GCSE

WJEC GCSE in

DESIGN AND TECHNOLOGY

APPROVED BY QUALIFICATIONS WALES

SPECIFICATION

Teaching from 2017
For award from 2019

Version 2 January 2019

SUMMARY OF AMENDMENTS

Version	Description	Page number
2	'Making entries' section has been amended to clarify resit rules and carry forward of NEA marks.	36

WJEC GCSE in DESIGN AND TECHNOLOGY

For teaching from 2017
For award from 2019

This specification meets the GCSE Qualification Approval Criteria which set out the requirements for all new or revised GCSE specifications developed to be taught in Wales from September 2017.

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GCSE DESIGN AND TECHNOLOGY (Wales)

SUMMARY OF ASSESSMENT

Unit 1: Design and Technology in the 21st Century
Written examination: 2 hours
50% of qualification

A mix of short answer, structured and extended writing questions assessing candidates' knowledge and understanding of one area selected from:

- engineering design
- fashion and textiles
- product design

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Unit 2: Design and make task
Non-exam assessment: approximately 35 hours
50% of qualification

A sustained design and make task, based on a contextual challenge set by WJEC, assessing candidates' ability to:

- identify, investigate, analyse and outline design possibilities
- design and make prototypes and evaluate their fitness for purpose

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This linear qualification will be available for assessment in May/June each year. It will be awarded for the first time in summer 2019.

Qualification Approval Number: C00/1166/7

GCSE DESIGN AND TECHNOLOGY

1 INTRODUCTION

1.1 Aims and objectives

This WJEC GCSE in Design and Technology offers a unique opportunity in the curriculum for learners to identify and solve real problems by designing and making products or systems. Through studying GCSE Design and Technology, learners will be prepared to participate confidently and successfully in an increasingly technological world; and be aware of, and learn from, wider influences on design and technology, including historical, social/cultural, environmental and economic factors.

The specification enables learners to work creatively when designing and making and apply technical and practical expertise, in order to:

- develop an appreciation of the importance of creativity and innovation to good design practice
- actively engage in the processes of design and technology to develop as effective and independent learners
- understand the key principles of designing and making
- use their knowledge, skills and understanding to make design decisions in order to make a quality prototype
- analyse existing products and produce practical solutions to meet needs, wants and opportunities, recognising their impact on quality of life
- critically analyse links between the principles of good design, existing solutions and technological knowledge
- understand the underlying technical principles within design and technology within their chosen endorsed area, with emphasis on emerging technologies, materials and practices.

This specification also gives learners an opportunity to produce extended written responses and demonstrate the quality of their written communication, including appropriate use of punctuation and grammar.

1.2 Prior learning and progression

There are no previous learning requirements for this specification. Any requirements set for entry to a course based on this specification are at the school/college's discretion.

This specification builds on subject content which is typically taught at key stage 3 and provides a suitable foundation for the study of design and technology at either AS or A level. In addition, the specification provides a coherent, satisfying and worthwhile course of study for learners who do not progress to further study in this subject.

1.3 Equality and fair access

This specification may be followed by any learner, irrespective of gender, ethnic, religious or cultural background. It has been designed to avoid, where possible, features that could, without justification, make it more difficult for a learner to achieve because they have a particular protected characteristic.

The protected characteristics under the Equality Act 2010 are age, disability, gender reassignment, pregnancy and maternity, race, religion or belief, sex and sexual orientation.

The specification has been discussed with groups who represent the interests of a diverse range of learners, and the specification will be kept under review.

Reasonable adjustments are made for certain learners in order to enable them to access the assessments (e.g. candidates are allowed access to a Sign Language Interpreter, using British Sign Language). Information on reasonable adjustments is found in the following document from the Joint Council for Qualifications (JCQ): *Access Arrangements and Reasonable Adjustments: General and Vocational Qualifications.*

This document is available on the JCQ website (www.jcq.org.uk). As a consequence of provision for reasonable adjustments, very few learners will have a complete barrier to any part of the assessment.

1.4 Welsh Baccalaureate

In following this specification, learners should be given opportunities, where appropriate, to develop the skills that are being assessed through the Skills Challenge Certificate within the Welsh Baccalaureate:

- Literacy
- Numeracy
- Digital Literacy
- Critical Thinking and Problem Solving
- Planning and Organisation
- Creativity and Innovation
- Personal Effectiveness.

1.5 Welsh perspective

In following this specification, learners must consider a Welsh perspective if the opportunity arises naturally from the subject matter and if its inclusion would enrich learners' understanding of the world around them as citizens of Wales as well as the UK, Europe and the world.

2 SUBJECT CONTENT

The specification content and assessment requirements are designed to ensure learners develop an appropriate breadth and depth of knowledge and understanding and skills in design and technology.

The subject content is presented under two headings: *knowledge and understanding* and *skills.*

The *knowledge and understanding* section and the *skills* section are divided into *core content* and *in-depth content.*

The *core content* is to be studied by all learners, irrespective of their choice of endorsed area. The *in-depth content* is to be studied with reference to one endorsed area*.

* *in-depth knowledge and understanding* is presented separately for each of the three endorsed areas.

Each learner will therefore study four areas of content:

1. Core knowledge and understanding
2. In-depth knowledge and understanding for one of:
    - engineering design
    - fashion and textiles
    - product design
3. Core skills
4. In-depth skills for one of:
    - engineering design
    - fashion and textiles
    - product design

2.1 Knowledge and understanding

2.1.1 Core knowledge and understanding is presented in six distinct topic areas:

- impact of new and emerging technologies
- evaluation of new and emerging technologies
- energy
- modern and smart materials
- ecological and social footprint
- investigating and analysing the work of others

Learners are required to study all of the content in these six areas, to ensure they have a broad knowledge and understanding of design and technology and that they are able to make effective choices in relation to which materials, components and systems to utilise within design and make activities.

2.1.2 In-depth knowledge and understanding is presented in distinct topic areas related to each of the three endorsed areas:

- engineering design
- fashion and textiles
- product design

Learners are required to study one of the three endorsed areas, to ensure they have an in-depth knowledge and understanding to support their design and make activities.

All topics within the core knowledge and understanding and the in-depth knowledge and understanding must be addressed. In each case, the left hand column identifies the content topic and the amplification indicates the areas that need to be covered. Centres are not restricted to how they will deliver this to the learner but it is anticipated that there will be an integrated approach between the core and the in-depth.

2.2 Skills

2.2.1 The core skills that learners are required to develop and apply are presented in nine topic areas:

- understanding design and technology practice takes place within contexts
- identifying and understanding user needs
- writing a design brief and specifications
- investigating challenges
- developing ideas
- using design strategies
- communicating design ideas
- developing a prototype
- making decisions

Learners are required to cover all of the content in these nine areas, to ensure they are able to apply a broad range of design and technology skills within design and make activities.

2.2.2 In-depth skills are presented in four distinct topic areas:

- selecting and working with materials and components
- marking out
- using specialist techniques and processes
- using surface treatments and finishes

Learners are required to cover all of the content in these four areas, related to one of the three endorsed areas:

- engineering design
- fashion and textiles
- product design

All topics within the core skills and the in-depth skills must be addressed. In each case, the left hand column identifies the content topic and the amplification indicates the areas that need to be covered. Centres are not restricted to how they will deliver this to the learner but it is anticipated that there will be an integrated approach between the core and the in-depth.

The subject content for GCSE Design and Technology will be assessed in the written examination and non-exam assessment (NEA).

Design and Technology in the 21st Century	**Design and make task**
Written examination: 2 hours	NEA: approximately 35 hours
50% of qualification	50% of qualification
100 marks	100 marks

Calculators may be used in Unit 1 and in Unit 2. Learners are responsible for making sure that their calculators meet the relevant regulations for use in written examinations: information is found in the JCQ publications *Instructions for conducting examinations* and *information for candidates for written examinations.*

2.1 Knowledge and understanding

2.1.1 Core knowledge and understanding

This section is designed to develop learners' knowledge and understanding in design and technology and its impact on daily life. Learners should develop a broad understanding of materials, systems and processes.

Learners need a breadth of technical knowledge and understanding in order to make effective choices in relation to the selection of materials, components and systems. They should consider emerging technologies, environmental issues and impacts on society. They should consider the needs of future generations as well as their own, and take a broad view of the impact of design and technology activities.

The design and manufacture of products depends upon material technology and the development and implementation of materials in products. Learners need to be aware of developments in materials technology and how these impact on the design and use of products.

