

Contents

WJEC GCSE in DESIGN & TECHNOLOGY (PRODUCT DESIGN)

For Teaching from 2009 For Award from 2011



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This is a unitised specification: candidates may be entered for separate units at stages during the course.

For subject awards from summer 2014, this specification will not be available to centres in England: centres in England will be required to follow the linear version of this specification.

DESIGN AND TECHNOLOGY (PRODUCT DESIGN)

SUMMARY OF ASSESSMENT

Unit 1: PRODUCT DESIGN WRITTEN PAPER (40%) Written Paper: 2 hours 120 marks (80 UMS) This will consist of one paper for each focus area.
Section A 20% (60 marks)
Four compulsory questions related to the world of Design and Technology and focus area specific.
Section B 20% (60 marks)
Four compulsory questions based on the specification content. These questions share a common structure across all focus areas.
Unit 2: PRODUCT DESIGN TASK (60%) Controlled Assessment 180 marks (120 UMS)
Part A Carry out an analysis of the problem, write a design specification, generate a range of ideas, develop a solution and produce the details of the final solution. (10 guided hours). Part B Plan the making process, carry out the making and evaluate project. (20 guided hours).
Both parts of the task have to comply with the controlled assessment rules.
Focus Areas Provided
Food Technology Graphic Products Resistant Materials Technology Systems and Control Technology Textiles Technology Product Design

AVAILABILITY OF ASSESSMENT AND CERTIFICATION

	Entry Code		June 2010	Jan 2011 and each year thereafter	June 2011 and each year thereafter
	Subject	Option*			
Unit 1	4141	01 or W1	✓		✓
Unit 2	4142	01 or W1			✓
Subject Award	4140	SA or GU			✓

* Option Codes

English Medium 01, Welsh Medium W1 - for units
English Medium SA, Welsh Medium GU - for subject award

Qualification Accreditation Numbers

500/8132/9 until 2013
600/5560/1 from 2014

DESIGN & TECHNOLOGY (PRODUCT DESIGN)

1 INTRODUCTION

1.1 Rationale

A course in Design and Technology offers a unique opportunity in the curriculum for candidates to identify and solve real problems by designing and making products or systems in a wide range of contexts relating to their personal interests. Design and Technology develops candidates' interdisciplinary skills, all six Key Skills and their capacity for imaginative, innovative thinking, creativity and independence.

The specification is based upon the view that design and technology is essentially a practical activity involving the combination of skills with knowledge and understanding in order to design and make quality products. It is intended to develop candidates' design and technological capability through a flexible and broad-based approach. The specification is planned to be sufficiently broad, balanced and relevant to interest all candidates.

Candidates should have the opportunity to analyse and evaluate situations, design and make products, and then appraise their performance. They should be provided with the opportunity to work with a range of materials and ICT.

Candidates should be presented with the subject matter in a stimulating and interesting way to promote discussion and research. They should be given the opportunity to experience the variety of roles involved in design and technology; client, designer, maker, manager, user etc. Candidates should be encouraged to consider the relationship between technology and society.

As a fundamental part of their course, candidates should design and make products. They should carry out activities related to industrial practices and the application of systems and control within their designing and making of these products.

The specification allows candidates to work in one or more of the following focus areas:

- Food Technology
- Graphic Products
- Resistant Materials Technology
- Systems and Control Technology
- Textiles Technology
- Product Design

1.2 Aims and Learning Outcomes

GCSE specifications in design and technology should encourage learners to be inspired, moved and changed by following a broad, coherent, satisfying and worthwhile course of study and gain an insight into related sectors, such as manufacturing and engineering. They should prepare learners to make informed decisions about further learning opportunities and career choices.

GCSE specifications in design and technology must enable learners to:

- actively engage in the processes of design and technology to develop as effective and independent learners;
- make decisions, consider sustainability and combine skills with knowledge and understanding in order to design and make quality products;
- explore ways in which aesthetic, technical, economic, environmental, ethical and social dimensions interact to shape designing and making;
- analyse existing products and produce practical solutions to needs, wants and opportunities, recognising their impact on quality of life;
- develop decision-making skills through individual and collaborative working;
- understand that designing and making reflect and influence cultures and societies, and that products have an impact on lifestyle;
- develop skills of creativity and critical analysis through making links between the principles of good design, existing solutions and technological knowledge.

1.3 Prior Learning and Progression

Although there is no specific requirement for prior learning, this specification builds upon the Programmes of Study for Design and Technology in Key Stages 1-3.

This specification may be followed by any candidate, irrespective of their gender, ethnic, religious or cultural background. This specification is not age specific and, as such, provides opportunities for candidates to extend their life-long learning.

This specification builds upon the Programmes of study for Design and Technology in Key Stages 1, 2 and 3 and allows candidates to fully address the knowledge, skills and understanding required by the National Curriculum Order for Design and Technology. The specification allows candidates to work in the following focus areas: Food Technology; Graphic Products; Resistant Materials Technology; Systems and Control Technology; Textiles Technology and Product Design promoting progression to a deeper level of knowledge, skill and understanding in one of the areas studied at Key Stage 3.

Whilst there is no specific requirement for prior learning in the WJEC Advanced Subsidiary / Advanced GCE specification in Design and Technology, there is a clear progression route from this GCSE specification. Candidates following the Graphic Products; Resistant Materials Technology; Textiles Technology or Product Design focus areas have an opportunity to extend their experience into the Product Design focus area at AS/Advanced level. Food Technology and Systems and Control Technology candidates have a clear progression route into focus areas with the same titles at AS/Advanced.

1.4 Equality and Fair Assessment

GCSEs often require assessment of a broad range of competences. This is because they are general qualifications and, as such, prepare candidates for a wide range of occupations and higher level courses.

The revised GCSE qualification and subject criteria have been reviewed to identify whether any of the competences required by the subject presented a potential barrier to any disabled candidates. If this was the case, the situation was reviewed again to ensure that such competences were included only where essential to the subject. The findings of this process were discussed with disability groups and with disabled people.

This review did not identify any potential barriers to disabled candidates within the criteria and no potential barriers have been added within the specification. It should be noted that candidates may use CAD/CAM for the making process and practical assistants may be used to support students with physical disabilities in this process.

Reasonable adjustments are made for disabled candidates in order to enable them to access the assessments. For this reason, very few candidates will have a complete barrier to any part of the assessment. Information on reasonable adjustments is found in the Joint Council for Qualifications document *Regulations and Guidance: Access Arrangements, Reasonable Adjustments and Special Consideration*. This document is available on the JCQ website (www.jcq.org.uk).

Candidates who are still unable to access a significant part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award. They would be given a grade on the parts of the assessment they have taken and there would be an indication on their certificate that not all of the competences have been addressed. This will be kept under review and may be amended in future.

1.5 Classification Codes

Every specification is assigned a national classification code indicating the subject area to which it belongs. The classification code for this specification is 9080.

Centres should be aware that candidates who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.

Centres may wish to advise candidates that, if they take two specifications with the same classification code, schools and colleges are very likely to take the view that they have achieved only one of the two GCSEs. The same view may be taken if candidates take two GCSE specifications that have different classification codes but have significant overlap of content. Candidates who have any doubts about their subject combinations should check with the institution to which they wish to progress before embarking on their programmes.

2

CONTENT**DEVELOPING, PLANNING AND COMMUNICATING IDEAS**

This part of the specification is concerned with the process of designing. This will start with an initial problem and conclude with a proposed solution giving due consideration to the issues that can and should influence the outcome.

Candidates should be taught to:

(a) develop and use design briefs and detailed specifications;

Understand the difference between design brief and design specification.
Analyse and clarify a design brief.
Identify essential criteria for inclusion in a design specification.
Use a specification to help develop a design.
Use a design brief and design specification for evaluation.
Use existing products as a source of ideas.

(b) consider issues that affect their research, designing and planning;

Use different research strategies to find information.
Consider the needs and values of a range of users.
Appreciate the economic costs involved.
Consider issues of sustainability.
Consider moral, social, environmental and cultural influences.
Take into account relevant safety legislation.
Prioritise and summarise research material.
Recognise the potential of new technologies.
Consider marketing and advertising.

(c) be flexible and adaptable in responding to changing circumstances and new opportunities;

Recognise that there is a range of possible ways forward when designing and making.

(d) generate, develop, model and communicate design proposals;

Use a variety of graphic techniques to communicate ideas clearly.
Use ICT to communicate ideas clearly.
Use appropriate modelling techniques to develop proposals.
Develop designs in a progressive way.
Communicate final design proposals in an appropriate form and level of detail.

