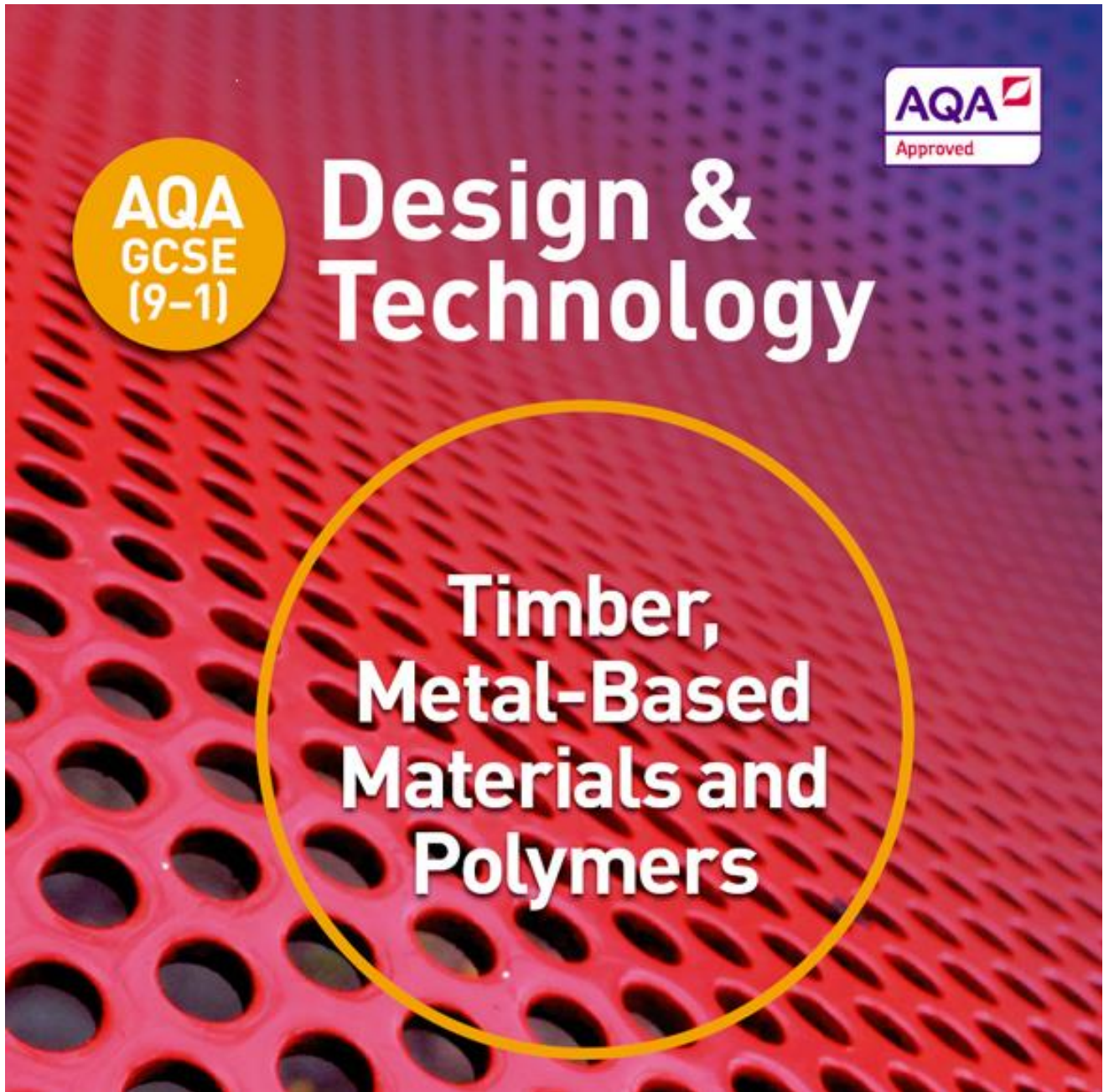


Name



CTP 3.1.1 New and Emerging Technologies

KEY POINTS

- Automation is the use of computers to control machinery in factories with minimal human involvement.
- Enterprise is a skill where people take risks to bring new products to the market.
- Sustainability is about meeting our own present-day needs without compromising the needs of future generations.
- Culture is the values, beliefs, customs and behaviours displayed by different groups of people.
- Just in time (JIT) production is a method of organising a factory so that materials and components are ordered to arrive at the workplace just in time for production.
- Planned obsolescence is when a product is deliberately designed to have a short life span or to go out of fashion.