Content	Amplification

(a) The impact of new and emerging technologies on:
• industry
• enterprise
• sustainability
• people
• culture
• society
• the environment
• production techniques
• systems
	• The impact of new and emerging technologies on industry and enterprise:
	  • market pull;
	  • technology push;
	  • consumer choice.
	• The Product Life Cycle. Introduction – researching, developing and then bringing a product to market; Growth – when sales are increasing; Maturity – sales are near their highest point; Decline – sales begin to fall.
	• Global production and its effects on culture and people.
	• Legislation to which products are subject. BSI (British Standards Institute) and ISO (International Standards Organisation). Their general roles/purpose, ISO numbers, the BSI kite mark and why as consumers these are important when purchasing products.
	• Consumer rights and protection for consumers when purchasing and using products. The basics of consumer rights, return policies, and the Trade Description Act.
	• Moral and ethical factors related to manufacturing products and the sale and use of products. Considering the needs of others in less developed countries and issues related to child labour, fair wage for a fair day's work, companies exploiting underdeveloped countries for profit.
	• Sustainability. Meeting today's needs without compromising the needs of future generations. i. e. sourcing of materials, using sustainable resources, waste materials and CFCs.
	• CAD/CAM the advantages and disadvantages of using computer aided design (CAD) and computer aided manufacture (CAM).

<table>
<tr><th>Content</th><th>Amplification</th></tr>
<tr><td>(b) How the critical evaluation of new and emerging technologies informs design decisions; considering contemporary and potential future scenarios from different perspectives, such as ethics and the environment</td><td>The importance of sustainability issues and environmental issues when designing and making products. e.g. with reference to rapidly updated products such as mobile phones.
Social, cultural, economic and environmental responsibilities in designing and making products.
Life Cycle Analysis to determine the environmental impact of bringing new products to market. i.e. cradle to grave.
Understand design obsolescence. i. e. the advantages and disadvantages to the designer/manufacturer.
The carbon footprint when designing and making.</td></tr>
<tr><td>(c) How energy is generated and stored in order to choose and use appropriate sources to make products</td><td>Types of renewable and non-renewable energy sources including: wind, solar, geothermal, hydroelectric, wood/biomass, wave, coal, gas, nuclear and oil.
Issues surrounding the use of fossil fuels including coal, oil and gas.
The advantages and disadvantages of renewable energy sources.
The use of renewable energy sources in modern manufacturing production systems including the use of solar panels and wind turbines in manufacturing sites.
Renewable energy sources for products including wind-up and photovoltaic cells.
Energy generation and storage in a range of contexts including motor vehicles (e.g. petrol/diesel, electricity) and household products (e.g. battery, solar, mains electricity).</td></tr>
<tr><td>(d) Developments in modern and smart materials</td><td>SMA – shape memory alloys.
Polymorph.
Smart fibres, fabrics and plastics that respond to the environment or stimuli -
photochromic
thermochromic
micro-encapsulation
biometrics.</td></tr>
<tr><td>(e) The ecological and social footprint of materials and components</td><td>Changing society’s view on waste and the ecological footprint. The Six Rs of sustainability: rethink, reuse, recycle, repair, reduce and refuse.
Living in a greener world.
Fair-trade policies.</td></tr>
<tr><td>(f) Investigate and analyse the work of past and present professionals and companies in the area of design and technology in order to help inform their own ideas.</td><td>Investigate and analyse the work of past and present designers and companies, including:
<table>
<tr><th></th><th>engineering design</th><th>fashion and textiles</th><th>product design</th></tr>
<tr><td>Company</td><td>Apple</td><td>Laura Ashley</td><td>Airbus</td></tr>
<tr><td>Designers</td><td>James Dyson
Shigeru Miyamoto</td><td>Stella McCartney
Orla Kiely</td><td>James Dyson
Bethan Gray</td></tr>
</table></td></tr>
</table>

2.1.2 In-depth knowledge and understanding
This section is designed to develop learners' in-depth knowledge and understanding in design and technology in relation to one of the three endorsed areas: Engineering design (pages 10 – 13) Fashion and textiles (pages 14 – 17) Product design (pages 18 – 22) In relation to their chosen endorsed area, learners are required to demonstrate in-depth technical knowledge and understanding in relation to the following materials, systems and components.

Engineering design	
Content	Amplification
(a) Ferrous and non-ferrous metals	• Classification as ferrous metals and non-ferrous metals. Ferrous Metals • Strengths and weaknesses. • Cast iron, mild steel, medium carbon steel and high carbon steel. • Stainless steel, high-speed steel and high-tensile steel. • Physical properties including: melting point, thermal and electrical conductivity. • Mechanical properties of metals including: tensile strength, toughness, plasticity, malleability and hardness. Non-Ferrous Metals • Strengths and weaknesses. • Aluminium, copper and pewter. • Heat treatment of metals including: annealing, normalising, hardening, tempering and case hardening. • Physical properties including: melting point, thermal and electrical conductivity. • Mechanical properties of metals including: tensile strength, toughness, plasticity, malleability and hardness.
(b) Thermoforming and thermosetting polymers	• Natural and synthetic plastic. • Polymers and the polymerisation process. • Common thermoplastics, their strengths, weaknesses and working properties, including: acrylic, polyvinyl chloride (PVC), polypropylene, styrofoam, acrylonitrile butadiene styrene (ABS) and nylon. • Common thermosetting plastics, their strengths, weaknesses and working properties, including: urea formaldehyde, melamine, carbon fibre, Kevlar and epoxy resins. • Physical properties of plastics including: thermal conductivity and electrical conductivity/insulation. • Mechanical properties of plastics including: tensile strength, toughness, plasticity, malleability and hardness.

Content	Amplification

(c) Electronic systems, including sensors and control devices and programmable components	• Graphical conventions for communicating concepts including circuit diagrams, block diagrams and flowcharts.
	• The 'systems' approach – input; process; output.
	• Principles of a control system -
	  • Input data from a sensor: light dependent resistor (LDR), thermistor
	  • Processing by control devices including semi-conductor, integrated circuit/chip (IC), microprocessor or computer
	  • Output where a signal is received that will perform a desired function: buzzer, light emitting diode (LED)
	• The importance of feedback within the system.
	• The methods of providing feedback in different systems.
	• Familiar products in terms of their control system.
	• Control devices that include counting, switching and timing.
	• Analogue and digital sensors as input components.
	• Sub routines or macros in control systems.
	• Programmable microcontrollers can be used to control a range of systems.
	• Programmable microcontrollers can interface with other devices.
	• Programmable microcontrollers can be reprogrammed repeatedly.
	• The benefits and limitations of programmable microcontrollers.
	• Programmable Interface Controllers (PIC) and how they can be used to control products or systems.

(d) Modern and smart materials and the effect of forces on materials and objects	• Electroluminescent film or wire i.e. LCD. • Quantum Tunnelling Composite (QTC) - when used in circuits the resistance changes under compression. • Conductive polymers.

(e) Mechanical devices	• Principle of a mechanical device to transform input motion and force into a desired output motion and force.
	• Analyse everyday mechanical devices and how they function.
	• Consider mechanical systems in terms of input; process; output.
	• Mechanical systems which:
	  • increase or decrease speed of movement/rotation;
	  • change magnitude/direction of force/movement/rotation.
	• Analyse the function of mechanical products that have:
	  • pulley systems, for example curtain rails, sewing machine;
	  • gear systems, for example whisk, hand drill;
	  • levers and linkages, for example scissors;
	  • rack and pinion, for example chair lift; cams, for example automata toys.

Content	Amplification
(f) The sources, origins, physical and working properties of materials, components and systems	Operational amplifiers and gain • Programmable micro controllers to control a variety of input and output devices. • The function of AND, OR, EOR, NOT, and NAND logic gates. • Combining logic gates to form control systems. Output Components • Including lamps, light emitting diodes (LEDs), buzzers, piezo sounders, loudspeakers, sirens, motors and solenoids. Functions of mechanical devices / systems • Simple and compound pulley and belt systems. • Calculate velocity ratio. RV of driver*dia of driver = RV of driven*dia of driven. • Simple and compound gear systems. • Calculate velocity ratio. RV of driver*teeth on driver = RV of driven*teeth on driven. • Worm drive systems. • Bevel gear systems. Levers • Classification. • Calculation of mechanical advantage. • Calculate forces acting in simple lever systems using the principle of moments. Others • Rack and Pinion. • Pawl and Ratchet. • Crank and Slider. • Cams.
(g) The way in which the selection of materials or components is influenced by a range of factors such as functional, aesthetic, environmental, availability, cost, social, cultural and ethical	• Components and their functional benefits or limitations. • Miniaturisation to reduce the size of control systems, or the number of components for functional or cost reasons. • Cultural, social, ethical and environmental responsibilities of designers and manufacturers with respect to: material/component selection should not be harmful to people or the environment; working conditions; recyclability and waste.
(h) Stock forms, types and sizes in order to calculate and determine the quantity of materials or components required	• Metals are available in a number of common forms including: (round) rod, square rod, hexagonal rod, strip, sheet, round tube, square tube, angle and channel. • Standard stock electronic components sizes. • Dual In Line (DIL) standard for electronic integrated circuit/chip (IC). • Manufactured boards are commonly available in sheet form and in standard sizes and various thicknesses. • Plastic polymers are available in a wide range of forms including: powders, granules, pellets, liquids, films, sheets and extruded shapes. • Calculate the costs involved in the design of engineering products including fixtures, fittings, finishes required and the material cost.

