**Faculty of Technology – Summative Assessment**

**Subject: Year 10 Design & Technology (Mr Wilson)**

If you studied **Design & Technology** during lockdown, you will be assessed on the following topics when you return to college in September.

**Topics to be Assessed:**

1. Sources and origins of Timber - Hardwood, Softwood & Manufactured Boards.

Deforestation

1. Selection, availability & cost of Timber
2. Seasoning & Treatment of Timber
3. Strengthening Timber
4. Forces & Stresses and Lamination
5. Manufacturing Processes
6. Joining & Finishing

**Resources to Help You:**

**Sources and origins of timber** - Different types of tree grow naturally in different parts of the world, due to different climates. In the past, this influenced which timbers were used in manufacturing, but globalisation means timber and goods are moved around the world. Most softwoods naturally grow in colder regions. Some hardwoods grow in temperate climates, such as Europe, while others grow in tropical rainforests.

**Natural timbers** – **hardwoods**. A hardwood comes from a tree with broad leaves and its seed in a fruit. Many hardwood trees are deciduous, meaning they lose their leaves in winter. Hardwood trees grow quite slowly, often taking more than 100 years to be big enough to use for timber. There used to be a lot of hardwood trees in Britain, but most of our natural forests were cut down a long time ago.

**Natural timbers** – **softwoods**. A softwood comes from a tree with needle-like leaves and seeds in a cone, like a Christmas tree. Most softwood trees are evergreen, meaning they have leaves on all year. Larch is an unusual softwood because it does lose its leaves in winter. Softwood trees grow quite quickly and can be used for timber after about 30 years. This means they can be grown commercially, so most forests planted for timber are softwoods. That is why softwood timber is a lot cheaper than hardwood timber.

**Manufactured Board** - Natural timber is a useful material, but because of the size of a tree trunk it is only available in narrow planks. Also, the grain lines in timber are what give it strength and they only go in one direction, so timber is strong lengthways but not across its width. Manufactured boards use timber to manufacture a board that has different properties to plain timber. If you want a large, thin sheet of wooden material you need a manufactured board.

**Deforestation**

Deforestation is a global problem, with trees being cut down faster than they grow. Most of Europe was deforested hundreds of years ago and deforestation is now a major problem for areas of the developing world, such as South America and West Africa. Deforestation can cause a lot of accompanying environmental issues such as soil erosion. For example, in Nepal deforestation has caused problems with landslides. Worldwide about 46,000–58,000 square miles of forest are lost each year. That is an area the size of England every year, or equivalent to 48 football fields every minute. Because trees absorb carbon dioxide from the air, scientists think that having fewer trees will make the greenhouse effect worse, which will warm the Earth and affect the climate and sea levels for the whole world.

**Checkpoint Questions**

What is the difference between hardwoods and softwoods?

Give three examples of manufactured boards.

In what parts of the world are you most likely to find oak and beech trees? Describe what impact deforestation can have on local communities and habitats.

Explain how large-scale deforestation can affect the atmosphere around the world.

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**Seasoning**

A freshly cut tree is about 85 per cent water, so it’s very wet. It must be dried out to below 18 per cent water and is often dried to 10–12 per cent water for indoor use. Drying timber is called seasoning. Seasoned timber has increased strength, resistance to decay, and stability, meaning it is less likely to warp (bend). Air seasoning stacks the planks outside and after a few years they have dried out to about 18 per cent water. This is a slow process and does not get the timber dry enough to use indoors. Kiln seasoning stacks the planks in a room and pumps first steam then warm dry air around them. This dries them to the required level in a few weeks. Kiln-drying is much quicker, it kills insect eggs in the timber, and it can dry the wood to the 10 per cent needed for use in our warm, dry, centrally heated houses. A designer will select timbers that have been correctly and appropriately seasoned for their intended purpose. This ensures that the final product, for example a wooden window frame, will not warp in use. Upcycling A timber product can sometimes be given a new lease of life.

**Treatments**

Timber will burn and rot quite easily and quickly. It can be treated with chemicals to reduce this. Timber can be pressure treated with a preservative. The pressure treatment forces the preservative chemicals deep into the wood and makes it resistant to rotting. Pressure treated timber can be used outside for years. A common chemical used is called Tanalith E, and the treated timber is called tanalised timber. Timber can be treated with fire proofing chemicals that make it burn less well. Correctly treated wood can slow the spread of flames, allowing more time for people to escape, reducing damage to the wooden structure and giving more time to extinguish the blaze.