(e) design for manufacturing in quantity;

Consider how products are designed to facilitate manufacturing in quantity.

(f) plan work schedules effectively;

Produce a realistic schedule of work.
Recognise critical points and constraints.

- (g) match materials and components with tools, equipment and processes, taking account of critical dimensions and tolerances when deciding how to manufacture the product.**

Select and justify the materials, components, tools, equipment and processes needed for successful manufacture.

PRODUCT ANALYSIS

This part of the specification is about knowing how to analyse a product.

This specification provides the opportunity for candidates, through their chosen focus area to develop a wider understanding of how products are designed and made.

Candidates should be taught to carry out a detailed analysis of a product addressing the following aspects:

- (a) the probable specification for the product;
- (b) the aesthetic appeal of the product;
- (c) the function and/or purpose of the product;
- (d) quality issues relating to the product;
- (e) the size data of the product;
- (f) the safety considerations of the product with reference to the end user;
- (g) the materials used in the manufacture of the product;
- (h) the scale of manufacture used to make the product;
- (i) the commercial processes used to make and assemble the product;
- (j) safety considerations of making the product;
- (k) sustainability and environmental issues.

SUSTAINABILITY AND LEGISLATIVE ISSUES

This part of the specification is about knowing that sustainability and environmental issues, legislation and standards affect and influence designing and manufacturing choices and decisions and use this information in their own designing and making.

Sustainability in Design and Technology

The specification requires candidates to develop a understanding of sustainability and environmental issues and to be able to use their understanding to guide and assist their decision making during designing in their focus area.

Candidates will have to be taught to look at the world we live in and to consider the needs of future generations and will need to consider how, as designers and manufacturers, they can minimise their environmental impact and also to show in their work how we can have a more sustainable future.

Candidates should be taught to:

- (a) recognise why sustainability issues and environmental issues are important;
- (b) consider sustainability issues and environmental issues when designing and manufacturing;
- (c) recognise and take account of social, economic and environmental responsibility in designing and making products;

- (d) understanding and use of SIX R's of sustainability, that is:
 - rethink
 - reuse
 - recycle
 - repair
 - reduce
 - refuse.
- (e) understand that sustainable designing is more than using recycled or recyclable materials to manufacture their products. It is about the total impact that the process of designing and making has on the environment;
- (f) carry out a "Life Cycle Analysis" to determine the environmental impact of a product.

Legislative Issues in Design and Technology

This specification requires candidates to develop an understanding of legislative issues and standards as they affect their designing and making in their chosen focus area and to be able to use the understanding they have gained to guide and assist their decision making during designing.

Candidates should be taught to:

- (a) know about the work of the British Standards Institution (BSI) and how it is related to the Committee for European Standardisation (CEN) and the International Standards Organisation (ISO);
- (b) know how standards are produced, what they are for and how products that reach the standards are marked;
- (c) know about and apply the current Standards applicable to Product Design:
 - (i) PP8888-1:2007 (at present)
Drawing Practice.
 - (ii) PP7321:204 (at present)
Compendium of British Standards for teachers of design and technology in schools and colleges.
- (d) know about the Packaging (Essential) Regulations (P(ER)R) 2003 and know how, in outline, the implementation of the provisions of the European Directive on Packaging and Packaging Waste affect Packaging design.

OTHER DESIGNERS / PRACTITIONERS

This part of the specification is about knowing about and understanding the work of professional designers and/or professional practitioners within the world of Design and Technology.

Candidates should be taught to recognise the influence of two Designers/Practitioners in the world of Design and Technology with respect to:

- (a) the range of work that each of the Designers/Practitioners have produced over time;
- (b) how to identify the work of each of the Designers/Practitioners;
- (c) the innovations and/or new ideas that the two Designers/Practitioners have introduced over time;
- (d) the influence that each of the two Designers/Practitioners has had on the world of Design and Technology.

Each Focus Area will specify two Designers/Practitioners for each examination year and the awarding body will review the two Designers/Practitioners each year. Centres will be informed of the details of each of the Designers/Practitioners two years before the examination to be taken.

COMMERCIAL MANUFACTURING PRACTICES

Candidates should be taught to:

Types of Commercial Manufacturing

Understand key points:

- Primary Processing.
- Secondary Processing.
- Quality Control.
- Quality Assurance.
- Tolerance.
- The process of Die Cutting.
- Product life cycle curve.

Consumer Protection

Appreciate the key points:

- Regulations.
- Legislations.
- BSI.
- European Standards.

Flat Pack Furniture

Appreciate the key points:

- Assembly instructions.
- Instruction booklets.
- Packaging.
- Marketing and Advertising.

The Purpose of Packaging

Appreciate the key points:

- To protect.
- To preserve.
- To inform.
- To display.
- To transport.
- To contain.

Product Labelling

Understand key information found on packaging:

- Product name.
- Description/contents.
- Manufacturer's details.
- Technical information.
- Safety information.
- Consumer Protection.
- Storage/maintenance information.
- Environmental information.
- Barcode.
- Design protection.

Select and use a range of hand and machine tools accurately, efficiently and safely process a variety of materials and components.

- Select the most appropriate way to expedite the work and justify the selection.
- Identify and use making methods that ease repetitious and time consuming hand processes.
- Use a range of marking out and measuring equipment accurately.
- Appreciate the scale of production in industry and the need for parameters and tolerances.
- Appreciate how products are manufactured in quantity.
- Visual checks of raw materials and components; correct choice of materials for end use in products.

Appreciate the ways in which a CNC machine can be used in batch or volume production.

- Use computer-aided manufacture (CAM) in single item production and in batch or volume production.
- An awareness of scales of production and type of machinery used in industry.

Manufacture single products and products in quantity, applying quality assurance techniques.

- Apply quality control techniques during preparation and manufacture.
- Visual checks of raw materials and components; correct choice of materials for end use in products.
- Test the completed product against the original specification.
- Appreciate how products are manufactured in quantity.
- Appreciate the scale of production in industry and the need for parameters and tolerances.

Have an understanding of marketing and advertising.

- An awareness of the mechanisms by which consumers are persuaded to buy products.
- They should understand the terms used.

The manufacture of single products and products in quantity i.e. one-off, batch production, volume production.

Understand product manufacture.

- One-off to produce single items, i.e. custom-made furniture.
- Batch production, to produce fixed quantities of identical products for stock or to order, i.e. fitted furniture systems for kitchens or bedrooms, flat pack/self assembly units.
- High volume, using a production line to produce large quantities of identical products, i.e. small storage units, cycle lights, torches, toys, household items.

Understand how different systems are set up for volume production.

- Be aware of the use of jigs and devices to repeat a task accurately; consider how quality is assured and controlled.

MATERIALS AND COMPONENTS

Candidates should develop an understanding of individual materials and components and how they can be combined. Candidates should be encouraged to consider the range of materials and components available and make reasoned selections and exclusions for given tasks.

Candidates should be taught to:

Materials can be classified according to their working characteristics and properties:

- Have a working knowledge of a wide range of materials that are evident in Product Design. This will need to cover the three main areas of product development – Modelling, Prototyping and Manufacturing.

Paper / Card

- Identify common papers / cards / boards such as cartridge, layout, tracing, grid, card, corrugate card, cast coated board, duplex board, foam core board.
- Understand that many paper based boards are composites. The composition can be adjusted to create different properties for specific purposes e.g. foil-backed for food packaging.
- Understand the stock forms for such materials i.e. size, thickness, weight and colour.
- Have a basic understanding of the primary processes involved in the production of such materials.

Woods

- Understand the classification of hardwoods, softwoods and manufactured boards.
- Identify common timbers such as pine, mahogany, teak, ash, birch.
- Identify common manufactured boards i.e. MDF, plywood, chipboard, blockboard, hardboard.
- Understand that many timber-based materials are composites. They can be adjusted to create different properties for specific purposes.
- Understand the stock forms for such materials i.e. rough sawn, sheet sizes.
- Have a basic understanding of the primary processes involved in the production of such materials.

Metals

- Understand the difference between ferrous and non ferrous metals.
- Identify common metals i.e. aluminium, brass, copper, mild steel, pewter.
- Understand the different properties and uses of such materials.
- Understand that many metals are alloys. They can be adjusted to create different properties for specific purposes e.g. casting alloys.
- Understand the stock forms for such materials i.e. sheet, rod, bar, tube.
- Understand that the properties of metal can be changed by heat treatment.