Content	Amplification
(i) Alternative processes that can be used to manufacture products to different scales of production	• Mass production. • One-off production. • Batch production. • Just in time manufacturing.

(j) Specialist techniques and processes that can be used to shape, fabricate, construct and assemble a high quality prototype	• The use of CAD/CAM in production.
	• Jigs and devices to control repeat activities.
	Wastage/Addition
	• Appropriate tools and equipment to mark out, hold, cut, shape, drill and form materials.
	• The pillar drill to drill holes to various diameters.
	• Jigs and formers to ensure accuracy.
	Deforming/Reforming
	• Bending plastics.
	• Hot/cold working of sheet metals, casting.
	• Drilling materials.
	• Vacuum forming, moulding.
	• Laser cutting.
	• 3D printing.
	• Lathe to turn materials.
	• Milling machine to create a slot or face edge.
	Assembly and components
	• Components for a particular purpose, including nuts, bolts, washers, screws, rivets.
	• Joining components together, e.g. soldering components to circuit boards.
	• Joining materials - mechanical or chemical bond.
	• Joining like and unlike materials together.
	• Material joining - metal joining can be permanent or temporary.
	• The main stages in the following joining processes:
	  • Permanent: riveting, welding, brazing, silver soldering and use of epoxy resins.
	  • Temporary: machine bolt and nut, self-tapping bolts, cutting threads for appropriate fixing bolt.
	• Temporary and permanent fixings of circuits for assembly and protection of components.

(k) Appropriate surface treatments and finishes that can be applied for functional and aesthetic purposes	• Surface finishes applied to electronic devices for functional or aesthetic purposes. e.g. instructions for the user / operating scale (and on/off) for adjustable components, the need for protective surface finishes for PCBs (printed circuit boards) used in different environments, such as high temperature or high humidity (functional); trademarks / logos / product name (aesthetic). • Powder and plastics coating of metals.

Fashion and textiles	
Content	Amplification

(a) Natural, synthetic, blended and mixed fibres	• The categorisation and working properties of fibres and textiles.
	• The raw materials of textiles are classified according to their source.
	• Natural polymers
	  • Animal polymers: wool/fleece – mohair, cashmere, angora, alpaca, camel (hair), llama.
	  • Insect polymers: silk.
	  • Plant polymers: cotton, linen, hemp, jute, bamboo, soya.
	• Manufactured polymers
	  • Synthetic: acrylic, polyester, polypropylene, nylon (polyamide), elastane, Lycra, aramid fibres.
	  • Regenerated: viscose, rayon, acetate, lyocell (Tencel®)
	• Microfibres – to include Tactel®, (Modal®).
	  • Fibre blends
	  • Mixed fibres
	  • The properties of textiles fibres including, strength, elasticity, absorbency, durability, insulation, flammability, water-repellence, anti-static and resistance to acid, bleach and sunlight.

(b) Woven and non-woven, and technical textiles	• Textile materials are made by different construction methods
	  • Weaving: plain, twill, satin, herringbone, pile.
	  • Knitting: weft knit and warp knit.
	  • Bonding: sticking with adhesives, heating thermoplastic fibres and stitching a web of fibres.
	  • Laminating.
	  • Felting.
	• Technical textiles: laminated fabrics, encapsulated fibres/fabrics, Geotextiles for landscaping and agricultural textiles.
	• Bonding breathable waterproof membranes to outer fabrics for all-weather wear: (Gore-Tex, Permatex, Sympatex®).
	• Nomex.
	• Carbon Fibre, Kevlar, Biosteel.

(c) Thermoforming and thermosetting polymers	• Categorisation and physical properties of polymers. • Properties of polymers including weight, hardness, elasticity, conductivity/insulation, toughness and strength. • Polymers can be made from both natural and synthetic resources. • The differences between a thermoforming (thermoplastic) and thermosetting material. • The properties of thermoplastics including polythene, polystyrene, polypropylene and polyvinyl chloride (PVC).

Content	Amplification
(d) Modern and smart materials	• Interactive textiles that function as electronic devices and sensors: circuits integrated into fabrics, such as heart rate monitors; wearable electronics such as mobile phones or music player, GPS, tracking systems and electronics integrated into the fabric itself. • Smart fibres and fabrics that respond to the environment or stimuli: photochromic, thermochromic, micro-encapsulation and biometrics. • Micro-fibres in clothing manufacture. • Phase changing materials: breathable materials; proactive heat and moisture management. • Sun protective clothing. • Rhovyl as an antibacterial fibre. • Breathable materials.

(e) The sources, origins, physical and working properties of materials, components and systems	• Construction methods, and how their advantages and disadvantages affect end use.
	• Weaving: plain, twill, satin, herringbone, pile.
	• Knitting: weft knit and a warp knit.
	• Bonding: sticking with adhesives; heating thermoplastic fibres; stitching a web of fibres.
	• Laminating.
	• Felting.
	• Fibres are the raw material of textiles and they can be classified according to their source.
	• The nature of staple and continuous filaments; textured yarns; novelty yarn (chenille) and these determine fabric weight, flexibility, handle and end use.
	• The properties of the main natural and manufactured fibres/fabrics including: strength, elasticity, absorbency, durability, insulation, flammability, water repellence, anti-static and resistance to acid, bleach, sunlight.
	• Blending and mixing fibres to improve the properties and uses of yarns and materials.
	• Blends, for example: polyester and cotton, silk and viscose, hemp and cotton or silk.
	• Mixture, for example: cotton and wool, lycra with wool cotton or nylon.
	• Bonding breathable waterproof membranes to outer fabrics for all-weather wear (Gore-Tex, Permatex).
	• Bonding foam to knitted or woven fabrics.
	• Bonding plastic to loosely woven cotton to simulate leather.
	• Quilting – polyester wadding between an outer and lining material.
	• Components-
	  • Fastenings: zips, buttons, buckles, velcro, eyelets, ties and press studs.
	  • Threads: embroidery, sewing, overlocker, conductive.
	  • Trims: lace, braids, ribbon, tapes, cords, elastics, support (boning etc.), beads, sequins and lights (LEDs).

Content	Amplification

(f) The way in which the selection of materials or components is influenced by a range of factors such as functional, aesthetic, environmental, availability, cost, social, cultural and ethical	• Selection of materials and components
	  • Aesthetic qualities – colour, pattern, texture, lustre, weight
	  • Physical – weave, density, drape
	  • Economic – fibre content, directional pile, cost, pattern match
	  • Performance – strength, durability, safety, stretch, absorbency, insulation, water/wind proof, anti-static.
	• Different methods of enhancing the appearance, prolonging and protecting life.
	• To enhance aesthetic quality
	  • Colouring, surface decoration, glazing, stiffening, increasing lustre (calendering, mercerising), brushing, stain resistance (Scotchguard, Teflon).
	• To enhance fabric life
	  • Flame retardant, moth proofing, stain resistance.
	• To improve functionality:
	  • Shower proofing using PVA or PVC or wax; crease resistance using resin; waterproofing using silicones; shrink resistance using chlorine treatment; anti-static finish, coating with PVC, neoprene, silicone rubber, polyurethane; use of barrier membranes laminated to an outer or inner shell to make them breathable yet waterproof; windproof materials made by very close weave construction.
	• Responsibilities of designers and manufacturers who design using textiles with respect to:
	  • the environment;
	  • working conditions in third world countries, low labour costs and poverty;
	  • exploitation of employees;
	  • recyclability and waste;
	  • biodiversity.

