GCE A LEVEL

eduqas
Part of WJEC

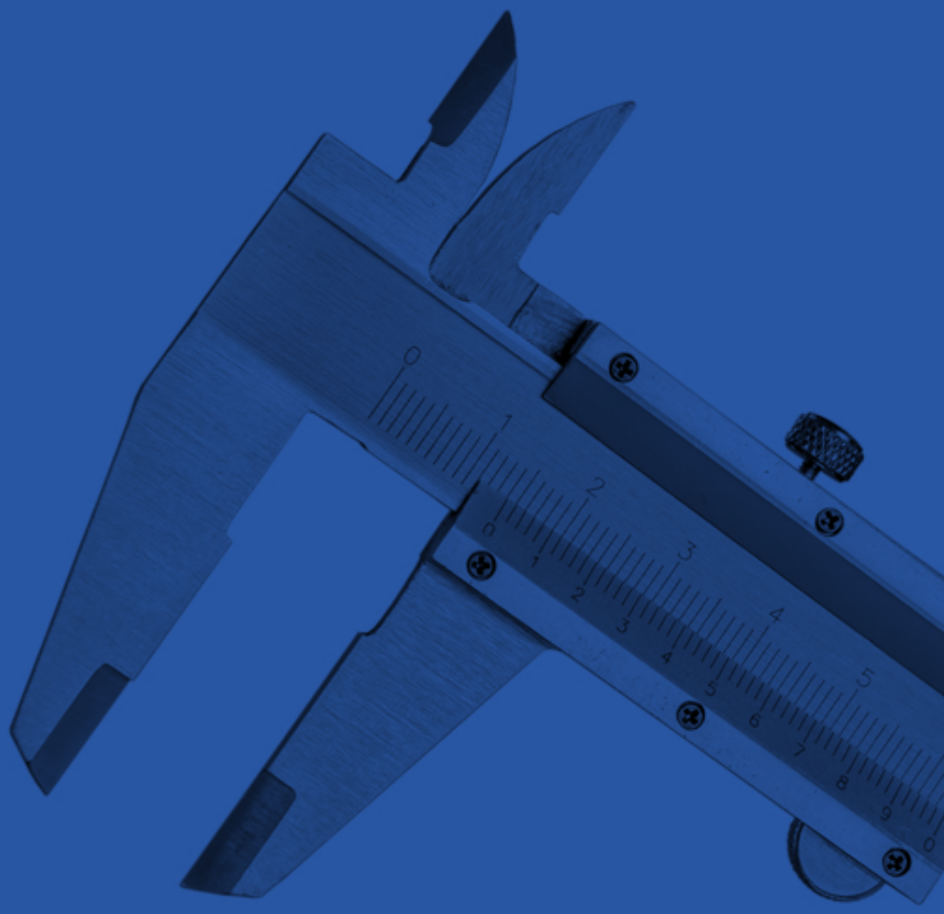
WJEC Eduqas GCE A Level in

DESIGN AND TECHNOLOGY

ACCREDITED BY OFQUAL

SPECIFICATION

Teaching from 2017
For award from 2019



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This Ofqual regulated qualification is not available for candidates in maintained schools and colleges in Wales.

WJEC Eduqas GCE A LEVEL DESIGN AND TECHNOLOGY

For teaching from 2017
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GCE A LEVEL DESIGN AND TECHNOLOGY

SUMMARY OF ASSESSMENT

Component 1: Design and Technology in the 21st Century
Written examination: 3 hours
50% of qualification

Learners take a single examination in one of the following endorsed areas:

- fashion and textiles
- product design.

The examination includes a mix of structured and extended writing questions assessing learners' knowledge and understanding of:

- technical principles
- designing and making principles

along with their ability to:

1. analyse and evaluate wider issues in design and technology.

Component 2: Design and make project
Non-exam assessment: approximately 80 hours
50% of qualification

A sustained design and make project, based on a brief developed by the candidate, assessing the candidate's ability to:

- identify, investigate and outline design possibilities
- design and make prototypes
- analyse and evaluate design decisions and outcomes, including for prototypes made by themselves and others

The design and make project will be based within the same endorsed area as the written examination.

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 Accreditation Number: 603/1178/2

GCE A LEVEL DESIGN AND TECHNOLOGY

1 INTRODUCTION

1.1 Aims and objectives

The WJEC Eduqas A level 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.

Design and technology is an inspiring, rigorous and practical subject. This specification encourages learners to use creativity and imagination when applying iterative design processes to develop and modify designs, and to design and make prototypes that solve real world problems, considering their own and others' needs, wants, aspirations and values.

The specification enables learners to identify market needs and opportunities for new products, initiate and develop design solutions, and make and test prototypes. Learners should acquire subject knowledge in design and technology, including how a product can be developed through the stages of prototyping, realisation and commercial manufacture.

Learners should take every opportunity to integrate and apply their understanding and knowledge from other subject areas studied during key stage 4, with a particular focus on science and mathematics, and those subjects they are studying alongside A level design and technology.

As learners need to demonstrate expertise in specialist areas, two subject endorsements are available (*fashion and textiles* and *product design*), linked to design disciplines that reflect possible higher education routes and industry.