Plastics

- Understand the difference between thermoplastic and thermosetting plastic.
- Identify common thermoplastics i.e. acetate, acrylic, HDPE, PVC, rigid polystyrene.
- Identify common thermosetting plastics i.e. Epoxy resin, GRP, MF, UF.
- Understand that most plastics are synthetic in composition. They can be adjusted to create different properties for specific purposes e.g. increase rigidity, reduce weight, insulation.
- Understand the stock forms for such materials i.e. foam, granules, powder, rod, sheet.
- Have a basic understanding of the primary processes involved in the production of such materials.

Commercial Packaging Materials

- Understand the variety of materials involved in commercial packaging:
Paper and boards: solid board, corrugated card;
Plastics: acrylic, PET, PVC, LDPE, HDPE, PP, expanded polystyrene;
Metals: aluminium, steel;
Glass.

Control Components

- Be able to identify common electronic and mechanical components and understand their functions and uses control components:
Switches, LED's, Capacitors, Resistors, Transistors, Integrated circuits (Ics), Bulbs, DC Motors, Buzzers;
Gears, Cam and Follower, Cranks, Pulleys, Linkages, Levers.
- Understand the process of soldering and be able to assemble pre-designed electric kits.
- Understand the process of Micro control:
i.e. Logicator, Pic Logicator, Picaxe, etc.

Micro and Nanotechnology

- Microencapsulation and its use in:
Slow release patches.
Scented Fragrance Inserts.
Tamper-indicating wrappers.
Olfactory packaging.
Pressure sensitive copying paper.
- Microspheres and their use in producing optical qualities and effects in paints and finishes for example "Flop" control of metallic finishes.
- Specialised screenprinting techniques to produce high tech products for example a potentiometric biosensor.

Know about the efficient use of materials, components and commercial manufacturing techniques.

- Identify and select materials and components for a particular purpose as determined by:
Aesthetic qualities - colour, texture, translucency, opacity tactile qualities, surface finish and decoration, *visual impact*.
Mechanical properties - tensile or compressive strength, durability (resistance to corrosion or wear), hardness, ductility, malleability.
Physical properties – density, electrical or heat conductivity, fusibility, optical, thermal properties, elasticity.
- Economic and sustainable use of materials and components.
Select and use specific manufacturing processes in relation to the type of material and the intended purpose of products.
- A range of adhesives to suit different materials and differing conditions to include water based and water proof:
PVA, Balsa cement, acrylic cement, epoxy resins, 'super glues' and contact adhesives.
Glue Stick, glue guns, fixatives, masking (sheet, tape, fluid), double sided tape.

- Know about finishes used to protect and/or enhance the appearance of materials.

Finishes to enhance or protect, as applied to a range of materials, to include:

Draw filing, buffing, polishing.

Lamination / encapsulation, mounting / framing.

UV varnishing, embossing, foil blocking.

Applied surface finishes such as:

Etching, engraving, painting, varnishing, dip coating, electroplating, anodising.

Combining materials to improve their properties and uses.

- Understand the properties and uses of appropriate composite materials.
- Understand that materials can be laminated to improve strength and or appearance.
- Be aware of card, paper, polymer and wood based composites; metal alloys.
- Be aware of current developments in materials technology together with knowledge of properties, characteristics and applications for example Smart Memory Alloys, Smart inks, Smart oils and gels, foams, composites, microfibers.

How materials are prepared for manufacture and how pre-manufactured standard components are used.

- Measure, mark out, cut and prepare appropriate materials for the manufacture of a component part or product. Use of correct equipment: Steel rule, steel tape measure, callipers, micrometer, vernier gauge, spirit level, try square.
- Recognise the importance of standardisation in product design and manufacturing.
- Choose and justify the most suitable components for the product and type of material to enhance both functional and aesthetic requirements such as mechanical fasteners and electronic components.

Match materials and components with tools, equipment and processes, taking account of critical dimensions and tolerances when deciding how to manufacture the product.

- Select and justify the materials, components, tools, equipment and processes needed for successful manufacture.
- Consider the options available to them in terms of components, materials and methods of working.
- Select suitable materials, components and processes in order to design and manufacture.
- Choose materials, components and processes that are appropriate to the scale of production.
- Develop a pre-production prototype.

TOOLS, EQUIPMENT AND MAKING

Use a range of hand tools, machine tools, equipment and software appropriate to the manufacture of Product Design products including the use of CAD/CAM equipment.

Candidates need to be taught to:

Observe safety procedures in the working environment.

- Use hand and machine processes safely.
- Appreciate and apply relevant aspects of the Health and Safety at Work Act 1978.
- Know how to carry out appropriate risk assessments.
- Review procedures in terms of safety.
- Check equipment set up; report faults.
- Wear appropriate protective clothing and safety equipment when working with materials and equipment (apron, safety glasses etc.).

Select and use the correct hand tools and equipment for a range of practical tasks.

- Select tools and materials appropriate to the task.
- Safety issues involved with using common tools.
- Safety issues involved with common machine processes.

Know how to set up and adjust equipment safely.

- Safety issues involved with setting up a CNC machine.

Know how to skillfully use range of media should be used including.

- Drawing Board, Tee Square, Set Squares, Compass, Rule, Protractor;
- Pencils, Coloured Pencils, Pens, Technical/ Fine Line Pens, Paints, Pastels;
- CAD Software, - Desk-Top Publishing Software, Presentation Software, Image Manipulation Software, Vector Drawing Software;
- CAM Software to run and control CAM machinery.

Know how to set up and use with accuracy and precision.

- Flat Bed Scanners considering the relationship between the output desired and the input settings.
- Digital Still Cameras.
- Appropriate Cam Machines for making sophisticated items.

MAKING

Candidates need to be taught to:

- Plan a sensible, realistic procedure for manufacturing a product.
- Plan a logical order of processes for manufacture and estimate the time involved.
- Anticipate problems and suggest solutions.
- Use testing and checking procedures to ensure accuracy of manufacture.
- Test completed products against the original specification.
- Use manufacturing processes and finishing processes for a range of graphic media.
- Select a method of manufacture appropriate to the task.
- Work in ways that attempt to reflect what is done in industry.
- Avoiding extensive use of laborious or repetitious handwork in product manufacture.
- Have experience of using a CNC machine to manufacture parts of a product.
- Select the most appropriate way to expedite the work and justify the selection.
- Identify and use making methods that ease repetitious and time consuming hand processes.
- Use processes and techniques that can be used to save time on such tasks.
Use jigs.
Multiple cutting by hand or machine.
Use of templates.
Use of CAM machine for repeat tasks.

To design and manufacture three-dimensional models suitable for their purpose.

- Understand the purposes of modelling.
- Know the function of sketch, block, working and prototype models.
- Select and use materials appropriate for the function of the model.
- Use construction techniques appropriate to the material used for manufacture and the function of the model.
- Know the properties of a range of modelling materials including: paper, cards, boards, foam core board, Styrofoam, expanding polystyrene, polymorph, HIPS, acrylic, wood based materials, composite materials and new and smart materials.
- Know how to apply a suitable finish to a model.

Use IMAGE EDITING SOFTWARE – Bitmap/Pixel or Painting Software

- Use Set Up tools.
Select the most appropriate colour mode for outputting the work.
Save files in an appropriate format.
Use multiple layers when working on an image.

Use VECTOR DRAWING SOFTWARE – Drawing packages

- Use Set Up tools
Set up a workspace for drawing.
Save and export images files in an appropriate format.
Use multiple layers when working on an image.

Use PAGE LAYOUT SOFTWARE – Desk Top Publishing packages

- Use Set Up tools.
Set up a single page document.
Set up and arrange text frames.
Set up and arrange image frames.
Save a layout as a master page.
Save and export files in an appropriate format.
- Use Text
Import text from a word processor.
Create and apply a Paragraph Style.
- Use Images
Import images from a drawing or painting programme.
Wrap text around a placed image.

Select and use a range of hand and machine tools to accurately, efficiently and safely process a variety of materials and components.

- Use a range of hand and machine tools appropriate to the manufacture of products from a range of suitable materials.
- Use CAD/CAM systems such as plotter cutters, laser cutters, millers and engravers to produce prototype components for products.

Select and use tools, equipment and process effectively and safely to make products that match a specification.

Observe safety procedures in the working environment.

- Wear appropriate protective clothing and safety equipment when working with materials and equipment (apron, safety glasses etc.).
- Check equipment set up; report faults.
- Know how to carry out risk assessment procedures.