Check your knowledge and understanding ?

- 1 Explain what is meant by a finite resource.
- 2 Give an example of a non-finite resource.
- 3 Explain why robots are used so extensively in many modern industries.
- 4 Give an example of a product developed as a result of technology push.
- 5 Discuss the advantages and disadvantages of just in time and lean manufacturing systems.

CTP 3.1.2 Energy Generation and storage

KEY POINTS

- We rely on energy to power most aspects of our lives, such as light, heat, transport and communication.
- All fuels and biofuels cause pollution when burnt.
- Coal, gas and oil are all fossil fuels, and are finite resources.
- Most renewable sources reduce the risk of pollution.
- Many renewables cannot provide a constant supply, unlike fossil fuel or nuclear-powered power stations.
- Storage systems cannot generate power, but are useful for when extra supply is needed quickly, or if it is not possible to connect to a supply.

Check your knowledge and understanding ?

- 1 What is the best time of day to store energy in a pumped storage system?
- 2 What advantages do fossil fuel have that make them so popular?
- 3 Briefly explain why growing crops for biofuels might not solve the world's energy problems.
- 4 How can a flywheel store energy?
- 5 Give two disadvantages of secondary batteries.

CTP 3.1.3 Developments in New Materials

Check your knowledge and understanding ?

- 1 Give an example of a product in which Kevlar may be used.
- 2 Give an example of a product in which a glass-fibre reinforced polymer (GRP) might be used.
- 3 Explain what composite materials are and why they are developed.
- 4 Explain what is meant by the term 'smart material'.
- 5 Give an example of a product in which photochromic pigments may be used.
- 6 Discuss the advantages and disadvantages of corn starch polymers.
- 7 Name a composite material.
- 8 Explain how microencapsulation works.
- 9 Explain the difference between GRP and carbon-fibre reinforced plastic (CRP).

CTP 3.1.4 Systems Approach to Designing

KEY POINTS

- System block diagrams describe what happens in a system.
- System block diagrams always have a minimum of one input, one process and one output block.
- Input devices provide information from outside into the system.
- Process devices handle information received and turn outputs on and/or off.
- Output devices send out information, heat, light, sound, or mechanical movement to the environment the system is operating in.

Check your knowledge and understanding ?

- 1 Analyse a moisture sensing system in terms of input, process and output.
- 2 Explain what a light dependent resistor does.
- 3 Give examples of products that contain microcontrollers.
- 4 Discuss why microcontrollers are used so frequently in products.

KEY POINTS

- There are four basic types of movement: linear, reciprocating, rotary, and oscillating.
- Levers and linkages are mechanisms used to transfer and alter force, and can change the direction of movement.
- There are three different orders of lever.
- Types of motion can be converted from one type to another by mechanisms.
- Diagrams and symbols are used to represent mechanisms.
- Mechanisms can change the magnitude and direction of forces.

Check your knowledge and understanding ?

- 1 Explain what is meant by the term 'torque'.
- 2 Give examples of machines that use a rack and pinion mechanism.
- 3 Explain what is meant by the terms 'rise', 'fall', and 'dwell' in a cam mechanism.
- 4 Give examples of tools that use levers.
- 5 Discuss the advantages and disadvantages of using stainless steel gears and pulleys in the marine industry.

CTP 3.1.6 Material Categories

KEY POINTS

- Paper is classed as less than 200 gsm.
- Board is classed as over 200 gsm.
- Other materials can be added to paper and card to make it stronger, waterproof or an insulator of heat, etc.
- Hardwoods come from deciduous trees, softwoods come from coniferous trees.
- Hardwoods take approximately ten times longer to mature than softwoods.
- Manufactured boards come in larger sizes than natural timbers.
- Manufactured boards are more stable than natural timber and won't split or twist.
- Veneers and laminates can be added to manufactured boards to improve their appearance.
- Ferrous metals contain iron and are normally magnetic.
- Non-ferrous metals do not contain iron.
- Alloys are combinations of two or more pure metals with other elements.
- Thermoforming polymers can be repeatedly heated, formed and cooled.
- Thermosetting polymers can only be formed with heat once.
- Thermosetting polymers cannot be recycled.
- Natural fibres can come from plant or animal sources.
- Synthetic fibres are manufactured from oil-based chemicals. Examples of synthetic fibres include polyester, polyamide and elastane.
- Different fibres are blended together to make them better suited to different products and to improve a fabric's properties.
- Plain weave fabrics are strong and hardwearing.
- Non-woven fabrics are made directly from fibres without being woven or knitted, and include felts and bonded fabrics.
- Knitted fabrics have yarns that are looped together to make looser, more flexible fabrics.