(g) Stock forms, types and sizes in order to calculate and determine the quantity of materials or components required	• Textile materials come in standard widths 90cm, 115cm, 150cm, 200cm, 240cm. • Estimate material quantities and costs based on best use of materials. • Calculate costs, sizes and quantities for components.
(h) Alternative processes that can be used to manufacture products to different scales of production	• Products can be manufactured in quantity. • Different methods of manufacture: job production (custom-made or one–off); batch production; mass production and when each is appropriately used. • Differentiate between street styles: contemporary fashion, ready to wear (prêt-à-porter), haute couture and the most appropriate scale for production. • The scale of production depends on the quantity of products required. • How manufacturing systems are organised: line production, progressive bundle system and cell production. • Understand the role of designers, image makers, trendsetters, fashion centres, fashion forecasting and predictions in the commercial development of fashion products.

Content	Amplification

(i) Specialist techniques and processes that can be used to shape, fabricate, construct and assemble a high quality prototype	• The correct materials, hand tools and equipment for a range of practical tasks such as template production; stencil preparation; cutting out and assembly.
	• Change accessories when appropriate for special processes e.g. using a specialist presser for piping.
	• Industrial manufacturing processes for example, stitch, trim and neaten seams with the over locker.
	• CAD/CAM equipment for cutting templates accurately and continuously.
	• Pattern language and markers for lay plans.
	• Visual checks for pattern drop/match.
	• The importance of accuracy and working to a tolerance - correct use of seam tolerances in joining/trimming.
	• Correct use of thread-colour, type, shade, stitch length.
	• The appropriate choice of construction and decorative processes for fabric type and product end use-
	  • Joining: seams – plain, French, double stitched, flat fell, lapped, overlocked, bound and neatening methods.
	  • Shaping: darts, princess line seams, gathers, tucks, pleats, casings (draw cord/elastic), use of elastic.
	  • Finishing edges: hems (types of) facings, piping, frills and binding.
	Use style details which reflect current trends-
	  • Sleeves: raglan, set-in, dolman, gathered, short/long.
	  • Necklines: square/round, V, halter, sweetheart, boat.
	  • Collars: tunnel, sailor, shirt, rever, roll, shawl.
	  • Pockets: patch, welt, shaped, in side seam.
	  • Fastenings: zips, buttons, buckles, velcro, eyelets, ties, poppers.
	  • Pleats: knife, box, inverted, kick.
	• The basic procedures for lay planning and use of pattern language.
	• Lengthwise / crosswise folds, cutting on the cross or bias, notches, grain lines, balance marks, tuck/pleat lines, dart markings, positions for pockets, buttons / holes, centre front / back lines, seam tolerance.
	• Different methods of transferring important marks onto material prior to product manufacture.
	• Tailor's chalk.
	• Hot notch marking in industry.
	• Different types of cutting tools and equipment used industry and know why they are used;
	• Cutting tools
	  • Straight knives, round or band knives, automated die cutters for products of constant shapes, computer controlled cutting machines and laser cutters.
	Other equipment used for: lay planning and estimating material quantities, fabric spreading to include several plies.

(j) Appropriate surface treatments and finishes that can be applied for functional and aesthetic purposes	• Dyeing: piece, dip, random, tie and dye, batik. • Printing: silk screen, roller, discharge, block, stencilling, digital. • Painting: felt tip, dimensional, fabric paint, silk paints. • Transfers: image-maker, ink-jet transfer (CAM). • Embroidery: hand embroidery, machine embroidery, CAM, Appliqué, beadwork and patchwork. • Laser engraving.

Product design	
Content	Amplification
(a) Papers and boards	• The aesthetic and functional properties of common papers, cards and boards including cartridge paper, photocopy paper, bleed proof paper, mounting board, foam board, solid white board, corrugated board and duplex board. • Papers and boards require finishes, these finishes are used to protect and improve aesthetic appeal.
(b) natural and manufactured timber;	• The aesthetic and functional properties of hardwoods and softwoods including beech, oak, balsa, jelutong, scots pine, western red cedar and parana pine. • Natural timber is protected using different finishes and these finishes are sometimes used to improve aesthetic appeal. • Manufactured timbers can be protected using finishes and these finishes are sometimes used to improve the aesthetic appeal.
(c) Ferrous and non-ferrous metals	• The aesthetic and functional properties of ferrous metals including, mild steel, medium carbon steel and high carbon steel. • The aesthetic and functional properties of non-ferrous metals including aluminium, copper and brass. • Ferrous metals may require a protective finish and the finish is sometimes used to improve the aesthetic appeal. • Non-ferrous metals may require a protective finish and the finish is sometimes used to improve the aesthetic appeal.
(d) Thermoforming and thermosetting polymers	• The aesthetic and functional properties of thermoforming and thermosetting polymers including acrylic, polythene, polypropylene, polycarbonate, styrofoam, expanded polystyrene, acrylonitrile butadiene styrene (ABS), polyvinyl chloride (PVC), nylon, urea formaldehyde, melamine, carbon fibre, Kevlar, Styrofoam, modelling foam board and epoxy resins. • Thermoforming plastics have a natural finish. • Thermoforming and thermosetting may require a protective finish and the finish is sometimes used to improve the aesthetic appeal
(e) Modern and smart materials	• Quantum Tunnelling Composite (QTC) - when used in circuits the resistance changes under compression. • Polymorph • Thermochromic polymers or dyes • Photochromic polymers • Nitinol

Content	Amplification
(f) The sources, origins, physical and working properties of materials, components and systems	Metals • Classification as ferrous metals, non-ferrous metals and alloys. • Metals are sourced from ores and are a natural resource. • Alloys of metals are a base metal mixed with other metals or non-metals to change their properties or appearance. • Heat treatment of metals including: annealing, normalising, hardening, tempering and case hardening. Ferrous Metals • Physical properties of metals including: melting point, thermal and electrical conductivity. • Mechanical properties of metals including: tensile strength, toughness, ductility, plasticity, elasticity, malleability and hardness. Non-Ferrous Metals • Physical properties of metals including: melting point, thermal and electrical conductivity. • Mechanical properties of metals including: tensile strength, toughness, plasticity, malleability and hardness. Natural and Manufactured timber • The difference between a hardwood and softwood. • Hardwoods and softwoods are natural resources and are sourced from trees. • The difference between natural wood and man-made boards. • The physical and working properties of hardwoods, softwoods and man-made boards: toughness, flexibility, grain structure, strength, absorbency, surface finish and colour. • Manufactured timbers are made from natural timbers and made from particles/fibres or laminates. • Strengths/weaknesses of the following manufactured boards: plywood, medium density fibreboard (MDF), chipboard and hardboard. • Natural timber is available in the following forms: plank, board, strip, square, and dowel. Thermoforming and Thermosetting Polymers • The differences between a thermoforming (thermoplastic) and thermosetting material. • Oil is the main source for modern polymers, though increasingly some plastics are made from natural sources. • Physical properties of thermoforming (thermoplastic) and thermosetting plastics including: thermal conductivity and electrical conductivity/insulation. • Mechanical properties of thermoforming (thermoplastic) and thermosetting plastics including: tensile strength, elasticity, toughness, plasticity, malleability and hardness.

Content	Amplification
	Papers and boards • The basic sources of paper and boards. • Recycled boards. • The use of microns to measure thickness of paper and boards. • That paper and board is often measured in gsm (grams per square metre). • The physical and working properties of paper and board including: texture, weight, thickness, strength, surface finish, transparency, folding ability and absorbency. • Papers, cards and boards can be laminated to improve strength, finish and appearance.

(g) The way in which the selection of materials or components is influenced by a range of factors such as functional, aesthetic, environmental, availability, cost, social, cultural and ethical	• Aesthetic and functional properties of the following: aluminium, copper, brass, pewter, mild steel, natural and manufactured timbers, common paper, card and cardboards
	• Responsibilities of designers and manufacturers with respect to:
	  • the environment;
	  • working conditions in third world countries, low labour costs and poverty;
	  • exploitation of employees;
	  • recyclability and waste;
	  • biodiversity and deforestation;
	  • new polymers that are being developed often for specific purposes including: biodegradability and compostability;
	  • estimating the true costs of a prototype or product;
	  • aesthetic and functional properties of cards and boards.

(h) Stock forms, types and sizes in order to calculate and determine the quantity of materials or components required	• Natural timber is available in different sectional forms, various standard sizes and can have a different finish (sawn or planed). • Manufactured boards are commonly available in sheet form and in standard sizes and various thicknesses. • Plastic polymers are available in a wide range of forms including: powders, granules, pellets, liquids, films, sheets and extruded shapes. • Standard sizes of papers and boards. i.e. rolls, A5, A4, A3. and measured in grams per square metre. • Cardboard is available in different forms with different cores. • Calculate the costs involved in the design of products including, fixtures, fittings, finishes required and the material cost.