**Genetic engineering**

Genetic engineering allows scientists to make changes to the DNA of a tree. If they can work out how to change the right parts of DNA in the right way they can create a tree that is different from natural trees. It is possible to make a tree resistant to particular diseases. Scientists are also trying to develop trees that grow faster than they do naturally. This would mean timber could be grown more quickly. Campaigners against genetic engineering of plants are concerned that we do not know enough about the long-term effects of releasing genetically engineered plants into the environment

**Cultural and ethical factors**

Avoiding offence, it is obvious that if people find your product offensive, they are not going to buy it. It is less obvious that people in different parts of the world, or other cultures and religions, might be offended by something that is not offensive to the product designer. It is important to have some understanding of different cultures and religions so that you can avoid accidentally causing offence with a word, symbol or picture that has a different significance to other people.

**Suitability for intended market**

 It is important to understand the intended market for a product, so you can make sure a product is suitable. It is also important that a product designed for a user of a particular age, or with a particular need, is suitable for people of that age or need. If you understand the needs of your user, you can make sure they can use the product and that it is safe for them.

**The consumer society**

In Britain, and much of the richer developed world, we live in a consumer society. We are relatively wealthy, and products are quite cheap, so some people can afford to buy a lot of things they do not really need. There are lots of companies advertising products to try to sell us these things we do not actually need. There is nothing wrong with people having nice things or useful things if they are affordable, but some people can go so far as to get themselves into debt consuming too much. From an environmental point of view, some people think that as a society we are using up limited resources too quickly and damaging our environment.

**Checkpoint Questions**

Why is it important to season timber?

How could you make a piece of timber better for use outdoors?

What are the advantages and disadvantages of using plastic-coated chipboard for furniture instead of solid oak?

Is the genetic engineering of trees a good thing? Explain your answer.

**Forces and stresses**

There is a range of different forces and stresses that can act on materials. When designing a product, it is important to understand the forces that will be put on it so you can choose the best material and make the product strong enough.

• Compression is a squashing force, like standing on something.

• Tension is a pulling force, like tugging on the ends of a rope.

Shear forces act in opposite directions, pushing one side up and the other side down, like the cutting action of scissors.

**Lamination**

A laminate is a thin layer of material. Lamination can be useful to make curved shapes from timber. The thin layers are glued and bent into shape. When the glue is dry, the layers are fixed together in the bent shape. Timber can be bent a little bit by steaming it, but laminating can achieve much larger bends. Lamination can also greatly increase the strength of material such as plywood. Lamination is used to increase the strength of wooden beams, for example Glulam and Laminated Veneer Lumber (LVL).

**Checkpoint Questions**

Draw diagrams to show tension and compression acting on a piece of timber.

Draw a rectangle and add a cross brace that would strengthen it.

What is laminating?

Draw a beam that is bending. Add arrows to show where it is in tension and where it is in compression.

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**PAR and PSE PAR** stands for ‘planed all round’. This means all four surfaces have been planed, and it will have slightly rounded edges to make handling easier and safer. Constructional timber, such as for studwork (frames for interior walls) is usually PAR. PSE is ‘planed square edge’. All four surfaces are planed, but the edges are left square. Joinery timber is usually PSE. PAR and PSE are planed and ready to use. They are often only available in long lengths (1.8m). The timber may be warped or twisted so check before use. It is worth knowing that timber is usually sold by the sawn size. The planed size is a few millimetres smaller. So, the 100 mm × 50 mm standard size is the rough sawn size. If you buy 100 × 50 PSE, it will measure about 96 mm × 47 mm.

**Dowel**

Wooden rods that are round in cross-section • Have a variety of uses, from model making to furniture construction – can be used to strengthen simple joints • Short lengths of dowel are used to join pieces of wood with a dowel joint. It requires accurate drilling of holes.

**Checkpoint Questions**

What do PAR and PSE mean?

Why is most timber sold in multiples of 25 mm?

What is a dowel?

Why is it important for a product designer to use standard-sized timber wherever possible?