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

- be open to taking design risks, showing innovation and enterprise whilst considering their role as responsible designers and citizens
- develop intellectual curiosity about the design and manufacture of products and systems, and their impact on daily life and the wider world
- work collaboratively to develop and refine their ideas, responding to feedback from users, peers and expert practitioners
- gain an insight into the creative, engineering and/or manufacturing industries
- develop the capacity to think creatively, innovatively and critically through focused research and the exploration of design opportunities arising from the needs, wants and values of users and clients

- develop knowledge and experience of real world contexts for design and technological activity
- develop an in-depth knowledge and understanding of materials, components and processes associated with the creation of products that can be tested and evaluated in use
- be able to make informed design decisions through an in-depth understanding of the management and development of taking a design through to a prototype/product
- be able to create and analyse a design concept and use a range of skills and knowledge from other subject areas, including mathematics and science, to inform decisions in design and the application or development of technology
- be able to work safely and skillfully to produce high-quality prototypes/products
- have a critical understanding of the wider influences on design and technology, including cultural, economic, environmental, historical and social factors
- develop the ability to draw on and apply a range of skills and knowledge from other subject areas, including the use of mathematics and science for analysis and informing decisions in design

1.2 Prior learning and progression

Any requirements set for entry to a course following this specification are at the discretion of centres. It is reasonable to assume that many learners will have achieved qualifications equivalent to Level 2 at key stage 4. Skills in numeracy / mathematics, literacy / English and ICT will provide a good basis for progression to this Level 3 qualification.

This specification builds on the knowledge, understanding and skills established at GCSE. Some learners may have already gained knowledge, understanding and skills through their study of design and technology at AS.

This specification provides a suitable foundation for the study of design and technology or a related area through a range of higher education courses, progression to the next level of vocational qualifications or employment. 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.

This specification is not age specific and, as such, provides opportunities for learners to extend their life-long learning.

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. learners 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.

2 SUBJECT CONTENT

Learners follow one endorsed route through this specification: either *fashion and textiles;* or *product design*.

The subject content within section 2.1 and section 2.2 for each of *fashion and textiles* and *product design* is presented under seven main headings:

- designing and innovation
- materials and components
- processes
- industrial and commercial practice
- product analysis and systems
- human responsibility
- public interaction – marketing and research.

Within each area, the content is further divided into sub-headings, each with specified content and amplification.

The structure of the content within the two endorsed routes is shown in the tables below. *Fashion and textiles* and *product design* share the same structure (though with material-specific amplification where appropriate).

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

Learners are required to study all of the content specified in relation to one endorsed route, 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.

All topics within the relevant technical principles and designing and making principles 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. The amplification column provides more information on the content presented in the left hand column, including the breadth and depth of study required. Where 'e.g.' is used in the amplification column, the list which follows is illustrative only. In all other instances, the list of items in the amplification column must 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 technical principles and designing and making principles content.

The subject content within sections 2.1 and 2.2 requires learners to develop knowledge and understanding of a broad range of technical principles. Whilst study of this content will prepare learners for the Component 1 assessment (examination, which will assess knowledge and understanding of technical principles *and* designing and making principles), it will also develop knowledge and understanding that can be applied in Component 2 (the design and make project).

Appendix B illustrates links to mathematics and science. These must be covered within GCE A level Design and Technology qualifications and will be assessed in this qualification in Component 1 (for *fashion and textiles* or *product design*).

There is no hierarchy implied in the order in which the content is presented and it does not imply a prescribed teaching order.

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

Design and Technology in the 21st Century
Written examination: 3 hours
50% of qualification
100 marks

Design and make project
NEA: approximately 80 hours
50% of qualification
100 marks

Calculators may be used in Component 1 and in Component 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.*

Content of sections 2.1 and 2.2

1	**Designing and innovation**	4	**Industrial & commercial practice**
(a)	Principles of designing	(a)	Manufacturing industry
(b)	Research techniques	(b)	Manufacturing systems
(c)	Analysis of the problem	(c)	Stages of production
(d)	Problem solving strategies	(d)	Detailed manufacturing methods
(e)	Quantitative and qualitative testing	(e)	Management systems
(f)	Ergonomics and anthropometrics	(f)	Safe working practices
(g)	Computer systems for designing	(g)	Industrial methodology
(h)	Innovation	**5**	**Product analysis and systems**
(i)	Consider issues when designing	(a)	Design and production
(j)	Research, plan and evaluate	(b)	Form and function
(k)	Generate and develop ideas	(c)	Trends & influences on design
(l)	Develop proposals	(d)	Intellectual Property & Standards
(m)	Detail design	(e)	Systems and sub-systems
(n)	Communicate ideas & information	(f)	Control systems
2	**Materials and components**	(g)	The use of ICT
(a)	Materials and their application	(h)	Issues when designing
(b)	Working characteristics of materials	(i)	Systems analysis
(c)	Materials with specific properties	(j)	ICT when planning
(d)	Modern material technology	(k)	ICT when designing and making
(e)	Materials for specific requirements	**6**	**Human responsibility**
(f)	Choice of finishes	(a)	Service to the customer
(g)	Components and their application	(b)	Regulatory frameworks
(h)	Safe working practices	(c)	Risk assessment procedures
(i)	Work with materials & components	(d)	Values in design solutions
3	**Processes**	(e)	Forms of energy
(a)	Hand methods	(f)	Responsibilities when designing
(b)	Machine methods	(g)	Quality (of the product)
(c)	Combining/forming materials	(h)	Quality (human processes)
(d)	Computer-aided manufacture	**7**	**Public interaction**
(e)	Work with tools and equipment	(a)	Innovation in the market
(f)	Work with materials, components	(b)	Researching the market
		(c)	Selling the product
		(d)	Diffusion of products
		(e)	Researching market/client needs
		(f)	Determine product marketability
		(g)	Evaluate products