Select and use correct materials, hand tools and equipment for a range of practical tasks.

- Select a method of manufacture appropriate to each task.
- Basic processes used for wasting, deforming, fabricating and finishing a range of materials.

Know how to set up and adjust equipment safely.

- Set up basic workshop equipment such as the drilling machine and lathe safely and accurately.

Use appropriate modelling techniques for developing and communicating proposals.

- Practical tests/trials with real or substitute materials (e.g. card, clay, styrofoam, polymorph).
- Use 3D computer modelling to refine and develop proposals.
- Produce nets or templates.

Devise and apply tests to check the quality of their work at critical points during development.

- Ensure, through testing and modification, that the quality of the product is suitable for the intended purpose.
Devise testing procedures to assess the viability of prototypes as necessary.
Test materials and finishes for functional and aesthetic qualities.
Test the suitability of constructional/assembly techniques.

Provide a detailed, objective evaluation of the final product.

- Undertake a critical, objective appraisal of the final product against the design specification.
- Carry out appropriate end testing of the product with the intended target audience to assess functional, ergonomic performance, safety and anthropometric features.
- Use a range of appropriate media to record and present the results of a summative evaluation.
- Evaluate the product against the concept of sustainability. Include issues pertaining to the product life cycle, e.g. recycling materials and components, re-using and repairing.

ICT, CAD and CAM

Product design candidates are expected to use computer systems with appropriate software and hardware to support their designing and manufacturing. They need to be able to use ICT systems to assist research for problem solving. They need to be able to use ICT systems to process text, analyse data, generate 2D and 3D images / models and manipulate digital images understanding the working properties related to individual tasks.

Candidates must be taught to:

Use word processing software to create text.

- Edit text using word processing software.
- Check spelling and grammar using word processing software.

Use spreadsheet software to collate numerical data.

- Create graphs and charts using spreadsheet software.
- Model simple ' *what if* ' scenarios using spreadsheet software.

Access the internet and world wide web.

- Use search engines to find information to aid the design process.
- Access remote design resources.
- Download information and resources for use.

Set up and use digital capture devices.

- Use a digital camera to capture still images.
Set up the camera for optimal use.
Upload the images to a computer for editing.
- Use a flat bed scanner to capture images of documents.
Set up the scanner for optimal use.
Set up the scanner to scan line art.
Set up the scanner to scan mono images.
Set up the scanner to scan colour images.

Output digital files as hard copy.

- Set up a printer to output colour prints.
- Set up a printer to output black and white prints.

CAD (Computer Aided Design)

- Know the advantages and disadvantages of the use of CAD.
- Use of appropriate CAD software.
- Know the limitations of CAD.

CAD SOFTWARE

- Know the correct choice of CAD software to perform a specific role.
- Using image editing software.
- Use vector graphics software.
- Use page layout software.
- Use presentation software.
- Planning software.
- Modelling software.

IMAGE EDITING SOFTWARE

- Know that the images produced often start as photographs, downloads, or are scanned.
- Know that the images are then manipulated using the software.

Vector drawing

- Know that the images are often drawn from scratch.
- Know that the images can start as clip art.
- Know that the images are constructed and manipulated using the software.

Page layout

- Know that these programmes produce pages that can include text, bitmap and vector images.
- Know that the software allows for consistency in the layout from page to page.
- Know that the software allows for editing of text and images.
- Know that the pages are constructed and manipulated using the software.

Modelling

- Know that the use of appropriate 2D and/or 3D modelling software can simulate a product.
- Know that the design can be exported into another format for use on a CAM machine such as .stl files, .dxf, etc.

CAM (Computer Aided Manufacture)

- The advantages and disadvantages of the use of CAM.
- The use of appropriate CAM equipment.
- The limitations of CAM.

CAM Software

- Using the appropriate software when linked to a CAM machine.

CAM

Using the appropriate CAM machine for a specific purpose.

- Two-axis machines.
Lathes, engraving machines, plotters and vinyl cutters.
- Three-axis machines.
Routers, millers.
- Four-axis machines.
Combining of several elements together i.e. adding a lathe to a milling machine for a full 3D effect to be achieved.
- Co2 lasers.

Tool Paths.

- The correct set-up for the specific CAM machine:
Offset or non-offset paths.
Correct colour for specific paths.
Correct size of tool for path.
Correct speed of cutter.
Correct force / depth for material.
Correct number of passes needed to cut / engrave material.
Ability to Load, save and edit existing parameters.

How ICT including CAD/CAM is used in batch and volume production, including how to simulate production and assembly lines.

- Use of ICT and CAD/CAM in batch and volume production.
- How ICT and computer systems enable easy and fast communication.
Use of email for exchanging information,
Use of the internet for gathering information.
- How CAD/CAM systems enable faster more flexible manufacturing through:
Computer Integrated Manufacture (CIM)
Managing product and design data, managing stock control.
2D modelling, creation of 3D 'virtual' products on screen.
Fast, accurate and repeatable production processes.
Production control, i.e. controlling CNC equipment.
Automatic production.
Quality control, i.e. sampling, optical monitoring of ink intensity and image register against printed control strips.

SYSTEMS AND PROCESSES

Candidates should be taught to:

- Analyse familiar products in term of input, process and output.
- Understand why feedback is important in some systems.
 - Input - what goes in to the system;
 - Process - what happens in the system;
 - Output - the end result of the process which meets the specifications;
 - Feedback - checks made during the process to control quality of the output, which could be tested.
- Analyse the nature of systems in products used everyday for example. Torch, stapler, electric kettle, radio, washing machine. Production, distribution, consumption of the product life cycle.
- Know how microprocessors are increasingly used in control systems.
- Know how control systems and sub-systems can be designed, used and connected to achieve different purposes.
Understand open and closed loop systems
- Understand that there are many types of systems.
 - Natural systems, such as weather, ecosystems.
 - Design systems, such as mechanical / electronic machinery.
 - Human activity systems, such as working to a timetable.
- Understand, reflect, where possible, industrial manufacturing processes.
- Have an awareness of processes and techniques that can be used to save time and enhance quality/accuracy when working with materials.
 - Such as using jigs.
 - Multiple cutting by hand or machine.
 - Use of CNC equipment to repeat tasks.
- Show how CAM allows for higher levels of accuracy and repeatability.
- Know how materials are cut, shaped and formed to specified tolerances.
- Wasting
 - Saw, plane, file, chisel, abrade, wood and metal turning, drill, polish, milling.
- Deforming
 - Laminate, bend, vacuum form, encapsulate.

- **Fabricating**
Temporary and permanently join including screws, nails, nuts and bolts, tapping and threading, adhesives, dowels, halving joints, butt joints, rebate joints, housings, mitre, rivet, braze, mortice and tenon joints, KD fittings, solder, weld.
- **Reforming**
Injection mould, cast.

Use a variety of graphic techniques to communicate ideas clearly.

- Be able to communicate ideas and information using appropriate methods including two and three-dimensional graphical techniques and the conventions for communicating technical information.
Freehand perspective sketches.
Annotated sketches.
Formal drawings, e.g. orthographic, isometric, oblique, etc.
Exploded drawings.
Concept boards.
- Be able to use drawing tools and drawing processes to make accurate presentations and products.
- Use appropriate digital and manual drawing tools and processes. Be able to select the most appropriate way to expedite the work and justify the selection.
- Rendering, both manual and digital, should be used to aid communication throughout the candidates' work.
- An understanding of the reasons for using colour, shading and texturing to clarify graphic work is required.
- Rendering should be used for improved impact, clarifying form and representing materials.
- A range of media should be used including: pencils, coloured pencils, pens, technical/ fine line pens, paints, pastels.
- Be able to define and use terms associated with the design of the aesthetic aspects of products for example.
Shape, form, colour, texture, balance, harmony, aesthetics.

To use both Plane and Solid Geometry

- **PLANE.**
Bisection of lines and angles.
Construction of circles / triangles / quadrilaterals from given information.
Construction of regular polygons with up to eight sides.
- **SOLID.**
Construction of developments (nets) of basic and cut geometrical solids.

Design and produce ways of communicating information graphically.

- Analyse functions and design signs and symbols for specific purposes. Warning symbols, direction signs, symbols for a video remote control.
- Produce simplified instructions.
- Produce corporate identity, trademark and/or logo for a company that reflects the business and aspirations of the company taking into account the range of uses for the corporate identity, trademark and/or logo.

To design and manufacture three-dimensional models suitable for their purpose.