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**Four Scales of Production**

**One-off**

A one-off product can be made in a workshop by a craftsperson. A one-off might be made for an individual client who wants something unique. A prototype of a product can be made as a one-off to test a design, before the time and cost of setting up machinery for mass production

**Batch**

A batch is a number of the same thing made at the same time. A batch production process might use a jig, a template or a mould to mark out or cut the same shape several times. For example, 20 chair legs of the same shape could be made by drawing around a template. Screw holes in the chair legs could be made in the right place by putting a jig over the end of the leg to guide the drill. Curved chair backs and seats could be made the same by laminating them over the same mould in a bag press.

**Mass production**

Mass production processes make the same product all the time. A factory is often set up to mass produce products. The chipboard pieces for flat-pack furniture will be cut to the correct size by automated saws. Holes for the fittings will be drilled in exactly the right place by computer-controlled drills. Machinery will be set up to make a particular part of a product and it will make that part all day long, day after

**Continuous**

Continuous production is a step up from mass production. Continuous production is used for products that have a high demand all the time. The factory will be highly automated and running 24 hours a day, 7 days a week.

**Templates**

A template is a cut-out shape that you can draw around to mark out the shape you want to cut from a piece of material. A template might be made from paper or card for a single use, or it might be made from a thin sheet of wood or metal if it is going to be used a lot. A template is really useful in batch production because it allows workers to mark out the same shape quickly and accurately. Templates must be accurately produced and protected from damage.

**Checkpoint Questions**

List the four scales of production.

What is a template used for?

Draw a jig that could be used to drill a line of four holes equally spaced along the edge of a piece of MDF 200 mm wide.

Explain why it can be a big risk for a company to invest in mass production facilities.

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**Forstner bits** are guided by the wide outside rim of the bit, unlike most drill bits, which are guided by the tip. Because of that, they can be used along with a drill press to drill angled holes, holes that partially overlap, and holes on the edge of the material.

**Knock Down Fittings** - can be put together easily, using only a screw driver, allen key, drill, mallet/hammer and other basic tools. Advantages to user - easy to assembly by everyone, no need for technical knowledge. Can be disassembled and reassembled.

A **mitre joint** is a joint made by cutting each of two parts to be joined, across the main surface, usually at a 45° angle, to form a corner, usually a 90° angle. It is called [bevelling](https://en.wikipedia.org/wiki/Bevel) when the angled cut is done on the side, although the resulting joint is still a mitre joint.

For woodworking, a disadvantage of a mitre joint is its [weakness](https://en.wikipedia.org/wiki/Strength_of_materials), but it can be strengthened with a spline (a thin wafer of wood inserted into a slot, usually arranged with the [long grain](https://en.wikipedia.org/wiki/Long_grain) of the spline across the [short grain](https://en.wikipedia.org/wiki/Short_grain) of the frame timber). There are two common variations of a splined mitre joint, one where the spline is long and runs the length of the mating surfaces and another where the spline is perpendicular to the joined edges.

**Countersunk Screws**

Countersunk Screws are a popular type of precision screw. They feature a countersunk head, which allows them to sit flush against a target housing. Countersunk Screws are intended to be used alongside pre-drilled holes featuring a countersink.

**Checkpoint Questions**

What type of drill bit makes a flat-bottomed hole in wood?

Why are knock-down fittings used a lot for flat-pack furniture?

Why is a mitre joint good for the corner of a picture frame?

Explain why knock-down fittings are good for flat-pack furniture.

List the steps in preparing and screwing two pieces of timber together with a countersunk screw.

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**Surface finishes and treatments**

There are many surface finishes and treatments that can be applied to wood. Wood is porous, so it will absorb water and grease and quickly look dirty and damaged. A surface finish fills the pores and makes it water resistant and easy to wipe clean. A finish can also make a product look better.

**Advantages of Varnish**

 Provides radiant beauty to the wood.

Helps in protecting the wood by binding the surface.

Helps to prevent hairline cracks and absorb the effects of scratching and external damage.

Helps in reducing the transfer of moisture between the wood and the surrounding weather.

Provides softness and lasting flexibility.

**Wood Stain**

Wood stain is a type of paint that is used to colour wood by soaking pigment into wood fibres with a solvent and then having it set and bind to the wood. ... The primary purpose of stain is to colour wood, while offering certain protections as a result of the colouring and absorption of the stain deep into the wood

**Checkpoint Questions**

Why is it important to apply a finish to a wooden product?

What is an advantage of using varnish?

Why is stain used?

What finish would you use on a dining table? Explain your choice.