the ends of the timber by joining the diagonals.



2. Saw along the diagonals on one end to take the fork centre.

3. Nail punch a hole on the opposite end to take the cone centre. Remember to grease the hole.

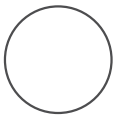
4. Use a jack plane to remove the four corners of the wood, making it octagonal in shape.



5. Place the wood into the fork centre and cone centre, tighten.

6. Adjust the tool rest to the correct position and height. Spin the wood to ensure adequate clearance.

7. Form a cylindrical shape using the gouge, smooth with glass paper.



Questions

Answer in sentences.

1. What is the function of a press drill?
2. State 3 safety precautions when using the press drill.
3. Explain the function of a mortise drill.
4. What joint would you be cutting if you used the mortise drill?
5. Name 2 types of sander.
6. State 3 safety precautions when using the belt sander.
7. What is the function of a sheet sander?
8. Which hand machine will allow the user to cut curved shapes from manufactured boards?
9. Name a product that could be turned on a wood lathe.