- Understand the purposes of modelling.
- Know the function of sketch, block, working and prototype models.
- Select and use materials appropriate for the function of the model. Use construction techniques appropriate to the material used for manufacture and the function of the model.
- Know the properties of a range of modelling materials including: Papers, cards, boards, foam core board, Styrofoam, expanded polystyrene, polymorph, HIPS, acrylic, wood based materials, composite materials and new and smart materials.
- Know how to apply a suitable finish to a model.

3

ASSESSMENT

3.1 Scheme of Assessment

Assessment for GCSE **Product Design** is untiered, i.e. all components/units cater for the full range of ability and allow access to grades A*-G for the subject award.

The scheme of assessment will consist of:

UNIT 1: PRODUCT DESIGN WRITTEN PAPER

Written Paper 2 hours (40 %)

Candidates will be required to sit an examination of two hours' duration (split into two sections), set and marked by the WJEC. Specific papers will be set for each of the six focus areas.

The papers for all focus areas follow a similar structure. Section 1 is designed to be answered in 60 minutes and consists of four questions. These questions are set so as to be accessible to candidates from all focus areas and will relate to Product Analysis, Overarching Principles, Designers and Practitioners and The Design Process. The quality of written communication will be integrated into question 3 and will necessitate paragraphs or essay style responses. Section 2 consists of four questions: these are focus area specific, and designed to take 60 minutes to answer.

Differentiation will be achieved by using a variety of styles of questioning to ensure that specification content is tested in such a way as to provide a meaningful examination to candidates of different levels of ability. The principle of incline of difficulty will be built into questions so that the examination will provide an adequate test across the targeted ability range.

UNIT 2: PRODUCT DESIGN TASK

Controlled Assessment 30 hours (60%)

The WJEC is responsible for 'task setting' and details of the controlled assessment tasks for Design and Technology will be forwarded to all centres in September each year.

Candidates are required to complete one 30 hour design, make and evaluate task. The task is divided into two sections. Section A is concerned with designing the product and Section B is concerned with planning, making and evaluating the product. The task is time limited and teachers are required to monitor and verify this time limit. Candidates will not gain additional credit by exceeding the time limit. Further details of the assessment process can be found in section 5.

3.2 Assessment Objectives

Candidates will be required to demonstrate their ability to:

AO1 Recall, select and communicate their knowledge and understanding in design and technology including its wider effects.

AO2 Apply knowledge, understanding and skills in a variety of contexts and in designing and making products.

AO3 Analyse and evaluate products, including their design and making.

3.3 Weighting of Assessment Objectives

Assessment objectives are weighted as follows across the two units:

	Unit 1 (Written Paper) %	Unit 2 (Controlled Assessment %	Total %
AO1	26.66	3.33	30
AO2	6.66	48.33	55
AO3	6.66	8.33	15
Total	40	60	100

3.4 Quality of Written Communication

For components involving extended writing (Written paper) candidates will be assessed on the quality of their written communication within the overall assessment of that component.

Mark schemes for these components include the following specific criteria for the assessment of written communication:

- legibility of text; accuracy of spelling, punctuation and grammar; clarity of meaning;
- selection of a form and style of writing appropriate to purpose and to complexity of subject matter;
- organisation of information clearly and coherently; use of specialist vocabulary where appropriate.

4 AWARDING, REPORTING AND RE-SITTING

GCSE qualifications are reported on an eight point scale from A* to G, where A* is the highest grade. The attainment of pupils who do not succeed in reaching the lowest possible standard to achieve a grade is recorded as U (unclassified) and they do not receive a certificate.

This is a unitised specification which allows for an element of staged assessment. At least 40% of the assessment must be taken at the end of the course, to satisfy the requirement for terminal assessment. Units may be re-taken once only (with the better result counting) before aggregation for the subject award.

Results for a unit have a shelf-life limited only by the shelf-life of the specification. A candidate may retake the whole qualification more than once.

Individual unit results are reported on a uniform mark scale (UMS) with the following grade equivalences:

GRADE	MAX.	A*	A	B	C	D	E	F	G
Unit 1	80	72	64	56	48	40	32	24	16
Unit 2	120	108	96	84	72	60	48	36	24
Subject Award	200	180	160	140	120	100	80	60	40

5

ADMINISTRATION OF CONTROLLED ASSESSMENT

The WJEC GCSE Design and Technology specification meets all regulations for controlled assessment as laid down by the regulatory authorities.

The controlled assessment task is worth 60% of the total marks available for the specification.

The controlled assessment tests all the assessment objectives for GCSE Design and Technology, within the weightings stipulated by the regulatory authorities.

Candidates will be required to demonstrate their ability to:

AO1 Recall, select and communicate their knowledge and understanding in design and technology including its wider effects.

AO2 Apply knowledge, understanding and skills in a variety of contexts and in designing and making products.

AO3 Analyse and evaluate products, including their design and making.

The weighting of assessment objectives across examination components is as follows:

	AO1	AO2	AO3	Total
Controlled Assessment (Marks and Percentages)	10 (3.3%)	145 (48.3%)	25 (8.33%)	180 (60%)

Rationale for Controlled Assessment

The controlled assessment is a compulsory component of GCSE Design and Technology. It complements the external examination by offering a distinct means of assessment. It is important for a number of reasons.

It enables candidates to:

- design creatively by generating, developing, planning and communicating ideas;
- make products by working safely with tools, equipment, components, materials and ingredients;
- apply systems and control. CAD/CAM, digital media and new technologies appropriate to the focus area;
- analyse and evaluate processes and products.

Levels of Control

The regulation of controlled assessment in GCSE Design and Technology is split into three stages:

- task setting
- task taking
- task marking

For each stage, the regulatory authorities have specified a certain level of control to ensure authenticity and reliability.

A. Task setting (High level of control)

The WJEC is responsible for **task setting** and details of the controlled assessment tasks for Design and Technology will be forwarded to all centres in September each year. Three tasks will be offered for each focus area. Candidates will choose one of these tasks. These tasks will be reviewed on a one-year cycle. The tasks will be open to interpretation and contextualisation by the centre/candidate.

B. Task taking (Medium level of control)

Candidates are required to complete one 30 hour design, make and evaluate task. The task is divided into two sections. Section A is concerned with designing the product and Section B is concerned with planning, making and evaluating the product. The task is time limited and teachers are required to monitor and verify this time limit. Candidates will not gain additional credit by exceeding the time limit. **Section A** of the task is to be completed in **10 hours** supervised time and **Section B** of the task is to be completed in the remaining **20 hours** of supervised time.

Supervision

The task must be supervised in such a way as to ensure that the contributions of individual candidates are recorded accurately and that plagiarism does not take place.

The task can be carried out in the normal classroom/workshop environment. Candidates are allowed supervised access to resources that may include information gathered outside the 30 hours of controlled assessment time.

Candidates may gather research/inspirational material prior to or during the assessment period and this can be referred to during the task but this material is not to be included in the material to be assessed. **Graphical work which has been prepared in advance by the candidate as part of an ongoing workbook or research cannot be included as part of the material assessed for the control assessment task.**

Candidates may collaborate/confer with others in relation to the task but all assessed material must be the candidates' work only.

The supervising teacher can give candidates limited guidance during the task in order to clarify what is to be done and to ensure that safe working practices are adhered to.

It is the responsibility of the centre to ensure the reliability and authenticity of all work presented for this controlled assessment. Teachers and students will be required to sign a declaration that all work presented is the work of the candidate alone. Failure to authenticate the work may result in grades being delayed or refused.

Presentation

All graphical and written work entered for this controlled assessment must be submitted on the pre-printed pages which are available for download from the WJEC website. Candidates are free to use ICT applications where they are appropriate. The assessment criteria for the task are detailed in section 3.

C. Task marking

The Task is to be assessed as follows.

Section A Designing

10 hours (60 marks) (Weighting 20%)

	Marks	Assessment objective
Analysis of the task	5	AO3
Design specification	5	AO2
Generation of ideas	10	AO2
Development and modelling Form/style/function (5) Materials/components (5) Construction/making (5) Size/quantity (5) Finish/quality (5)	25	AO2
Final solution – graphical presentation	5	AO1
Final solution – technical details	5	AO2
Creative thinking	5	AO2
Total marks	60	

Section B Planning, Making and Evaluating

(20 hours) (120 marks) (Weighting 40%)

	Marks	Assessment objective
Plan the make	10	AO1(5) AO2(5)
Making Range and difficulty of processes (10) Quality of construction (25) Dimensional accuracy (15) Quality of finish/appearance (15) Function (10 marks) Independent working (15)	90	AO2
Evaluation	10	AO3
Improvements	10	AO3
Total marks	120	

Internal Moderation

Teachers are responsible for marking the controlled assessment by applying the criteria provided. In centres where more than one teacher is involved in a focus area and/or in centres where there is more than one focus area being taught it will be beneficial if the marking criteria are discussed before marking takes place so that some agreement on the application of the criteria can be arrived at. It is essential also that a system of cross moderation between teachers is applied before final marks are submitted to the WJEC.