2.1 Fashion and textiles technical principles

The following content is for the <u>fashion and textiles</u> option

	1. Designing and innovation	
	This section is concerned with learners developing their ability to design and enhance their basic design skills in order to solve problems. Learners should also develop an understanding of a range of external influences and demands which affect the work of product designers.	
	Content	Amplification
Fashion and textiles	(a) Principles of designing	• The generation, development and expression of ideas; development of aesthetic values; fitness for purpose; • the understanding and application of design processes in a logical and creative manner; • writing appropriate and effective specifications as used in the Textile Industry; Fabric specifications; product specification; manufacturing specification; garment specification;. • the generation of specific, measurable performance criteria to inform designing and evaluating; • use of sketchbooks in design development; • communication of ideas and solutions in appropriate contexts using a variety of media, such as freehand sketching, formal working and presentation drawings, 2D and 3D modelling, 3D printing, ICT generated image, toiles.
	(b) Research techniques	• Primary and secondary research; the discerning use of reference material from a variety of sources such as libraries, Internet, databases, fashion shows, magazines and exhibitions, to produce valid and reliable information.
	(c) Analysis of the problem	• Effective analysis and synthesis of material to guide development of innovative and creative ideas; • investigate and analyse a problem, consider the needs, wants and values of users, leading to the production of design briefs, specifications, to inform, direct and evaluate the end product; • reflection on the problem.

Fashion and textiles	(d) Problem solving strategies	• Investigation, team work (including brainstorming), research, modelling, prototyping, trialling and toiles; • how skills and knowledge from other subject areas (including mathematics, science, computer science) will support problem solving including the application of technology; • the process of innovation – collaborative and commercial approaches; • key concepts in innovation such as the impact of past and present textile/fashion designers and historical influences; fashion forecasters; image makers; trendsetters and fashion centres; • innovation techniques such as inversion (turning the problem around), morphological analysis (evaluating possible solutions in a table or matrix), analogy and lateral thinking; • analysis and exploration of the needs of users.
	(e) Quantitative and qualitative testing	• Techniques of evaluating performance against specific measurable criteria such as comparative testing of materials for a specific application; devising fair tests for materials; • 2D/3D modelling prototyping and toiles to evaluate proposals; • identification of criteria for value judgements such as ratings charts for aesthetics, function, user-friendliness; • feasibility studies on proposed solutions.
	(f) Ergonomics and anthropometrics	• Relevant use of human and environmental measurements and statistics to inform design and production.
	(g) Computer systems for designing	• Use of CADD both in formative and summative stages of designing, Internet, DVD, databases, spreadsheet, word processing/DTP and control programs, as appropriate to the task undertaken; • make use of appropriate software to communicate fashion/textile ideas clearly such as: Corel draw, Speedstep, Photoshop; Adobe Illustrator. • product data management – using software to manage and monitor production.
	(h) Innovation	• Appreciate the importance of innovation in both designing and making.

Fashion and textiles	(i)	Consider a range of issues when designing	• Take into account consumer needs, market trends, manufacturing, multiple materials, maintenance and product life when designing.
	(j)	Research, plan and evaluate	• Investigate, organise and manage time and resources effectively, responding to changing circumstances; • exercise entrepreneurial, collaborative and team working skills as appropriate; • identify and apply relevant external standards, such as BSI, Kite marking ;safety labelling on furnishings, textile products and clothes; European directives. • achieve optimum use of materials and components by taking into account the complex relationship between: material, form and manufacturing processes; the scale of production; the environmental factors affecting disposal of waste, surplus and by-products; and the cost; • evaluate outcomes by devising quality assurance procedures, assessing the impact of actions and regularly reviewing and establishing the best approach. Review the way the work plan is followed after considering its effectiveness in order to achieve improvements; • use and select methods of testing the performance of fashion and textile products against specified criteria and act on their findings. Ensure, through testing, modification and evaluation, that the quality of products is suitable for the intended user.
	(k)	Generate and develop ideas	• Use a range of design methods and strategies to originate ideas and possible solutions which are appropriate to the problem, for example brainstorming, disassembly of existing products, inversion, morphological analysis, analogy and lateral thinking; • use of mood boards, design sketches, storyboards, concept sketches and contract designs, final collection ideas. • in the light of thorough analysis and the specifications, use knowledge and understanding to develop and refine alternative designs and/or design detail, demonstrating creativity and innovation; critically evaluate all ideas against the specification.
	(l)	Develop proposals	• Model aspects of ideas and proposals including samples and toiles; use ICT as appropriate and use a systems approach to solve problems.