Check your knowledge and understanding

- 1 What is a common use for duplex board?
- 2 Compare the properties of cartridge paper with those of foil-lined board.
- 3 What are the major differences between a hardwood and softwood? Suggest a product made from one of each.
- 4 Why do ferrous metals rust?
- 5 Why are thermosetting polymers less commonly used than thermoplastic polymers?
- 6 Describe the difference between hardness and toughness.
- 7 List three properties of cotton and name three products commonly produced from cotton.
- 8 Describe the differences between woven and non-woven fabrics.

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STP 3.2.1 Selection of materials and components

Check your knowledge and understanding ?

- 1 Give three different factors that will affect the cost of materials for a product.
- 2 What are ethical factors?
- 3 Explain what bulk buying means.

STP 3.2.2 Forces and stresses

KEY POINTS

- There are five main types of force that can act upon any object or structure: tension, compression, shear, bending and torsion.
- Some materials are better at resisting certain forces.
- Materials can be reinforced and stiffened in order to resist certain forces.

Check your knowledge and understanding ?

- 1 Give an example of a material that is good in tension.
- 2 Explain why designers have to understand the forces and external loads that can act upon a structure they design.
- 3 Give an example of a material that is good in compression
- 4 Explain how concrete can be reinforced.
- 5 List materials that rope could be made from.

Check your knowledge and understanding ?

- 1 What are the advantages and disadvantages of a mining company arriving in an area of rainforest?
- 2 Explain the term 'deforestation'.
- 3 When does deforestation occur?
- 4 What impact does farming have on the environment?
- 5 What are the six Rs?
- 5 How do designers ensure safe working conditions?

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STP 3.2.4 Sources and Origins

KEY POINTS

- Newly felled timber contains a lot of moisture that needs to be reduced before the timber can be used.
- Trees are a renewable source and it is vital that we only use new timber from managed forests.

Check your knowledge and understanding ?

- 1 Describe the work of the FSC.
- 2 Use notes and sketches to describe the four methods of converting timber.
- 3 Explain why it is necessary to season wood.
- 4 Draw a cross-section and fully label a seasoning kiln.
- 5 Why is air seasoning considered to be environmentally friendly?

STP 3.2.5 Using and working with materials

KEY POINTS

- Marking out is the process of transferring a design to the material you are working on.
- A template is a profile shape of the part you want to make, like a stencil.
- Tenon saws will cut straight lines in wood.
- Coping saws will cut curved lines in wood.
- Wood joints vary in strength and complexity.

Check your knowledge and understanding

- 1 Identify and describe how to use marking out tools for wood.
- 2 Draw and explain how to safely use different types of saws for cutting wood.
- 3 Show two different ways of jointing a box, a stool and a frame.
- 4 Explain the advantages and disadvantages of using PVA glue and contact adhesive.
- 5 Explain the term 'hygroscopic'.

KEY POINTS

- ### Check your knowledge and understanding ?

- 1 What is a dowel?
- 2 Where would you find a concealed hinge being used?
- 3 Draw a labelled diagram of the three stages you would undertake when using a countersunk woodscrew.
- 4 What are the advantages of using knock-down fittings?
- 5 Where would you find a cross dowel being used?

STP 3.2.6 Stock forms, types and sizes (plastics)

KEY POINTS

- Most stock forms of polymers are thermoplastic polymers.
- Thermoset polymers are found in powder form.

Check your knowledge and understanding

- 1 What is an extrusion?
- 2 Give examples of products that use foam.
- 3 Why might you not use a polymer nut and bolt?
- 4 What are the benefits of using a polymer hinge with a polymer fabrication?
- 5 What process may use a polymer powder?

STP 3.2.7 Scales of production

Check your knowledge and understanding ?