Annotation

There is an opportunity on each page of the task for teachers to make some notes that support the marks being awarded and to record any information that may have some bearing on the candidates' performance. A note of the time taken is also recorded on each sheet.

External Moderation

All candidates' marks are recorded on the appropriate form and those marks are submitted in the summer term. The WJEC will select a sample of work that will be moderated externally. A visiting moderator will moderate this sample of work. This external moderation will take place **at the centre**.

WJEC's *Internal Assessment Manual* gives instructions about selecting and despatching samples of work to the moderator.

As a result of the moderation, the marks of candidates may be adjusted to bring the centre's marks into line with the national standard.

It assists the moderation process considerably if the final marks of all the candidates are submitted to the moderator in rank order. It is only if this is done that the moderator can be fully aware of the full impact of any scaling.

In the event of concern over the awarding procedures, the normal appeals process will apply.

Authentication

Candidates will be required to confirm in writing, with any exceptions stated, that the work has been completed unaided. This will be achieved by signing the Controlled Assessment box on the pre-printed sheet.

Teachers will be required to confirm in writing that, to the best of their knowledge, all the work submitted for moderation, with any exceptions stated, is the candidate's own unaided work. This will be achieved by signing the composite mark sheet and the Controlled Assessment sheet.

Malpractice discovered prior to the candidate signing the declaration of authentication need not be reported to WJEC but must be dealt with in accordance with the centre's internal procedures.

Before any work towards the Controlled Assessment is undertaken, the attention of candidates should be drawn to the relevant JCQ Notice to Candidates. This is available on the JCQ website (www.jcq.org.uk) and included in *Instructions for Conducting Coursework/Portfolios*. More detailed guidance on the prevention of plagiarism is given in *Plagiarism in Examinations; Guidance for Teachers/Assessors* also available on the JCQ website.

Material that candidates may have acquired in their research such as multiple copies of questionnaires and pre-printed material should not be submitted.

Retention of Controlled Assessment

Centres need to retain the Controlled Assessments until the end of November following the Summer Examination.

Details of assessment criteria

The assessment criteria provided should be applied to each controlled assessment task and are applicable to all focus areas in Design and Technology. The mark descriptors provide a general indication of the performance of candidates in each mark range.

Section A Designing

Analysis of the task (5 marks)

This is an opportunity for candidates to define and contextualise the task in their own terms and to formulate an appropriate initial design brief. Candidates are free to carry out any research they consider necessary but the work presented for assessment will be confined to a summary of how their product sits in the market place together with an evaluation of a similar or competitor's product.

Mark	Description of Attainment
0	No analysis presented.
1	There is a very basic analysis of where the product fits in the market place together with a limited evaluation of a similar product. The work presented shows little evidence of prior research and preparation. A simple brief may be evident.
2	There is a basic but appropriate analysis of where the product fits in the market place together with a basic evaluation of a similar product. The work presented shows limited evidence of prior research and preparation. A simple brief is evident.
3	There is a good analysis of where the product fits in the market place together with an evaluation of a similar product. The work presented shows some evidence of prior research and preparation. A clear brief is evident.
4	There is a very good analysis of where the product fits in the market place together with a detailed evaluation of a similar product. The work presented shows good evidence of prior research and preparation. A well-worded brief is evident.
5	There is a comprehensive analysis of where the product fits in the market place together with a very detailed evaluation of a similar product. The work presented shows clear evidence of detailed research and preparation. A clear and appropriate brief is evident.

Design Specification (5 marks)

This is an opportunity for candidates to present a detailed design specification of the intended product.

Mark	Description of Attainment
0	No specification presented.
1	A design specification comprising a list of basic attributes for the product. The specification shows little or no links with the analysis of the task. Information is poorly organised, little or no use of technical language/vocabulary. Written communication is limited in terms of organisation of material, with many errors of grammar, punctuation and spelling.
2	A basic design specification comprising a list of relevant attributes for the product. The specification shows superficial links with the analysis of the task. Information shows evidence of structure, limited use of technical language/vocabulary. Written communication is limited in terms of organisation of material with some errors of grammar, punctuation and spelling.
3	A good design specification comprising a prioritised list of attributes for the product presented under appropriate headings. The specification illustrates clear links with the analysis of the task. Information is organised, basic use of technical language/vocabulary. Written communication is adequate in terms of organisation of material, with some errors of grammar, punctuation and spelling.
4	A comprehensive design specification comprising a prioritised list of attributes for the product presented under appropriate headings. The specification demonstrates strong links with the analysis of the task. Information is well organised, good use of technical language/vocabulary. Written communication is good, presenting mainly appropriate material in a coherent manner, with few errors of grammar, punctuation and spelling.
5	An excellent design specification comprising a prioritised list of attributes for the product presented under appropriate headings. The specification is well founded in the analysis of the task. Information is well organised, presented in a highly appropriate manner, very good use of technical language/vocabulary. Written communication is good, presenting appropriate material in a coherent manner, and largely error-free.

Generation of ideas (10 marks)

This is an opportunity for candidates to present up to four initial design ideas for the product. Ideas are to be clearly sketched and annotated.

Mark	Description of Attainment
0	No ideas presented. No evidence of written communication.
1 - 2	A small range of barely appropriate ideas that are poorly annotated. The ideas and annotation show little attention to the specification. Information is poorly organised, little or no use of technical language/vocabulary. Written communication is limited in terms of organisation of material, with many errors of grammar, punctuation and spelling.
3 - 4	A range of appropriate ideas that are annotated. The ideas and annotation show some attention to the specification. Information shows evidence of structure, limited use of technical language/vocabulary. Written communication in terms of organisation of material with some errors of grammar, punctuation and spelling.
5 - 6	A range of clear ideas that are appropriately annotated. The ideas and annotation show some attention to the specification. Information is organised, basic use of technical language/vocabulary. Written communication is adequate in terms of organisation of material, with some errors of grammar, punctuation and spelling.
7 - 8	A range of good initial ideas that are well annotated. The ideas and annotation show good attention to the specification. Information is well organised, good use of technical language/vocabulary. Written communication is good, presenting mainly appropriate material in a coherent manner, with few errors of grammar, punctuation and spelling.
9 - 10	A range of excellent initial ideas that are very well annotated. The ideas and annotation show close attention to the specification. Information is well organised, presented in a highly appropriate manner, very good use of technical language/vocabulary. Written communication is good, presenting material in a coherent manner and largely error-free.

Development and modelling (25 marks)

This is an opportunity for candidates to choose their best idea and to develop it into its final form. This section is an opportunity for candidates to use appropriate ICT. Marks are awarded for evidence of development under the headings shown. Candidates must offer options and make reasoned decisions under each heading. Evidence of these areas may be presented in integrated form across the 5 pages available.

Form/Style/Function

Mark	Description of Attainment
0	No development of form presented.
1	Limited evidence of the form/style being developed or modelled. An alternative shape or style may be evident. There is no evidence of decision-making.
2	Some evidence of the form/style being developed or modelled. Several options are presented. There is evidence of decision-making but with little reasoning offered.
3	Clear evidence of the form/style being developed or modelled. Several options have been offered. There is evidence of reasoned decision-making.
4	Good evidence of the form/style being developed and modelled. Several appropriate options have been offered. There is clear evidence of informed decision making.
5	A variety of forms/styles have been presented and the shape and form of the product have been developed and modelled in a progressive way. A final decision based on sound reasoning has been made.

Materials/Components

Mark	Description of Attainment
0	No development of materials/components presented.
1	Limited evidence of the selection of appropriate materials/components. Materials/components have been stated. There is no evidence of decision-making.
2	Some evidence of the selection of appropriate materials/components. Alternatives have been offered. There is some evidence of decision-making.
3	Clear evidence of the selection of appropriate materials/components. Alternatives have been offered. There is evidence of reasoned decision-making.
4	Clear evidence of the selection of appropriate materials/components. Appropriate alternatives have been offered. There is clear evidence of reasoned decision-making.
5	Full and clear evidence of the selection of appropriate materials/components. Appropriate alternatives have been offered. There is evidence of well-reasoned decision-making.