Content	Amplification
(i) Alternative processes that can be used to manufacture products to different scales of production	• Manufacturing systems, including one off, batch and high volume production. • Manufacturing systems, the advantages and disadvantages of producing single, one off products. • The advantages and disadvantages of producing products in limited quantity (batch production). • Jigs and devices to control repeat activities. • The advantages and disadvantages of high volume, continuous production. • The importance of CAM in modern high volume production. • A range of products suitable for high volume, continuous production. • The principles of producing plastic products and components using the following processes: injection moulding, vacuum forming, press moulding and compression moulding. • On-press and the finishing processes used by commercial printers to produce products in batches or mass/high volume. • Techniques used to produce books, magazines, leaflets, flyers, packages and other printed products.
(j) Specialist techniques and processes that can be used to shape, fabricate, construct and assemble a high quality prototype	**Wastage/Addition** • Cutting materials to the required shape or contour. • Tools and equipment to mark out, hold, cut, shape, drill and form materials. • The pillar drill to drill holes to various diameters. • Jigs and formers to ensure accuracy as part of the process of drilling. • Pilot, clearance, tapping, countersunk and counter bored holes. • Marking out materials using a range of workshop tools. **Deforming/Reforming** • Metal joining can be permanent or temporary, by welding, soldering and the use of nuts, bolts, washers, screws, rivets, hinges, catches. • Lathe to turn materials. • Milling machine to create a slot or face edge. • The main stages in the following joining processes: • Permanent: riveting, brazing and use of epoxy resins. • CAM machines including lasers. • Wood joining can be permanent or temporary. • The principles of producing wood products using the following processes: jointing, veneering, laminating and steam bending. • Frame: mitre, dowel, mortise and tenon, halving and bridle joint. • Box/carcass: butt, lap, housing, dovetail and comb joint.

Content	Amplification
	• Adhesives: Polyvinyl acetate (PVA) (wood to wood), contact adhesive and epoxy resin (wood to other materials). • Temporary: screw (countersunk and round head) and knock down fittings. • Plastics joining can be permanent or temporary, by plastic welding and the use of nuts, bolts, washers, screws, rivets, hinges, catches. • Injection moulding, vacuum forming, press moulding, bending plastics, 3D printing. • Score and fold paper and card. • Embossing, debossing, cropping, folding and binding methods.
(k) Appropriate surface treatments and finishes that can be applied for functional and aesthetic purposes	• Metal surface treatments and finishing processes: plastic coating, enamelling, oil finishing and black steel, paint and primer. • Surface treatments of natural timber and manufactured: sealants and primers. Finishes for aesthetic or functional reasons: varnish, wood stains, oils, polishes and preservative paints. • Self-finishing nature of many thermosetting and thermoforming plastics. Textured finishes of plastics.

2.2 Skills

2.2.1 Core skills	
This section is designed to develop learners' understanding, application and skills when designing and making prototypes. It describes the activities learners are required to undertake as part of the sustained design and make activity which forms the non-exam assessment (NEA) in this qualification.	
Content	Amplification
(a) Understand that all design and technological practice takes place within contexts which inform outcomes	• Contexts are a starting point to inform possible outcomes, situations to create design briefs.
(b) Identify and understand client and user needs through the collection of primary and secondary data	• Identify the needs and wants of the end user. • Suggest possible design problems from the contexts. • Explore and investigate existing products, situations before deciding upon whether there is a real need for a product. • Explore and investigate existing products, situations to inform possible specification points for designing. • Primary research data: collecting data and using this to explore and aid further work. • Secondary research data: collecting existing data and using this to explore and aid further work.
(c) Demonstrate an ability to write a design brief and specifications from their own and others' considerations of human needs, wants and interests	• Write design briefs for specific needs, wants or interests. • Write specifications that are derived from their own investigations, the needs and wants of clients.
(d) Investigate factors, such as environmental, social and economic challenges, in order to identify opportunities and constraints that influence the processes of designing and making	• Designing should not take place in isolation but there are wider needs to be considered. • Ergonomics - how the design of a product interacts with the user. • Anthropometrics - how anthropometric data can be used to make decisions on the final sizes of a product. • Environmental - consider the use of materials and the impact of these materials on the environment. • Social - the need to consider the views of others. • Economic - be aware of the costs of materials and scales of production.

Content	Amplification
(e) Explore and develop their ideas, testing, critically analysing and evaluating their work in order to inform and refine their design decisions thus achieving improved outcomes	• The importance of testing and evaluating ideas. • Continuously reviewing and critically analysing work as it develops to improve the final design outcome. • Refine and modify design ideas based upon learners' own decisions and those of others.

(f) Use different design strategies, such as collaboration, user-centred design and systems thinking, to generate initial ideas and avoid design fixation	• Use of design strategies such as:
	  • Collaboration – Discover, Define, Develop, Deliver
	  • User-centred design- Contexts, Requirements, Design Solutions, Evaluate, and Iteration.
	• Systems thinking.

(g) Develop, communicate, record and justify design ideas, applying suitable techniques	• Formal and informal 2D and 3D drawing. • System and schematic diagrams. • Annotated sketches. • Exploded diagrams. • Fashion illustrations or fashion drawings. • Models / Toiles • Presentations. • Written notes. • Flow diagrams • Working drawings. • Schedules. • Audio and visual recordings. • Mathematical modelling. • Computer-based tools.

Content	Amplification
(h) Design and develop at least one prototype that responds to needs and/or wants and is fit for purpose, demonstrating functionality, aesthetics, marketability and consideration of innovation	Design and develop a prototype which: • Responds to needs and/or wants of the user/context. • Is fit for purpose. • Demonstrates functionality. • Aesthetics, feel, texture, shape and functional qualities of the prototype (whilst all may feature to a degree, functional qualities are likely to be the main consideration in design engineering; aesthetics and texture in fashion and textiles; aesthetics and functional qualities in product design). • Marketability - is the prototype marketable in its current form or would it need to be further developed (e.g. using different production processes and/or materials or components)? Note: One-off products may be aimed solely at a single user and have to meet their needs and wants only. Prototypes aimed at a wider market should have the potential to be produced in quantity. • Innovative features - does the prototype have any features that are innovative? This could be the use of materials (for example, use of smart materials as a switching device, technical textiles within garments or papers/cards as structural components in a product). *Note: In the context of this component, 'prototype' is used to describe all working solutions including products, models and systems. (The final outcome in any endorsed area could be in the form of a scaled model).*
(i) Make informed and reasoned decisions, respond to feedback about their own prototypes (and existing products and systems) to identify the potential for further development and suggest how modifications could be made	• Respond thoughtfully and make informed judgements when evaluating their own prototype. • Act on the views of others. • Make suggestions for improvements of their own prototype and how these modifications could be made. • Respond to feedback from others or clients and suggest improvements/modifications of their prototype.

2.2.2 In-depth skills
Learners are required to develop and apply in-depth understanding, application and skills in: • engineering design • fashion and textiles • product design As for the core skills described above, this section describes activities learners are required to undertake as part of the sustained design and make activity which forms the non-exam assessment (NEA) in this qualification.

Engineering design	
Content	Amplification
(a) Select and work with appropriate materials and components in order to produce a prototype	• Select and work with appropriate materials or components that will realise their chosen prototype. i.e. ferrous or non-ferrous metals, thermoforming or thermosetting plastics, Programmable Interface Controllers (PICs) to control products or systems. Output component such as LEDs, buzzers etc. • Learners will need to select and use the most appropriate material/components to the prototype under manufacture.

(b) Use appropriate and accurate marking out methods to create a specific outcome	• When making prototypes, measure and mark out accurately using a range of tools such as steel rules, scribes, engineer's squares, punches, odd leg callipers etc. as appropriate to the material being worked.
	• Before a cutting or manufacturing process is undertaken by the learner he/she should consider how to minimise waste and make allowances for effective cutting methods.
	• Marking methods
	  • Measuring and use of reference points/datum faces.
	  • Lines and surfaces.
	  • Centre squares or combination squares for marking centres of round bars.
	  • Surface plates and Vee block for accurate measurements.
	  • Use of accurate templates, jigs and/or patterns.
	  • Work within tolerances.