- 1 Why is the end-cost of a bespoke product higher than something that has been mass produced?
- 2 Why do designers make prototypes?
- 3 Give two reasons why shoes need to be batch produced.
- 4 Complete the following table.

Labour	Equipment	Unit cost	Scale of production/ manufacturing method used
Unskilled workforce	Specific to the task with some flexibility	Low	
Highly automated with a small workforce	Highly specialised	Very low	
High skills, traditional craftsperson	General purpose with some specialism	Very high	
Skilled and flexible	General purpose with specific adaptations for the type of product being made	High	

- 5 What type of products benefit from continuous production methods?

STP 3.2.8 Specialist Techniques and Processes

KEY POINTS

- Accurate marking out is essential if you are to achieve a quality product.
- Jigs and templates will speed up the making process and help achieve consistency.
- There are many saws that will cut wood and it is important to be able to match the saw to the process.
- Chisels and planes help to shape and smooth wood.
- Disc sanders, belt sanders and finishers will mechanically smooth wooden surfaces.
- Wood can be bent by kerfing, steam bending and laminating.
- Wood can be formed into cylinders, spheres and cones by woodturning.

Check your knowledge and understanding

- 1 Explain the following terms: datum line, face edge, face side
- 2 Identify and describe the different types of saw used to cut wood.
- 3 List the advantages and disadvantages of using a cordless drill.
- 4 List the stock forms and sizes of different types of wood and manufactured boards.
- 5 Explain how moisture content is calculated.
- 6 Describe the process of woodturning.
- 7 Explain how to laminate wood.

KEY POINTS

- ### Check your knowledge and understanding ?

- 1 Why is it important to sand timber with the grain before applying a finish?
- 2 Describe the process of preparing a piece of timber before applying a stain.
- 3 What is the difference between a water-based and an oil-based finish?
- 4 What is tanalising?
- 5 What PPE should be worn when spraying a piece of timber in a school environment?

DMP 3.3.1 Investigation, Primary and Secondary Data

KEY POINTS

- Market research is carried out to gain an understanding of the target market for a product.
- Interviews, questionnaires and focus groups are examples of primary research methods that use questions to find out what people are thinking.
- A designer must take into account human factors when designing products, including physiological, psychological and sociological factors.
- Anthropometrics is a record of human measurements that is very useful to anyone who intends to produce something that will be used by a large number of people.
- A design brief describes the problem or situation that needs a design solution.
- When you have completed initial research, you will have answers to many of the questions that you set yourself at the beginning of your project. These answers will influence ideas for your project. You will not necessarily have done all the research at the beginning of the project, and you may not have all the answers. Further, ongoing research may be needed during the design process.
- A design specification is a list of design criteria; it is used to determine the success of your ideas.
- A manufacturing specification contains all the information necessary to make the product.
- As designers work through projects and make attempts to solve the problems, new problems may be found which change how the design brief is understood.
- If further research and testing finds aspects that are critical to the success of the project, and without which the project would not work, changes to the design brief should be made.

Check your knowledge and understanding

- 1 State three examples of sources of secondary research.
- 2 Explain the difference between anthropometrics and ergonomics.
- 3 Describe how would you present primary research data that you had gathered from a questionnaire.
- 4 What two key documents are needed at the start of a project?
- 5 Why might a designer need to alter a design brief when working through a project?

DMP 3.3.1 Investigation, Primary and Secondary Data (continued...)

Check your knowledge and understanding ?

- 1 State three examples of sources of secondary research.
- 2 Explain the difference between anthropometrics and ergonomics.
- 3 Describe how would you present primary research data that you had gathered from a questionnaire.
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- 5 Why might a designer need to alter a design brief when working through a project?

KEY POINTS

- Designers have the responsibility for choosing their materials and processes carefully, so as to have the least impact on the environment and vulnerable communities.
- Deforestation can be avoided with the correct management of forests. Designers can choose to use FSC materials, which are wood, paper or board that has been taken from sustainable and well-managed forests.
- Fair trade products have been made by communities who have been given a fair price for their goods. This offers some protection to these communities against exploitation.

Check your knowledge and understanding ?

- 1 Explain the term 'deforestation'.
- 2 What are the main causes of global warming?
- 3 What does fair trade do for farmers and workers?
- 4 What are designers and makers trying to do to address problems of deforestation, increased carbon dioxide and unfair trading?