Construction/Making

Mark	Description of Attainment
0	No development of the construction/making presented.
1	Limited evidence of the construction/making being developed. A construction/making method has been offered. There is no evidence of decision-making.
2	Some evidence of the construction being developed. A small variety of construction/making methods have been offered. There is some evidence of decision-making.
3	Clear evidence of the construction/making being developed. A variety of construction/making methods have been offered. There is evidence of reasoned decision-making.
4	Clear evidence of the construction/making being developed. A variety of appropriate construction/making methods have been considered. There is evidence of well-reasoned decision-making.
5	Full and clear evidence of the construction/making being developed. A range of appropriate construction/making methods has been considered. There is evidence of well-reasoned decision-making.

Size/Quantity

Mark	Description of Attainment
0	No development of size/quantity presented.
1	Limited evidence of sizes and or quantities being developed. Sizes or quantities may be evident. There is no evidence of decision-making.
2	Some evidence of sizes and or quantities being developed. Alternative sizes and or quantities will be evident. There is some evidence of decision-making.
3	Clear evidence of sizes and or quantities being developed. Alternative sizes and or quantities will be evident. There is evidence of reasoned decision-making.
4	Clear evidence of sizes and or quantities being developed. Sizes and or quantities have been developed in a progressive way. There is evidence of reasoned decision-making.
5	Full and clear evidence of sizes and or quantities being developed. Alternative sizes and or quantities have been systematically evaluated. There is clear evidence of well-reasoned decision-making.

Finish/Quality

Mark	Description of Attainment
0	No development of finish/quality presented.
1	Limited evidence of the development of finish/quality. A suitable finish may be offered. There is no reference to quality control. There is no evidence of decision-making.
2	Some evidence of the development of finish/quality. An alternative finish is offered. There is brief reference to quality control. There is evidence of decision-making.
3	Some evidence of the development of finish/quality. Alternative finishes are offered. There is reference to aspects or quality control. There is evidence of decision-making.
4	Clear evidence of the development of finish/quality. Alternative finishes are offered. There is reference to aspects of quality control. There is evidence of reasoned decision-making.
5	Full and clear evidence of the development of finish/quality. A range of alternative finishes is offered. There is reference to a variety of quality control issues. There is evidence of well-reasoned decision-making.

Final solution

This is an opportunity for candidates to give full details of their final design using presentation techniques appropriate to the chosen focus area. Details of the form, dimensions, construction, components, materials and finish will be included as appropriate. This section is an opportunity for candidates to use appropriate ICT. Marks are awarded for (a) a graphical presentation of the final design and (b) The technical details that support manufacture.

(a) Graphical presentation (5 marks)

This is an opportunity for the candidate to present a clear and expressive graphical presentation of their final design. Any appropriate method of communication may be used.

Mark	Description of Attainment
0	No graphical presentation presented.
1	A basic illustration of the final product. It is recognisable but lacks proper form. It offers little evidence of shading or colour rendering.
2	An illustration of the final product. It is recognisable and shows reasonable form. It offers evidence of shading and/or colour rendering.

- 3 A clear illustration of the final product. It is recognisable and shows good form. It offers evidence of good shading and/or colour rendering.
- 4 A very good graphical presentation of the final product. It uses a recognised graphical technique, is accurate in its structure and It shows effective shading and or colour rendering.
- 5 A very high quality graphical presentation of the final product. It uses a recognised graphical technique, is accurate in its structure and shows expressive shading and/or colour rendering.

(b) Technical details (5 marks)

This is an opportunity for candidates to present the final technical details of their design. These could include dimensions, materials/components, construction and finish as appropriate to each focus area.

Mark	Description of Attainment
0	No technical details presented.
1	Limited evidence of technical detail.
2	Evidence of some technical detail.
3	Evidence of many technical details.
4	Evidence of most technical detail.
5	Evidence of virtually all technical details.

Creative thinking (5 marks) (Throughout)

This is an opportunity for candidates to show a measure of flair, imagination and creativity in their designing. It can be evident at any stage through the design process.

Mark	Description of Attainment
0	No creative thinking presented.
1	Evidence of limited creative thinking.
2	Evidence of some creative thinking.
3	Evidence of creative thinking in several areas.
4	Evidence of much creative thinking. Some ideas show imagination and flair. Creative thinking is evident throughout the development of the product and imaginative presentational techniques are evident.
5	A high level of creative thinking. Very imaginative ideas are evident. A highly creative development of the product is evident. Presentational techniques show much flair.

Section B Planning, making and evaluating

Planning the make (10 Marks)

This is an opportunity for the candidate to plan the stages and processes necessary to manufacture the product. It must be done before the candidates begins making.

Mark	Description of Attainment
0	No plan for making presented. No evidence of written communication.
1 - 2	A list of manufacturing steps is evident but shows little appreciation of the work involved or the time needed. Information is poorly organised, little or no use of technical language/vocabulary. Written communication is limited in terms of organisation of material, with many errors of grammar, punctuation and spelling.
3 - 4	A list of basic manufacturing steps is evident. The steps contain some detail of the processes required. There is little attempt to quantify the time needed. Information is organised, basic use of technical language/vocabulary. Written communication is limited in terms of organisation of material with some errors of grammar, punctuation and spelling.
5 - 6	A list of realistic manufacturing steps is evident. The steps contain some detail of the processes required. There is an attempt to quantify the time needed. Information is organised, with basic use of technical language/vocabulary. Written communication is adequate in terms of organisation of material with some errors of grammar, punctuation and spelling.
7 - 8	A list of realistic manufacturing steps is evident. The steps contain some detail of the processes required and note any constraints. There is a realistic estimate of the time needed to manufacture the outcome. Information is well organised, with good use of technical language/vocabulary. Written communication is good, presenting mainly appropriate material in a coherent manner, with few errors of grammar, punctuation and spelling.
9 - 10	A clear, appropriate and detailed list of manufacturing steps is evident. Constraints have been recognised. There is a realistic estimate of the time needed to manufacture the outcome. Information is well organised, presented in a highly appropriate manner, with very good use of technical language/vocabulary. Written communication is good, presenting appropriate material in a coherent manner, and largely error-free.

Making the product (90 marks)

This is an opportunity for candidates to demonstrate the range and quality of their manufacturing skills. The 90 marks available for making are apportioned under the following headings.

Range and difficulty of practical processes (10 marks)

Mark	Attainment
0	No practical processes evident.
1 - 2	One straightforward practical processes are evident.
3 - 4	One or two more demanding practical processes are evident.
5 - 6	A range of fairly demanding practical processes are evident.
7 - 8	A range of demanding practical processes are evident.
9 - 10	A range of challenging practical processes are evident.

Quality of construction/making (25 marks)

Mark	Attainment
0	No practical processes evident.
1 - 5	Little acceptable accuracy is evident in the construction/making.
6 - 10	An adequate level of accuracy is evident in only a few aspects of the construction/making.
11 - 15	An adequate level of accuracy is evident in some aspects of the construction/making.
16 - 20	A good level of accuracy is evident in all aspects of the construction/making.
21 - 25	A high level of accuracy is evident in all aspects of the construction/making.

Dimensional accuracy (15 marks)

Mark	Attainment
0	No practical processes evident.
1 - 3	The finished product bears little resemblance to the final design proposal.
4 - 6	The finished product matches some details, both visual and technical, of the final design proposal.
7 - 9	The finished product matches many details, both visual and technical, of the final design proposal.
10 - 12	The finished product matches most details, both visual and technical, of the final design proposal.
13 - 15	The finished product matches virtually all details, both visual and technical, of the final design proposal.

Quality of finish/appearance (15 marks)

Mark	Attainment
0	No practical processes evident.
1 - 3	No elements of the product displays an adequate finish.
4 - 6	Some elements of the product display an adequate finish.
7 - 9	Most elements of the product display an adequate finish.
10 - 12	Most elements of the product display a good finish.
13 - 15	Great care is taken to achieve a very high quality finish on all elements of the product.

Function (10 marks)

Mark	Attainment
0	The product does not function on any level.
1 - 2	The product functions in a very limited or partially finished way.
3 - 4	The product functions to a limited extent.
5 - 6	The product functions fairly well.
7 - 8	The product functions well.
9 - 10	The product functions perfectly.