(c) Use specialist techniques and processes to shape, fabricate construct and assemble a high quality prototype, as appropriate to the materials and/or components being used	• Select and use specialist techniques, hand tools and appropriate machinery. i.e. Micrometers, Vernier callipers, lathes, vacuum formers, laser cutters, CNC lathes, pillar drills as appropriate to the material being shaped or worked. • Be aware of the need to sub-assemble parts/components before any finishing processes should be applied. • Adhere to relevant Health and Safety regulations will need to be applied as appropriate to the environment they are working in. • Quality prototypes need to be manufactured with care and attention and the final manufactured product should be made to their best of learners' ability. • Include techniques such as wastage, addition, deforming and reforming, as appropriate to the prototype, materials and/or components being used.

(d) Use appropriate surface treatments and finishes for functional and aesthetic purposes.	• Be aware and use appropriate surface finishing for different materials. • Metals- dip-coating, bluing, primers and paints etc. • Plastics- although many are self-finishing, attention to detail and the removal of saw marks and scratches on edges needs to be given due care and attention. • The importance of finishing techniques to protect and enhance the aesthetics qualities of the material/s.

Fashion and textiles	
Content	Amplification
(a) Select and work with appropriate materials and components in order to produce a prototype	• Select and work with appropriate materials or components that will realise their chosen prototype. i.e. natural and/or manmade materials, woven, knitted, bonded, laminated, felted. • Learners will need to select and use the most appropriate materials and components for the prototype under manufacture.
(b) Use appropriate and accurate marking out methods to create a specific outcome	• When making prototypes/toiles, measure and mark out accurately using a range of tools, equipment and methods such as rulers, tape measures, set squares, tailor's chalk, tacking, tailor's tacks, pins etc. as appropriate to the material being worked. • Before a cutting or manufacturing process is undertaken by the learner he/she should consider how to minimise waste and make allowances for effective cutting methods. • Marking methods Measuring standard seam allowances. Pattern language and markings e.g. Darts, pleats, grain lines, centre lines, button holes. Size and position of embellishments. Use of accurate templates and/or patterns. Work within tolerances.
(c) Use specialist techniques and processes to shape, fabricate construct and assemble a high quality prototype, as appropriate to the materials and/or components being used	• Select and use specialist techniques appropriate to the material being shaped or worked e.g. colouring, surface embellishments, construction methods: seam types, edge finishes. • Select and use specialist hand tools and machinery appropriate to the material being shaped or worked e.g. sewing machine, CNC embroidery machines, over-locker, laser cutters, sublimation printers. • Adhere to relevant Health and Safety regulations will need to applied appropriate to the environment they are working in. • Quality prototypes need to be manufactured with care and attention and the final manufactured product should be made to their best of learners' ability. • Include techniques such as wastage, addition, deconstructing and reconstructing as appropriate to the materials and/or components being used.

(d) Use appropriate surface treatments and finishes for functional and aesthetic purposes.	• Be aware and use appropriate surface finishing for different materials: surface embellishments i.e. beading, sequins, embroidery techniques, printing/colouring, quilting. • The importance of finishing techniques to protect and enhance the aesthetics qualities of the material/s: fixing colours, seam finishes (external / internal), pressing.

Product design	
Content	Amplification
(a) Select and work with appropriate materials and components in order to produce a prototype	• Select and work with appropriate materials or components that will realise their chosen prototype. i.e. Ferrous or non-ferrous metals, thermoforming or thermosetting plastics, man-made and natural woods. • Learners will need to select and use the most appropriate material/components to the prototype under manufacture

(b) Use appropriate and accurate marking out methods to create a specific outcome	• When making prototypes, measure and mark out accurately using a range of tools such as steel rules, scribes, engineer's, squares, punches, odd leg callipers etc. as appropriate to the material being worked.
	• Before a cutting or manufacturing process is undertaken by the learner he/she should consider how to minimise waste and make allowances for effective cutting methods.
	• Marking methods
	  • Measuring and use of reference points/datum faces.
	  • Lines and surfaces.
	  • Centre squares or combination squares for marking centres of round bars.
	  • Surface plates and Vee block for accurate measurements.
	  • Use of accurate templates, jigs and/or patterns.
	  • Work within tolerances.

(c) Use specialist techniques and processes to shape, fabricate construct and assemble a high quality prototype, as appropriate to the materials and/or components being used	• Select and use specialist techniques, hand tools and appropriate machinery. i.e. Micrometers, Vernier callipers, pillar drills, lathes, vacuum formers laser cutters, CNC lathes as appropriate to the material being shaped or worked. • Be aware of the need to sub-assemble parts/components before any finishing processes should be applied. • Adhere to relevant Health and Safety regulations will need to be applied as appropriate to the environment they are working in. • Quality prototypes need to be manufactured with care and attention and the final manufactured product should be made to their best of learners' ability. • Include techniques such as wastage, addition, deforming and reforming, as appropriate to the prototype, materials and/or components being used.

(d) Use appropriate surface treatments and finishes for functional and aesthetic purposes.	• Be aware and use appropriate surface finishing for different materials. • Metals- dip-coating, bluing, primers and paints etc. • Woods- both natural and man-made, varnishes, stains, polishes, waxes, preservatives etc • Plastics although many are self-finishing, attention to detail and the removal of saw marks and scratches on edges needs to be given due care and attention. • The importance of finishing techniques to protect and enhance the aesthetics qualities of the material/s.

3 ASSESSMENT

3.1 Assessment objectives and weightings

Below are the assessment objectives for this specification. Learners must demonstrate their ability to:

AO1
Identify, investigate, analyse and outline design possibilities to address needs and wants

AO2
Design and make prototypes and evaluate their fitness for purpose

AO3
Analyse and evaluate:

- design decision and outcomes in relation to products
- wider issues in design and technology

AO4
Demonstrate and apply knowledge and understanding of design and technology principles

The table below shows the weighting of each assessment objective for each component and for the qualification as a whole.

	AO1	**AO2**	**AO3**	**AO4**	**Total**
Unit 1	-	-	10%	40%	50%
Unit 2	10%	40%	-	-	50%
Overall weighting	**10%**	**40%**	**10%**	**40%**	**100%**

3.2 Arrangements for non-exam assessment

The contextual challenge requires learners to demonstrate, at GCSE level, their understanding and application of the skills detailed in section 2.2, in the context of a sustained design and make activity. Learners are required to:

- work within a context which will inform the outcome
- identify and understand client and user needs
- write a design brief and specifications
- identify opportunities and constraints that influence the processes of designing and making
- explore, develop, test, critically analyse and evaluate ideas
- use different design strategies to generate initial ideas
- develop, communicate, record and justify design ideas
- design and develop at least one prototype* that is fit for purpose
- make informed and reasoned decisions to identify the potential for further development

In addition, when designing and making in relation to the endorsed area of choice, learners are required to:

- select and work with appropriate materials and components to produce a prototype
- use appropriate and accurate marking out methods; work within tolerances; understand efficient cutting and minimise waste
- use specialist techniques and processes to shape, fabricate, construct and assemble a high quality prototype, as appropriate to the materials and/or components being used
- use appropriate surface treatments and finishes

** In the context of this component, 'prototype' is used to describe all working solutions including products, models and systems.*

Assessment criteria for the contextual challenge

The assessment criteria for learners' contextual challenge (a sustained design and make task) are summarised in the table below and shown in detail in Appendix A.

Assessment Criteria		Marks	Assessment objective
(a)	Identifying design possibilities.	10	AO1
(b)	Developing a design brief and specification.	10	
(c)	Generating and developing design ideas.	30	AO2
(d)	Making a prototype.	30	
(e)	Evaluating a prototype's fitness for purpose	20	
	Total	100	

The design and make task is worth 50 per cent of the total marks available for this GCSE design and technology qualification. The design and make task is assessed by the centre and moderated by WJEC.

Contextual challenge titles

WJEC will publish the details of contextual challenges for GCSE Design and Technology on the WJEC secure website on 01 June in the calendar year preceding the year in which the qualification is to be awarded. This information may be shared with candidates on or after 01 June.

Learners will choose **one** contextual challenge from a range of **three** possible contextual challenges. The contextual challenges will be reviewed by WJEC every year.

Learners are required to complete **one** sustained design and make task, based on the contextual challenge they have chosen. Approximately 35 hours should be devoted to this task. Teachers are only required to monitor learners and because the design folio is iterative the learners should manage their time appropriately. In completing the design and make task, the learner will be required to produce the following evidence:

- a design brief developed in response to one of the contextual challenges set by WJEC
- a final prototype (or prototypes) based on that design brief, and
- additional evidence as necessary, including an A3 design portfolio, to enable the assessment of the learner's attainment in each of the categories (a) to (e) in the table above. The portfolio should be in the form of 15 to 20 x A3 single-sided sheets of paper or in the form of an electronic document equivalent in size to this.