DMP 3.3.3 The Work of Others

KEY POINTS

- Design movements are particular styles popular with a group of people. Within these design movements there were key influential designers.
- Harry Beck is famous for the design of the London Underground map.
- Marcel Breuer was part of the school of design named 'Bauhaus'.
- Norman Foster is a successful architect.
- Sir Alec Issigonis designed the Morris Minor and the Mini.
- William Morris is famous for his furniture and wallpaper designs
- Louis Comfort Tiffany designed the famous Tiffany lamps, which are still manufactured and widely copied today.
- Raymond Templier is famous for his influence in the Art Deco style.
- Gerrit Rietveld designed products for the group De Stijl.
- Charles Rennie Mackintosh is a famous Scottish designer who produced a wide range of products, from posters to furniture.
- Aldo Rossi, Ettore Sottsass and Philippe Starck all worked at some point for the Italian design group, Alessi.
- Braun, Dyson, Apple and Alessi are successful companies that still design products today.

Check your knowledge and understanding ?

- 1 Give an example of a product which may have been inspired by an alternative design movement.
- 2 Give an example of a designer and explain the key features of their products.
- 3 Name a designer that has influenced you and explain what you like about their designs.
- 4 Explain the key features of the Alessi design group.

DMP 3.3.4 Design Strategies

KEY POINTS

- Negative feedback is used in a system to hold an output at a fixed level, whereas positive feedback is used to make sure that something happens by magnifying a small change.
- Hunting is when a system is trying to achieve something but keeps overshooting the target and tries to correct but overshoots again.
- Flow charts are used to show or plan sequences.
- Complex systems can be split into sub-systems, which simplifies both designing and testing.
- When designing systems, look at the opportunities that incorporating feedback would offer.
- Modelling, whether actual or virtual, allows the system to be tested before committing to manufacture

Check your knowledge and understanding ?

- 1 Give an example of a design you think is innovative and provide two reasons for your choice.
- 2 Explain one way in which a company may get their team to work together in analysing a task.
- 3 How might a collaborative approach to design improve your initial ideas?
- 4 Using a specific product as an example, explain what led to developments in this product over time.
- 5 Give three advantages of using a client during the design process.
- 6 Give three examples of ways in which designers can produce ideas that are unusual and creative.
- 7 What is the difference between a hard and a soft system?
- 8 What effect does positive feedback have on a system?
- 9 Give two advantages to using a virtual rather than actual prototyping system.

DMP 3.3.5 Communication Of Ideas

KEY POINTS

- Freehand, isometric and perspective sketching techniques are used to communicate design intent.
- A range of enhancement and rendering techniques can improve the communication of design intent.

Check your knowledge and understanding

- 1 What techniques can be used to make a design idea stand out on a page of ideas?
- 2 What is the preferred method of freehand sketching in 3D?
- 3 What is a construct of framework for sketching in 2D or 3D and how is it used?
- 4 What is meant by the term 'weight of line'?
- 5 What is annotation used for?

KEY POINTS

- Prototypes are used to test and modify design ideas.
- Prototypes can be physical or virtual models.
- Prototypes often form part of the agreement between a manufacturer and the client.
- Prototypes can be used to show innovative designs and check their viability.
- Rapid prototyping allows small numbers of specialised products to be made economically.
- A rigorous testing and evaluation scheme is important to decide if the product design will be successful.

Check your knowledge and understanding ?

- 1 Name three different materials commonly used for making prototypes.
- 2 Give two reasons why virtual prototyping is used in commercial manufacture.
- 3 List two commercial uses for rapid prototyping.
- 4 Give two ways that a virtual prototype can help a client to decide if a new design is right.
- 5 Identify four ways that a prototype can be evaluated.
- 6 Give three reasons for making a prototype of a new design.

DMP 3.3.7 Selection of materials and components

Check your knowledge and understanding ?

- 1 State the stock size of manufactured board.
- 2 Give an example of a modelling timber.

Check your knowledge and understanding ?

- 1 Name an inexpensive metal used to manufacture car bodies.
- 2 Explain the main reasons for selecting metal as a material.

Check your knowledge and understanding ?

- 1 List the properties that are associated with polymers.
- 2 Explain how polymer-based products can be low cost.