Fashion and textiles	(m) Detail design	• Use knowledge and understanding of the working characteristics of materials and components (such as tensile strength, stiffness, density, absorbency, crease or abrasion resistance, insulation properties) and restrictions imposed by tools, equipment and processes to prepare detailed design proposals to meet specifications; • technical factors – maintenance, safety and how the fashion/textile product is used; take into account information gained during research, from manufacturers or suppliers, the Internet, experimentation etc.; • carry out feasibility studies on the practicability of the proposed solution to meet the needs of the market place.
	(n) Communicate ideas and information	• Present ideas and design possibilities in appropriate formats such as word processing/DTP, freehand sketching, formal working or presentation drawings, CAD/ICT generated images; solid modelling; 3D printing; toiles; • record and explain fashion/textile design decisions; • communicate information unambiguously to enable others to interpret design intentions using appropriate conventions and technical language, sketching, presentation drawings, ICT generated graphs, drawings, spreadsheet printouts, digital or conventional pictures/images and writing reports.

	2. Materials and components	
	This section is about developing a general appreciation of the wide range of materials and components available to designers and manufacturers. This general appreciation should be supported by a more detailed knowledge of a range of materials, partly developed through use in specialist NEA work.	
	Content	Amplification

Fashion and textiles	(a) Materials, components and their potential application	• Classification, general characteristics and uses of:-
		  • Natural polymers:
		  • Animal: wool/fleece, mohair, cashmere, angora, alpaca, camel(hair)
		  • Insect polymers: silk;
		  • Plant polymers: cotton, linen, hemp, jute;
		  • Manufactured polymers:
		  • Natural: rayon; viscose; rubber; metal; glass.
		  • Synthetic: polyester, polypropylene; nylon; elastane; aramid fibres;
		  • Microfibres: tactel; tencel;
		  • Stock forms of the above materials to include: textile materials are made by different construction methods - weaving, knitting, bonding, laminating, felting
		  • Identify and use components that are appropriate to the type of material, user and intended purpose of the product.

	(b) Working characteristics of materials: physical, chemical and composite	• Textile materials reflect the characteristics of the fibres and yarns they are made from - staple and continuous filaments, textured yarns and novelty yarns, all affect the fabric weight, flexibility, handle and end use. • The physical working properties of a range of textile material to include: tensile strength, elasticity, absorbency, thermal, flammability, weight, durability, crease resistance, water repellency, anti-static, resistance to acid, bleach and sunlight. • Appreciation of the complex interrelationships between material, form and manufacturing process and consideration of how the material affects the structure of the fashion/textiles product.
	(c) Methods of creating materials with specific properties	• Combining textile materials to improve their properties and uses: • quilting; • blending and mixing fibres; • bonding breathable water proof membranes to outer fabrics (Gore-Tex, Permatex, Sympatex) • the advantages of fabrics combined as laminates: in clothing, furnishings, geotextiles, sport and leisure and medical. • microfibres, performance fabrics and metallicised materials.

Fashion and textiles	(d) Awareness of modern material technology	• The importance of Micro and NanoTechnology in fibre and and material production for a range of fashion/textile products. • An appreciation of how fashion/textile product development is influenced by modern materials, to include an understanding of a range of composites and application of functional (SMART) and modern materials. • Interactive textiles that function as electronic devices and sensors: wearable electronic fashionable garments and textile products; electronic systems integrated into fabrics; conductive fibres and yarns; conductive polymers; heat storage material; optical fibres; • The impact of biotechnology; micro-encapsulation; • Geotextiles for landscaping; • Medical textiles: sun protective clothing, Rhovyl as an antibacterial fibre; • Kevlar (modular compression engineering); biodegradable fibres (recycling PET bottles into fleece); carbon fibres; Nomex; biosteel.
	(e) The choice of materials for specific service requirements	• Know about the efficient use of materials, components and constructional techniques; aesthetic qualities, performance properties, physical characteristics and economic considerations; • Use the correct style details and use specific construction processes in relation to the type of fabric and intended purpose of the fashion/textile product; • How materials other than fibres and fabrics can be used in fashion and textiles design; • Quantitative and qualitative testing of materials; (to include tests for flammability, absorbency, durability, insulation, elasticity).

Fashion and textiles	(f)	The choice of finishes for specific service requirements	• Finishing techniques including both self-finished and applied finishes and different methods of enhancing the appearance, prolonging and protecting life;
			• Know about finishes used to:
			  • enhance aesthetic quality (such as colouring, surface decoration, embossing, glazing, brushing);
			  • enhance fabric life (such as flame retardant, moth proofing);
			  • improve functionality (such as shower and waterproofing, shrink resistance, crease resistance, coating with PVC, anti-static finish.

	(g)	Components and their potential application.	• A broad understanding of the availability and use of a wide range of bought-in components and fittings appropriate to the material(s) and application; • a knowledge of temporary means of joining/fastening a broad range of materials, such as velcro, zips, buckles; • the use of adhesives, permanent and semi-permanent fixings to join similar or dissimilar fabrics.
	(h)	Safe working practices, including identifying hazards and making risk assessments.	• Commercial working practices and responsibilities and their application to project work; • five-step risk assessment. (Identify hazard, who might be harmed & how, evaluate potential for risk, record, review if details change); provision of equipment, signage etc.
	(i)	Work with materials and components	• Work accurately, creatively, innovatively and imaginatively with materials, components, appropriate technologies, tools, processes and resources to achieve high quality fashion and textile products which match their specification; • demonstrate an appreciation of the working properties and functions of a variety of materials (as identified in section (a) above), and components/fasteners (as identified in (g) above), and use these with confidence.