Supervision

The design and make task must be appropriately supervised to ensure that assessors are able to confidently authenticate each learner's work.

The design and make task should be carried out in the normal design and technology classroom/workshop environment. Learners are allowed supervised access to resources that may include information gathered outside the 35 hours of assessment time.

Each learner must produce their final prototype or prototypes under *'immediate guidance or supervision'.* This means the prototype(s) have to be produced either:

(i) with the simultaneous physical presence of the learner and the supervisor, or
(ii) remotely by means of simultaneous electronic communication.

In most cases supervision will be of the form described in (i), but in some circumstances, for example if the learner is carrying out a specialist process away from the centre, (ii) may be more appropriate.

The supervising teacher may give candidates limited guidance during the design and make task in order to clarify what is to be done and to ensure that safe working practices are followed. However, any guidance given must be taken into account when assessing the work.

Limited guidance refers to giving general advice to:

- support the learner only;
- ensure that the learner knows the exact requirements of the whole design and make task i.e. design folio of evidence, models, times etc.
- ensure that the learners route through the contextual challenge will meet the requirements of the marking criteria and be of sufficient demand to achieve the marks from the highest bands;
- enable the learner to feel comfortable in using the iterative process within the design and make task;
- ensure that all work being completed during the iterative journey is that of the learner. Where design work has been taken outside of the school environment, the teacher must monitor periodically to validate that the work being produced is solely that of the learner;
- ensure safe storage and security of all work, to ensure plagiarism does not take place;
- advise on any health and safety issues.

Within limited guidance **you are not allowed to:**

- give the learner detailed advice and take the lead through the design and make process;
- specify the situation/task or brief, it must be the leaner's own decision;
- correct or modify the work of a learner;
- give specific direction to the learner to achieve higher marks;
- produce any form of writing frame within a design folio;
- initially mark work and then return the work to the learner to improve;
- return the work to the learner once it has been submitted for marking and final marking has taken place ready for submitting to the board.

Where a teacher has had to give detailed guidance advice and support to the learner this **must be declared in writing by the centre** and marking of the work should be adjusted to reflect this support.

All practical work should be completed within the school or college under the guidance or supervision of the teacher. The final prototype should be completed within the school or college and not be allowed to be taken home at any point. Where a specific making process needs to be done outside the establishment, a declaration of the work completed will need to be submitted with the work and also reflected within the marking.

It is the responsibility of the centre to ensure the authenticity of all work presented for assessment. All learners are required to sign an authentication statement endorsing the originality of their work presented for assessment, and assessors must countersign that they have taken all reasonable steps to validate this. Authentication documentation must be completed by all learners, not just those selected for moderation.

All assessors who have marked learners' work must sign the declaration of authentication to confirm that the work is solely that of the learner concerned and has been conducted under the required conditions. Centres must ensure that the authentication documents are completed for each learner and made available to the moderator.

Instructions for non-exam assessments are provided by JCQ. These inform the operational practices required during non-exam assessment sessions. The head of the school or college is responsible for making sure that supervision and authentication is conducted in line with JCQ instructions and those laid out in this specification.

Assessment of the design and make task

The design and make task is assessed using the criteria shown in Appendix A.

The marks awarded will arise by matching the learner's performance in the design and make task to each of the five sets of criteria (targeting AO1 and AO2) and then deciding upon the extent to which the learner has demonstrated those criteria in their work.

Beginning at the lowest band, the assessor should consider the learner's work and establish whether it matches the descriptor for that band. If the descriptor at the lowest band is satisfied, the assessor should move up to the next band and repeat this process for each band until the descriptor accurately reflects the work.

If the work covers different aspects of different bands within the assessment criteria, a 'best fit' approach should be adopted to decide on the band and then careful analysis of the learner's work should be made to decide on the mark within the band. For example, if the work is judged to be mainly in band 2, but with a limited amount of band 3 content addressed, the work would be placed in band 2, but the mark awarded would be close to the top of band 2 as a result of the band 3 content.

It is important that learners are not discouraged from attempting challenging tasks and producing innovative solutions. Candidates should be appropriately rewarded for their achievements, however complex/simple their task. So a candidate who has attempted a complex task, has been innovative in their choice of materials / manufacturing processes and has not been entirely successful could achieve a high overall mark for the NEA, when the nature of the task is taken into account.

Assessors need to consider the quality achieved in the context of the demands of the prototype. Outcomes do not need to be perfect to achieve full marks, but should reflect the standard expected at GCSE.

Internal moderation/standardisation

Where there is more than one assessor in a centre, for example, where more than one endorsed area is delivered, the assessment of learners' design and make tasks must be standardised internally. This is to ensure that the final assessment, whatever the endorsed area, or whoever the assessor, accurately reflects a single agreed standard for all GCSE design and technology candidates entered for assessment by the centre.

Internal standardisation should involve all assessors independently marking sample pieces of work to identify any differences in marking standards. Such differences should be discussed collectively to arrive at an agreed common standard for the centre. Standardising material will be issued by WJEC to assist with this process.

Submission of marks

Centres are required to submit marks for the design and make task online at the beginning of May of the year in which the qualification is to be awarded. When marks have been submitted to WJEC, the online system will apply the sample formula based on the overall rank order for the entry and immediately identify the sample of learners whose work is selected for moderation.

Once learners' design and make tasks have been assessed by the centre and the marks have been submitted to WJEC, learners must not have access to their work for further development and the work must not be removed from the centre.

Moderation

A moderator appointed by WJEC will visit the centre during May in the year in which the qualification is awarded. For learners making up the moderation sample (identified in advance of the visit by WJEC) across endorsed areas, their portfolio and prototype(s) must be made available for the moderator.

Moderators will provide detailed feedback to centres through a written report which will be made available on the day results are issued. Adjustments will be made when it is deemed that the centre's internal assessment does not conform to agreed common standards established by WJEC. If centres have concerns about the outcomes of moderation, they may access a range of post-results services as outlined on the WJEC website.

4 TECHNICAL INFORMATION

4.1 Making entries

This is a linear qualification in which all assessments must be taken at the end of the course. Assessment opportunities will be available in May/June each year, until the end of the life of this specification. Summer 2019 will be the first assessment opportunity.

A qualification may be taken more than once. Candidates must resit all examination units in the same series.

Marks for NEA may be carried forward for the life of the specification. If a candidate resits an NEA unit (rather than carrying forward the previous NEA mark), it is the new mark that will count towards the overall grade, even if it is lower than a previous attempt.

Where a candidate has certificated on two or more previous occasions, the most recent NEA mark is carried forward, regardless of whether that mark is higher or lower (unless that mark is absent).

The entry codes appear below.

Qualification title	Entry codes	
	English-medium	Welsh-medium
WJEC GCSE Design and Technology (Engineering Design)	3601QS	3601CS
WJEC GCSE Design and Technology (Fashion and Textiles)	3602QS	3602CS
WJEC GCSE Design and Technology (Product Design)	3603QS	3603CS

The current edition of our *Entry Procedures and Coding Information* gives up-to-date entry procedures.

4.2 Grading, awarding and reporting

GCSE qualifications are reported on a nine point scale from A* to G, where A* is the highest grade. Results not attaining the minimum standard for the award will be reported as U (unclassified).

APPENDIX A

Non-exam assessment marking criteria

The assessment criteria for learners' contextual challenge (a design and make task) are summarised in the table below and shown in detail in the following pages. A definition of key terms used within each assessment objective precedes the relevant assessment criteria.