DMP 3.3.8 Tolerances

KEY POINTS

- Tolerances are the acceptable range of size a product or part can be.
- Tolerances are shown as + or – the acceptable dimension.
- Tolerances are important where components fit together.
- The smaller the tolerance the more accurate the product.
- More accurate tolerances will make a more consistent product, but may also increase manufacturing costs.

Check your knowledge and understanding ?

- 1 What are tolerances?
- 2 Why do we use tolerances?
- 3 Why is it difficult to maintain an accurate tolerance with timber once machined?
- 4 Give an example of where an accurate tolerance is not necessary.
- 5 You are cutting a piece of material 270×285 mm where each dimension has a tolerance of ± 2 . Which of the following is within tolerance?
 - a 271.5×287.5
 - b 285×270
 - c 268.5×284.9
 - d 265×284

KEY POINTS

- Stock sizes, where possible, should be used to reduce further processing.
- Select the smallest piece of material that is big enough for the job.
- Tessellate designs when marking out to make efficient use of space.
- All waste material should be considered when costing an item.
- A datum point is a position from which an accurate measurement can take place.

Check your knowledge and understanding

- 1 Why is a datum point important?
- 2 What is tessellation?
- 3 Why is using a material in a stock size more cost efficient?
- 4 On what material would you find 'face side' and 'face edge'?
- 5 Why does a template help when marking out?

DMP 3.3.10 Specialist tools and equipment

KEY POINTS

- A 3D router can convert two-dimensional and three-dimensional CAD drawings into three-dimensional products made from timber- or polymer-based materials.
- A laser cutter can cut thin sections of timber-based materials and can etch images onto the surface.
- A vacuum bag can be used as a clamping aid when veneering or laminating.

Check your knowledge and understanding ?

- 1 Which materials can be used with a 3D router?
- 2 Describe a process where would you use a vacuum bag.

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KEY POINTS

- A CNC machine works from CAD drawings.
- CNC machines are fast, accurate and consistent.
- A plasma cutter can cut thick sections of metal plate.

Check your knowledge and understanding

- 1 What are the advantages of using CNC machinery?
- 2 When would you use a plasma cutter?

DMP 3.3.10 Specialist tools and equipment (continued ...)

KEY POINTS

- A vacuum former can be used to blow a dome. The polymer sheet is heated in the same way as when vacuum forming, but instead of sucking the sheet over a mould the sheet is blown.

Check your knowledge and understanding ?

- 1 Use notes and sketches to describe the process of blowing a dome.

DMP 3.3.11 Specialist techniques and processes (TIMBERS)

KEY POINTS

- Timber can be shaped accurately into complex shapes using CNC machinery.
- Laminating can be used to create curved products in timber.
- End-grain is more absorbent than the surface of a piece of timber.
- Finishes for timber can be both protective and aesthetic.
- Thorough surface preparation is key to a high-quality surface finish.

Check your knowledge and understanding

- 1 Why are manufactured boards suitable for CNC machining?
- 2 In what two ways can a laminated shape be achieved?
- 3 What are the three reasons you apply a finish to a timber?
- 4 Why can knots cause problems when applying a finish?
- 5 Why would you use a primer?

DMP 3.3.11 Specialist techniques and processes (METALS)

KEY POINTS

- It is hard to achieve high levels of accuracy with hand tools.
- Metals can be shaped into intricate shapes by reforming by casting.
- Corrosion in ferrous metals is known as rust.
- Anodising can be used to add an aesthetic protective finish to aluminium.
- Surfaces must be clean and free of grease for a finish to adhere properly.

Check your knowledge and understanding

- 1 How can you accurately shape metal?
- 2 What can moulds be made out of for pewter casting?
- 3 Why does corrosion occur?
- 4 Why does galvanising help protect steel from corrosion?
- 5 When would sand blasting be used?

KEY POINTS

- Thermoplastic polymers are most commonly in schools and colleges.
- 3D printing and vacuum forming both use heat to shape and form thermoplastic polymers.
- Many polymers are said to be self-finished.
- Pigment can be added before the moulding process takes place.
- Polymers are the same colour from their core through to their surface.

Check your knowledge and understanding ?

- 1 How can you form polymers with heat?
- 2 How can you accurately cut polymers?
- 3 What is the benefit of a polymer having a pigment added before moulding?
- 4 Why are most polymers not painted?
- 5 Why should some paints not be used on polymers?