Independent working (15 marks)

Mark	Attainment
0	The candidate cannot work without constant support and advice.
1 - 3	The candidate has required considerable support and advice during the making of the product.
4 - 6	The candidate has required fairly frequent support and advice during the making of the product.
7 - 9	The candidate has required some support and advice during the making of the product.
10 - 12	The candidate has required only minor support and advice during the making of the product.
13 - 15	The candidate has worked almost entirely unaided whilst making the product.

Evaluation (10 marks)

This is an opportunity for the candidate to evaluate the final product and to suggest any improvements that could be made. Evaluations must compare the final outcome with the initial intention.

Evaluation of practical outcome (10 marks)

Mark	Attainment
0	No evaluation presented. No evidence of written communication.
1 - 2	A basic evaluation of the outcome is evident. Comments are general and do not relate back to the initial specification. Information is poorly organised, little or no use of technical language/vocabulary. Written communication is limited in terms of organisation of material, with many errors of grammar, punctuation and spelling.
3 - 4	An evaluation of the outcome is evident. Comments offer some detail and relate in part back to the initial specification. Information shows evidence of structure, limited use of technical language/vocabulary. Written communication is limited in terms of organisation of material, with some errors of grammar, punctuation and spelling.
5 - 6	A critical evaluation of the outcome is evident. Comments offer some detail and relate in part back to the initial specification. Information is organised, with basic use of technical language/vocabulary. Written communication is adequate in terms of organisation of material, with some errors of grammar, punctuation and spelling.
7 - 8	A critical evaluation of the outcome is evident. The comments are perceptive and detailed and relate back to the initial specification. Information is well organised, with good use of technical language/vocabulary. Written communication is good, presenting mainly appropriate material in a coherent manner, with few errors of grammar, punctuation and spelling.
9 - 10	A critical evaluation of the outcome is evident. The comments are perceptive and detailed and relate in full back to the initial specification. Information is well organised, presented in a highly appropriate manner, very good use of technical language/vocabulary. Written communication is good, presenting appropriate material in a coherent manner, and largely error-free.

Suggested improvements (10 marks)

This is an opportunity for candidates to put forward suggestions for improving the design and/or suggesting any improvement of techniques to ensure better quality of manufacture.

Mark	Attainment
0	No improvements presented. No evidence of written communication.
1 - 2	An improvement to the design and/or manufacturing process has been suggested. Written communication is limited in terms of organisation of material, with many errors of grammar, punctuation and spelling.
3 - 4	Several suggestions for improvements to the design together with a suggestion of how quality of manufacture could be improved. Written communication is limited in terms of organisation of material, with some errors of grammar, punctuation and spelling.
5 - 6	Several relevant suggestions for improvements to the design together with suggestions of how quality of manufacture could be improved. Quality of written communication is basic, some errors of grammar, punctuation and spelling.
7 - 8	Well-founded suggestions for improvements to the design together with suggestions of how quality of manufacture could be improved. Information is well organised, with good use of technical language/vocabulary. Written communication is good, presenting mainly appropriate material in a coherent manner, few errors of grammar, punctuation and spelling.
9 - 10	Well-founded suggestions for improvements to the design together with detailed suggestions of how quality of manufacture could be improved. Information is well organised, with very good use of technical language/vocabulary. Quality of written communication is good, presenting appropriate material in a coherent manner, and largely error-free.

6

GRADE DESCRIPTIONS

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content specified by the specification; they are not designed to define that content. The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of candidates' performance in the assessment may be balanced by better performances in others.

Grade A

Candidates recall, select and communicate detailed knowledge and thorough understanding of design and technology, including its wider effects.

They apply relevant knowledge, understanding and skills in a range of situations to plan and carry out investigations and tasks effectively. They test their solutions, working safely and with a high degree of precision.

They analyse and evaluate the evidence available, reviewing and adapting their methods when necessary. They present information clearly and accurately, making reasoned judgements and presenting substantiated conclusions.

Grade C

Candidates recall, select and communicate sound knowledge and understanding of design and technology, including its wider effects.

They apply knowledge, understanding and skills in a range of situations to plan and carry out investigations and tasks. They test their solutions, working safely and with precision.

They review the evidence available, analysing and evaluating some information clearly, and with some accuracy. They make judgements and draw appropriate conclusions.

Grade F

Candidates recall, select and communicate knowledge and understanding of basic aspects of design and technology, including its wider effects.

They apply limited knowledge, understanding and skills to plan and carry out simple investigations and tasks, with an awareness of the need for safety and precision. They modify their approach in the light of progress.

They review their evidence and draw basic conclusions.

7 THE WIDER CURRICULUM

Key Skills

Key Skills are integral to the study of GCSE Design and Technology and may be assessed through the course content and the related scheme of assessment as defined in the specification. The following key skills can be developed through this specification at levels 1 and 2:

- Communication
- Problem Solving
- Information and Communication Technology
- Working with Others
- Improving Own Learning and Performance
- Application of Number

Mapping of opportunities for the development of these skills against Key Skills evidence requirement is provided in 'Exemplification of Key Skills for Design and Technology', which are available on the WJEC website.

Opportunities for use of Technology

This specification gives candidates the opportunity to use their ICT skills for practical purposes, especially in the production of their design folios and associated products. These opportunities will apply particularly to the generation of information together with its processing and presentation though, depending on resources and the specific project in question, may include CAD and/or CAM work.

Spiritual, Moral, Ethical, Social and Cultural Issues

This specification provides opportunities for candidates, through the study of their chosen focus area, to develop an understanding of spiritual, moral, ethical, social and cultural issues as they relate to the designer, manufacturer or user. The specification provides a framework and includes specific content through which individual courses may address these issues

Project work may serve to extend understanding of these issues in order that a balanced appreciation of the conflicts and dilemmas involved in the design and manufacture of products or systems may be encouraged.

Design and Technology also provides opportunities to promote enterprise and entrepreneurial skills through the process of identifying an opportunity to design a product or system to meet a specific need, investigating the work of professional designers, the manufacturing industry, developing their own product or system and finally evaluating the whole process. Tasks linked to the project provide opportunities to develop independent thinking skills, through candidates identifying relevant sources of information and developing specific performance criteria for their designs to guide their thinking.

Citizenship

In this context citizenship is taken to include the development of social and moral responsibility, participation in community activity and development of political literacy. This specification is designed to make a contribution to the development of the knowledge, skills and understanding of citizenship. In particular, the coursework element will encourage pupils to take an effective part in school-based and community-based activities, showing a willingness and commitment to evaluate such activities critically. Aspects of the project, for example, could be directly related to the needs of the school or local community, which would provide candidates with the opportunity to tackle problems which are real and meaningful to themselves. In doing so, they will be encouraged to demonstrate personal and group responsibility in their attitudes to themselves and others: they would also need to consider critically and constructively the views of others when developing and evaluating possible solutions.

Environmental Issues

This specification supports all aspects of environmental education. Candidates are expected to develop and appreciate a deeper understanding of the environment. The specification has been developed to consider environmental issues and candidates will be examined on their knowledge and understanding in section A of the written paper.

Health and Safety Consideration

This part of the specification is about ensuring the safety of everyone working in the school Design and Technology rooms.

Health and safety is vital and centres must take into account all relevant safety legislation and observe all appropriate safety procedures in the working environment.

It is essential for centres to ensure that health and safety and related issues are applied and consideration of these issues must therefore be an integral part of all teaching in Design and Technology.

The specification provides candidates with the opportunity to learn about Health and Safety as it applies to them in the Design and Technology rooms and to become familiar with the processes of ensuring that safe working practices are always employed.

Candidates are should know:

- (a) the safety procedures that apply in the Focus Area that they are studying;
- (b) how to carry out a risk assessment for the tools and equipment they use;
- (c) how to carry out a risk assessment for the machines they use;
- (d) how to carry out a risk assessment for the manufacturing processes they use;
- (e) how to carry out a risk assessment for the materials that they use;
- (f) how to set up, adjust and use tools and equipment safely;
- (g) how to set up, adjust and use machines safely;
- (h) how to carry out manufacturing processes safely;
- (i) how to minimise the risk to themselves and others in the working environment.

The European Dimension

This specification supports environmental education, the European dimension and health education, consistent with EC agreements.

The approach used in constructing the specification lends itself to the establishment of links with other areas of study, particularly those involving problem solving or the use of ICT skills, knowledge and understanding, for example in the completion of tasks and assignments for other GCSE specifications.

The above approach conforms with the aspirations expressed in the 1998 Resolutions of the European Community and the Ministers of Education meeting within the Council, concerning the European dimension in education and environmental education, particularly those intended at the level of member states.