Assessment Criteria	Marks	Assessment objective
Identifying design possibilities.	10	AO1
Developing a design brief and specification.	10	
Generating and developing design ideas.	30	AO2
Making a prototype.	30	
Evaluating a prototype's fitness for purpose	20	
Total	100	

(a)	**Identifying design possibilities** [AO1] *The candidate has:*	**Band**
	9 – 10 marks • undertaken thorough and effective identification of opportunities for the development of designs within the prescribed context. • undertaken detailed, relevant research and investigation, clearly linked to the context and, where appropriate, the work of past/present professionals and companies. • undertaken detailed and effective analysis of information, reflecting the needs, wants and values of clients or potential users. • identified a broad range of problems/opportunities to clearly inform the development of possible design briefs.	**4**
	6 – 8 marks • undertaken effective identification of opportunities for the development of designs within the prescribed context. • undertaken relevant research and investigation, linked to the context and, where appropriate, the work of past/present professionals and companies. • undertaken effective analysis of information, reflecting the needs, wants and values of potential users. • identified a range of problems/opportunities to inform the development of possible design briefs.	**3**
	3 – 5 marks • identified some opportunities for the development of designs within the prescribed context. • undertaken research and investigation, generally linked to the context and, where appropriate, the work of past/present professionals and companies. • undertaken some analysis of information, though the needs, wants and values of potential users may not have not been fully considered. • identified some problems/opportunities which partially inform the development of possible design briefs.	**2**
	1 – 2 marks • identified one opportunity for the possible development of designs within the prescribed context. • undertaken little research and investigation, which is only partially linked to the context. • undertaken a basic analysis of information, with little or no consideration of the needs, wants and values of potential users. • identified few problems/opportunities and developed a design brief with little reference to their investigations.	**1**
	0 marks • produced no work that is worthy of a mark.	

(b)	**Developing a design brief and specification** **[AO1]** *The candidate has:*	**Band**
	9 – 10 marks • fully considered a range of problems/opportunities before deciding upon a final design brief. • demonstrated a very good understanding of the task ahead and the requirements which have to be met, to satisfy the needs, wants and interests of potential users. • written a design brief, relevant to the context, based upon a thorough analysis of their research and investigation. • written a detailed, relevant specification, including a range of objective and measurable criteria, to direct and inform the design and manufacture of a prototype.	**4**
	6 – 8 marks • considered a range of problems/opportunities before deciding upon a final design brief. • demonstrated a good understanding of the task ahead and most of the requirements which have to be met, to satisfy most of the needs, wants and interests of potential users. • written a design brief, relevant to the context, based upon a general analysis of their research and investigation. • written a relevant specification, including a range of objective and measurable criteria, to inform the design and manufacture of a prototype.	**3**
	3 – 5 marks • considered some problems/opportunities before deciding on a final design brief. • demonstrated a general understanding of the task ahead and one or two requirements have been identified to satisfy some of the needs, wants and interests of potential users. • written a design brief, based upon some aspects of the analysis of their research and investigation. • written a specification, including the key points, to partially inform the design and manufacture of a prototype.	**2**
	1 – 2 marks • focussed on a single opportunity to produce a design brief. • demonstrated a limited understanding of the task ahead, with little or no consideration of the needs, wants and interests of potential users. • written a design brief based upon simple analysis of their research and investigation. • produced a small range of partially appropriate specification points.	**1**
	0 marks • produced no work that is worthy of a mark.	

(c)	**Generating and developing design ideas** **[AO2]** *The candidate has:*	**Band**
	24 – 30 marks • considered a range of design strategies, techniques and approaches and applied an iterative design process to generate and communicate a broad, complex and diverse range of initial ideas. • identified and considered social, moral and economic factors which are relevant to the context and potential user(s). • clear, effective and detailed use of testing to evolve ideas and to refine their design decisions. • developed a detailed proposal, including comprehensive and relevant details of materials, dimensions, finishes and production techniques, which clearly addresses all requirements of the design brief and specification. • demonstrated sophisticated use of a range of skills/techniques to clearly communicate ideas and proposals to a third party.	**4**
	16 – 23 marks • considered a range of design strategies, techniques and approaches and applied an iterative design process to generate and communicate a broad range of initial ideas. • identified and considered social, moral and economic factors which are generally relevant to the context and potential user(s). • clear and effective use of testing to evolve ideas and to refine their design decisions. • developed a proposal, including relevant details of materials, dimensions, finishes and production techniques, which addresses the main requirements of the design brief and specification. • demonstrated good use of a range of skills/techniques to communicate ideas and proposals to a third party.	**3**

8 – 15 marks • considered some design strategies and techniques and applied an iterative design process to generate and communicate a range of basic initial ideas. • identified social, moral and economic factors with some attempt to relate these to the context and potential user(s). • made some use of testing to evolve ideas and to refine their design decisions. • developed a proposal, including some details of materials, dimensions, finishes and/or production techniques, which addresses some requirements of the design brief and specification. • demonstrated satisfactory use of a small range of skills/techniques to communicate ideas and proposals to a third party.	**2**
1 – 7 marks • generated and communicated a limited range of undeveloped initial ideas. • identified aspects of social, moral or economic factors, though these are not closely related to the context and or potential user(s). • made little or no use of testing to evolve ideas. • developed a proposal, with superficial details of materials, dimensions, finishes and/or production techniques which addresses few requirements of the design brief and/or specification. • demonstrated limited ability to communicate their idea(s) to a third party.	**1**
0 marks • produced no work that is worthy of a mark.	

(d) **Making a prototype** [AO2] *The candidate has:*	**Band**
24 – 30 marks • clearly communicated comprehensive relevant details of a logical sequence and achievable timeline for the stages of production and testing of their final prototype. • selected and worked with appropriate materials and components to successfully complete the manufacture of their prototype to a defined schedule. • used a range of appropriate making skills and processes to produce a high quality functioning prototype that meets the requirements of the design specification and is fit for purpose. • an excellent understanding of the working properties and performance characteristics of the specified materials and, where appropriate, demonstrated consideration of surface treatments/finishes. • selected and safely used specialist tools, appropriate techniques, processes, equipment and machinery with a high level of accuracy and precision to enable the prototype to perform as intended and meet the user's requirements.	**4**
16 – 23 marks • communicated details of a logical sequence and achievable timeline for the stages of production and testing of their final prototype. • selected and worked with appropriate materials and components to successfully complete the manufacture their prototype, generally to a defined schedule. • used a range of appropriate making skills and processes to produce a good quality functioning prototype that generally meets the requirements of the design specification one or two major points have not been addressed and is fit for purpose. • a good understanding of the working properties and performance characteristics of the specified materials and, where appropriate, demonstrated consideration of surface treatments/finishes. • selected and safely used specialist tools, appropriate techniques, processes, equipment and machinery with accuracy and precision to enable the prototype to perform as intended and meets the user's requirements.	**3**
8 – 15 marks • communicated details of a sequence for manufacture and testing of their final prototype. • selected and worked with materials and components to partly complete the manufacture of their prototype, generally to a defined schedule. • used an adequate range of making skills and processes to be able to produce a functioning prototype that has tentative links to the requirements of the design specification and is generally fit for purpose. • an understanding of the main working properties and performance characteristics of the specified materials and, where appropriate, demonstrated basic consideration of surface treatments/finishes. • selected and safely used specialist tools, techniques, processes, equipment and machinery with a limited degree of accuracy and precision, the prototype only just performs as intended and meets some aspects of the user's requirements.	**2**

1 – 7 marks • communicated superficial or no details of a sequence for manufacture and/or testing of their final prototype. • worked with materials and components to partly complete the manufacture of their prototype. • implemented some making skills and processes to produce a partially functioning prototype, aspects of which meet elements of the design specification. • a limited understanding of the working properties and/or performance characteristics of the specified materials. • selected and safely used specialist tools, techniques, processes, equipment and machinery with a limited degree of accuracy, the prototype partially or is unable to fully perform as intended, though meets few aspects of the needs, wants and values of the user.	**1**
0 marks • produced no work that is worthy of a mark.	

(e) Evaluating a prototype's fitness for purpose [AO2] *The candidate has:*	**Band**
16 – 20 marks • undertaken a critical, objective analysis, evaluation and testing of their ideas and decisions whilst applying iterative design processes. • undertaken a critical and objective evaluation and testing of their final prototype, taking into account the views of potential users. • responded to feedback and clearly identified the potential for further development of their prototype, with detailed suggestions for how modifications could be made.	**4**
11 – 15 marks • undertaken an objective analysis, evaluation and testing of their ideas and decisions whilst applying iterative design processes. • undertaken an objective analysis, evaluation and testing of the final prototype, with some consideration of the views of potential users. • responded to feedback and identified the potential for further development of their prototype, suggesting how modifications could be made.	**3**
6 – 10 marks • undertaken some analysis, evaluation and/or testing of their ideas and decisions whilst applying iterative design processes. • undertaken some analysis, evaluation and/or testing of their final prototype, with partial consideration of the views of potential users. • identified the potential for some further development of their prototype, including suggestions of how modifications could be made.	**2**
1 – 5 marks • produced a limited evaluation of their ideas and decisions. • produced a limited evaluation of their final prototype. • partially identified how their prototype could be modified.	**1**
0 marks • produced no work that is worthy of a mark.	