	3. Processes	
	This section is about developing a detailed knowledge and understanding of a broad range of processes leading to the acquisition of associated skills through practical activity.	
	Content	Amplification
Fashion and textiles	(a) Hand methods of preparing, processing and manipulating materials	• Understand the physical problems of handling different kinds of natural and synthetic materials; know how materials dictate specific processes; • the use of templates, patterns and guides, pattern drafting, developing a prototype or toile before production;
	(b) Machine methods of preparing, processing and manipulating materials	• Template production, stencil preparation, modelling, prototyping, measuring, marking out, cutting out and assembly; • identify style details and use specific construction processes in relation to type of fabric.
	(c) Combining/forming materials to enhance their properties	• Knowledge of construction techniques for joining, shaping and finishing edges appropriate to material and intended product; • laminating, blending and bonding, quilting, felting
	(d) Computer aided manufacture	• Use of CAM: for preparation of stencils, templates, pattern blocks; 3D printing • use of CNC miller for preparation of printing blocks; • use of CNC embroidery machines for design work or logo work on a range of fashion/textiles products; • the benefits and limitations of computer controlled machines, to include CADD, CAM, CIM, digital media.
	(e) Work with tools and equipment.	• Selection of an appropriate range of tools, equipment and processes in order to make quality products; • select and use a range of hand and machine tools to accurately, efficiently, and safely process a variety of materials and components; • experiment with techniques in order to improve and refine intended methods of realising a design; • demonstrate care, precision and attention to detail in the use of tools and equipment; • work to a plan in order to achieve the desired objective.
	(f) Work with materials, components and appropriate technologies.	• Selection of appropriate materials, components and methods in order to make quality products; • experiment with techniques in order to improve and refine intended methods of realising a design; • demonstrate care, precision and attention to detail in the use of materials and components.

Fashion and textiles

4. Industrial and commercial practice	
This section is about understanding various methods of production and being able to apply appropriate commercial practices in practical projects.	
Content	*Amplification*
(a) The main features of the textile/clothing manufacturing industry, including employment and commercial practices	• Principles of industrial manufacturing systems across a range of scales and levels of production to include: mass, batch, one-off and different product types, repetitive flow production, progressive bundle system, unit production system, cell production; • staffing needs, allocation of costs, 'Just in Time' manufacture and commercial liability; • bought-in, standardised part assembly, sub-contracting. • the effect of production across manufacturing sites.
(b) Manufacturing systems, including one off, batch, high volume, bought-in parts	• The use of different levels of production taking into account economic decisions; • unit/one-off (bespoke, made to measure, Haute Couture) modular/batch and high volume production.
(c) Stages of production.	• Primary and secondary processing; • sourcing of materials, the buying cycle, forward ordering, storage, processing, assembly, finishing, packaging/ labelling and transportation.
(d) Detailed manufacturing methods, when preparing, combining, manipulating or processing materials	• Comparison of hand and commercial methods of preparing, shaping, cutting/wasting, joining materials, such as: computer controlled cutting machines, laser cutters, 3D printers, use of CAM for the preparation of stencils, pattern blocks and templates; • the influence of the above on the time taken to produce the product, its quality and final cost; • knowledge of manufacturing through the analysis of products.
(e) Management systems for production, quality assurance, organisation of equipment and people	• Internal Quality Control (QC) and external Quality Assurance (QA) requirements; • project management systems including flow charts, GANTT charts and critical path analysis; • modern methods of labour organisation to include single craft, progressive bundle and cell. Total quality manufacturing principles.
(f) Safe working practices, including identifying hazards and making risk assessments	• Commercial working practices and responsibilities and their application to project work; • five-step risk assessment. (Identify hazard, who might be harmed & how, evaluate potential for risk, record, review if details change); provision of equipment, signage etc.
(g) Industrial methodology and approaches	• Use an awareness of industrial methods and approaches in their own work to design, manufacture and implement quality control procedures.

	5. Product analysis and systems	
	This section is about understanding the requirements a product must satisfy, critical assessment of existing products and visualising new products in a context of past, present and future possibilities.	
	Content	Amplification
Fashion and textiles	(a) The processes involved in the design and production of a range of manufactured fashion/textile products	• Concept and product development - how fashion/textile products are conceived and developed; • to include historical influences, technological performance and components, functional success and aesthetic detailing, or other techniques for product analysis; • performance modelling, prototyping and toiles; • the influence of equipment on fashion/textile product manufacture in a range of materials; • interaction of new technologies and design needs especially on fabric development
	(b) Form and function of different products	• Aesthetic detailing, functional and marketing constraints such as maintenance and cost of a range of manufactured products; • stylistic and fashion design; • analysis of existing fashion/textile products in relation to specified criteria using a variety of strategies such as disassembly, qualitative and quantitative tests; • considerations of 'above the line' (visible and consumer required characteristics) and 'below the line' (invisible, operational characteristics, construction) assessment; • appreciate the relationship between fashion/textile products and human form and environment (ergonomics and anthropometrics) to ensure suitability and ease of use.
	(c) Trends, styles, new technical capabilities, and social, moral, political and ethical influences on the design, production and purpose of products.	• Design theory, including key historic movements/figures and their methods; • the historical influences on selected fashion/textile products; the influence of design movements, fashion cycles, traditions of other cultures, street style; • comparison of 'new' fashion/textile products with existing types; cultural trends and differences and their effect on new product development; ethical, moral and social considerations; pollution, recycling, re-using; • the development of fashion/textile products through time – recognising the work of image makers, trend setters, contemporary fashion, ready to wear, haute couture, fashion designers and fashion centres; • development of a fashion/textile design consciousness in society; considering environmental issues; • levels of technological development (including new materials and technologies) and their influence on designing and fashion products; • global manufacturing.

Fashion and textiles	(d)	Intellectual Property and International Standards	• The implications of Intellectual Property - Patents, Registered Designs, Design Right, Registered Trade Marks, Copyright; • the issues of copyright, patenting and their importance to the designer and manufacture of fashion/textile products. • the importance and effect of international standards on the design of fashion/textile products – BSI, CEN and ISO Standards.
	(e)	The use and detailed design of systems and sub-systems for manufacturing and management	• The fundamental characteristics of a system in terms of Input, Process and Output; • the applications of systems for manufacture and management; • designing and making of systems;
	(f)	Detailed design of control systems: loops, feedback, control functions to achieve desired purposes	• The extension of simple systems, using feedback and loops, to enhance the system's performance; • the importance of reliable data in feedback.
	(g)	The use of ICT by industry in the design and manufacture of products	• Examining the current use of ICT by industry in designing and manufacturing including:- • CADD - Computer Aided Drawing and Design; • CAM - Computer Aided Manufacture; • CIM – Computer Integrated Manufacture; • PPC – Production Planning and Control – production plans, quantity planning, quality assurance, ordering; • CAA – Computer Aided Administration – personnel, marketing, sales, order processing, procurement, stock control, costing, accounting; • retail stock control, distribution scheduling, customer / supplier relationships - JIT - 'Just-in-Time'.
	(h)	Consider a range of issues when designing	• Take into account the characteristics and features of existing fashion/textile products when designing.
	(i)	Systems Analysis	• Use a systems approach to analyse problems; • identify key features of a problem; • devise strategies to meet the needs and model detailed aspects of a solution.
	(j)	Use ICT when planning	• Produce block, flow and systems diagrams to formulate solutions; • use ICT appropriately for planning and data handling; • work to devised plans.
	(k)	Use ICT when designing and making	• Use ICT appropriately for communicating, modelling, controlling and manufacturing.

	6. Human responsibility	
	This section is about acquiring the knowledge and understanding needed to support design activities through an increased awareness of the designer's social, moral, ethical and legal responsibilities. It also allows learners to explore the environmental and consumer factors which impact on designers and which might affect the final nature of a product.	
	Content	Amplification
Fashion and textiles	(a) Service to the customer, including legal requirements, availability of resources	• Appreciate the need to offer product support and customer services; • take account of consumer group opinions in a competitive market; • understand the effect of legislation/regulations related to fashion/textile design, national and international standards. • consumer protection and trading standards.
	(b) How to find information on the regulatory and legislative frameworks related to product design	• How to find relevant information related to a fashion/textiles product's design and use, from documents such as Health and Safety legislation, BSI / ISO.
	(c) Standard risk assessment procedures in product design	• The identification of risks to the consumer in using a fashion/textiles product, making risk assessments, reduction of risks; testing fabrics and labelling requirements.
	(d) The values (technical, economic, aesthetic, social, environmental and moral) implicit in product design solutions.	• Needs, wants and acceptability to consumers; Maslow's hierarchy of needs • concept of quality by designers and to consumers; • client profiles; • identifying target markets; • the effect of product life cycles; • sustainable design issues when making design choices; • manufacturing and the environment; • conservation of raw materials; • intermediate technology.

Fashion and textiles	(e) The forms of energy used by industry, its impact on design, manufacturing and the environment	• Consideration of cost and type of energy and the effect on the final product and quality. Using and setting up an environmental management system (EMS); • the efficient use of energy in manufacturing fashion/textile products, the environmental implications of the industrial/technological age; • green/environmental issues; • sustainability issues- influencing the future, resource management; • energy conservation, including re-cycling/green issues; • the effect of energy costs on the final product; • new technology and environmentally friendly manufacturing processes within the fashion / textiles industry.
	(f) Consider appropriate issues and responsibilities when designing	• Design for economic and environmentally friendly manufacture; • consider product maintenance, repair and life cycle when designing; • design for safe use by the consumer; • appreciate the needs of specific consumers, such as young children, the elderly or those with special physical needs.
	(g) Quality in terms of the product: • fitness for purpose; • meeting the criteria of the specification; • accuracy of production; • appropriate use of technology; • aesthetic aspects.	• Manage and use control systems in quality assurance and quality control. • generate criteria and specifications required to judge quality: material testing.
	(h) Quality in terms of the human process of designing and making	• Recognise the importance of quality in the personal processes of designing and making, production systems, attention to detail; consider socio-economic, cultural and ethnic factors involved in material choice, availability and distribution.

	7. Public interaction – marketing and research	
	This section is about product design and its place in the market, for example how a design idea may be transformed into a marketable fashion/textiles product. It seeks to examine the many factors influencing product design, market research techniques and their influence on producing innovative fashionable products. Learners should develop an appreciation of the effects of social, economic, cultural and ethical issues in addition to material and manufacturing technologies.	
	Content	Amplification
Fashion and textiles	(a) Innovation in the market	• Needs and demands of consumers, technology-push and market-pull; • the totally new (radical) textile product and the product which has been subjected to improvements over time (incremental); • marketing strategies and how market research is conducted.
	(b) Researching the market	• The process of market research and its place in the process of innovation; • the market environment, who buys, lifestyle changes, market segmentation; • technological trends and how market research is conducted; • the importance of the target audience and market trends.
	(c) Selling the product	The four Ps: • Product life cycle; • Price and how it is determined; • Place and how products are distributed; • Promotion, which considers different ways in which fashion/textile products are presented to their market. • how the digital world affects the four P's; • enterprise and how products are brought to the market place.
	(d) Diffusion of products	• Factors influencing the success of fashion / textile products such as criteria which are important in purchasing decisions made by consumers (target audience; market penetration, who buys products).
	(e) Clarify tasks, by analysing and researching market/client needs: producing quantifiable performance specifications.	• Identify user needs, the nature of the problem to be solved and the target audience. Adopt strategies to produce design specifications which inform and guide decision making, seeking specialist advice and information as appropriate; • develop initial design briefs for performance manufacturing, maintenance and product life.
	(f) Use appropriate measurements to determine product marketability.	• Assess the success of existing products; the effectiveness of a product using social, economic and moral parameters.
	(g) Evaluate products.	• Use personal sources and external sources – target audience, specialists, when evaluating products against performance specification.

2.2 Product design technical principles

The following content is for the <u>product design</u> option

	1. Designing and innovation	
	This section is concerned with learners developing their ability to design and enhance their basic design skills in order to solve problems. Learners should also develop an understanding of a range of external influences and demands which affect the work of product designers.	
	Content	Amplification
Product design	(a) Principles of designing	• The generation, development and expression of ideas; development of aesthetic values; fitness for purpose; • the understanding and application of design processes in a logical and creative manner; • user centred design: the investigation and analysis of a problem within a context, the needs wants and values of users to define a design opportunity or problem that could lead to the production of a design brief and specification; • writing appropriate and effective specifications; • the generation of specific, measurable performance criteria to inform designing and evaluating; • use of sketchbooks in design development; • communication of ideas and solutions in appropriate contexts using a variety of media, such as freehand sketching, formal working and presentation drawings, 2D and 3D modelling, ICT generated images.
	(b) Research techniques	• The discerning use of reference material from a variety of sources such as libraries, Internet, databases, magazines and exhibitions, to produce valid and reliable information.
	(c) Analysis of the problem	• Effective analysis and synthesis of material to guide development of innovative and creative ideas; • investigate and analyse a problem, consider the needs, wants and values of users, leading to the production of design briefs, specifications, to inform, direct and evaluate the end product; • reflection on the problem.
	(d) Problem solving strategies	• Investigation, team work (including brainstorming), research, modelling, prototyping and trialling; • how skills and knowledge from other subject areas (including mathematics, science, computer science) will support problem solving including the application of technology; • the process of innovation – collaborative and commercial approaches; • key concepts in innovation such as the impact of product champions and entrepreneurs; • innovation techniques such as inversion (turning the problem around), morphological analysis (evaluating possible solutions in a table or matrix), analogy and lateral thinking; • analysis and exploration of the needs of users.

Product design	(e) Quantitative and qualitative testing	• Techniques of evaluating performance against specific measurable criteria such as comparative testing of materials for a specific application; devising fair tests for materials; • 2D/3D modelling and prototyping to evaluate proposals; • identification of criteria for value judgements such as ratings charts for aesthetics, function, user-friendliness; • feasibility studies on proposed solutions.
	(f) Ergonomics and anthropometrics	• Relevant use of human and environmental measurements and statistics to inform design and production.
	(g) Computer systems for designing	• Use of CADD both in formative and summative stages of designing, Internet, CD-ROM, databases, spreadsheet, word processing/DTP and control programs, as appropriate to the task undertaken; • understand the principles of concurrent engineering; • product data management – using software to manage and monitor production.
	(h) Innovation	• Appreciate the importance of innovation in both designing and making.
	(i) Consider a range of issues when designing	• Take into account design strategies when designing, be innovative and open to creative ideas at the start of the process.
	(j) Research, plan and evaluate	• Investigate, organise and manage time and resources effectively, responding to changing circumstances; • exercise entrepreneurial, collaborative and team working skills as appropriate; • identify and apply relevant external standards, such as BSI, IEE, to their design tasks; • achieve optimum use of materials and components by taking into account the complex relationship between: material, form and manufacturing processes; the scale of production; the environmental factors affecting disposal of waste, surplus and by-products; and the cost; • evaluate outcomes by devising quality assurance procedures, assessing the impact of actions and regularly reviewing and establishing the best approach. Review the way the work plan is followed after considering its effectiveness in order to achieve improvements; • use and select methods of testing the performance of products against specified criteria and act on their findings. Ensure, through testing, modification and evaluation, that the quality of products is suitable for the intended user.

Product design	(k) Generate and develop ideas	• Use a range of design methods and strategies to originate ideas and possible solutions which are appropriate to the problem, for example brainstorming, disassembly of existing products, inversion, iteration, morphological analysis, analogy and lateral thinking; design strategies – mood, lifestyle or theme boards; • in the light of thorough analysis and the specifications, use knowledge and understanding to develop and refine alternative designs and/or design detail, demonstrating creativity and innovation; critically evaluate all ideas against the specification.
	(l) Develop proposals	• Model detailed aspects of ideas and proposals, using ICT as appropriate and use a systems approach to solve problems.
	(m) Detail design	• Use knowledge and understanding of the working characteristics of materials and components (such as tensile and/or compressive strength, shear, stiffness, density, insulation properties) and restrictions imposed by tools, equipment and processes to prepare detailed design proposals to meet specifications; • carry out feasibility studies on the practicability of the proposed solution to meet the needs of the market place.
	(n) Communicate ideas and information	• Present ideas and design possibilities in appropriate formats such as word processing/DTP, freehand sketching, formal working or presentation drawings, CAD/ICT generated images; solid modelling; • record and explain design decisions; • communicate information unambiguously to enable others to interpret design intentions using appropriate conventions and technical language, sketching, presentation drawings, ICT generated graphs, drawings, spreadsheet printouts, digital or conventional pictures/images and writing reports.

	2. Materials and components	
	This section is about developing a general appreciation of the wide range of materials and components available to designers and manufacturers. This general appreciation should be supported by a more detailed knowledge of a range of materials, partly developed through use in specialist NEA work.	
	Content	Amplification
Product design	(a) Materials, components and their potential application	Classification, general characteristics and uses of:- • natural materials and elements to include, copper, hardwoods, silver, softwoods, wool; • plastic/pure synthetic materials to include, acrylic, cellophane, epoxy resin, kevlar, polyamide (nylon), polyester, PTFE, polypropylene, PVC; • regenerated materials to include, blockboard, cellulose-based boards (cards), chipboard, MDF, paper; • alloys and composites to include, aluminium alloy, brass, pewter, bronze, carbon fibre, GRP, low and medium carbon steels; • stock forms of the above materials to include, bonded, laminated, profiled, sheet and woven forms, availability and comparative costs.
	(b) Working characteristics of materials: physical, chemical and composite	• The physical, working and chemical properties of range of materials, to include conductivity, relative hardness, density, toughness, ductility, tensile and compressive strength, malleability, as appropriate to the material in question; • appreciation of the complex interrelationships between material, form and manufacturing process and consideration of how the material affects the structure of the product.
	(c) Methods of creating materials with specific properties	To include compositing, combining, laminating and reforming; • awareness of current developments of new materials and alloys together with their application, including SMART materials; • foams, rubbers, wood-based composites and metallised materials.
	(d) Awareness of modern material technology	• An appreciation of how product development is influenced by modern materials, to include an understanding of the application of functional (SMART) and modern materials

Product design	(e)	The choice of materials for specific service requirements	• To include resistance to abrasion, weathering and fire, suitability for embossing, cold working, dimensional integrity; • quantitative and qualitative testing of materials.
	(f)	The choice of finishes for specific service requirements	• Finishing techniques, including both self-finished and applied-finishing processes to improve aesthetic and/or physical characteristics, such as coating, painting, varnishing, laminating, sealants, preservatives, anodising, holographic finishes, plating, galvanizing and cathodic protection.
	(g)	Components and their potential application.	• A broad understanding of the availability and use of a wide range of bought-in components and fittings appropriate to the material(s) and application; • the use of adhesives, permanent and semi-permanent fixings to join similar or dissimilar materials; • a knowledge of temporary means of joining/fastening a broad range of materials.
	(h)	Safe working practices, including identifying hazards and making risk assessments.	• Commercial working practices and responsibilities and their application to project work; • five-step risk assessment. (Identify hazard, who might be harmed & how, evaluate potential for risk, record, review if details change); provision of equipment, signage etc.
	(i)	Work with materials and components	• Work accurately, creatively, innovatively and imaginatively with materials, components, appropriate technologies, tools, processes and resources to achieve high quality products which match their specification; • Demonstrate an appreciation of the working properties and functions of a variety of materials (as identified in section (a) above).

	3. Processes	
	This section is about developing a detailed knowledge and understanding of a broad range of processes leading to the acquisition of associated skills through practical activity.	
	Content	Amplification
Product design	(a) Hand methods of preparing, processing and manipulating materials	• Methods of testing, conditioning, cutting/wasting, forming and finishing a variety of materials; • the use of templates, patterns and guides.
	(b) Machine methods of preparing, processing and manipulating materials	• Methods of cutting/wasting, industrial forming. (a range of materials) joining and finishing a variety of materials such as casting ,stamping, laminating, milling, turning, injection moulding, extrusion, bonding; CAD/CAM and prototyping; • the use of jigs and fixtures to increase speed of production and help ensure consistency.
	(c) Combining/forming materials to enhance their properties	• Joining and forming of a wide range of materials within modern industry for different levels of production; • laminating, combining, jointing, folding and other methods of reinforcing.
	(d) Computer aided manufacture	• Software applications and the transfer of information to CAM machines, e.g. laser cutters, micro -routers, CNC lathes, milling machines and 3D printers. • the benefits and limitations of computer controlled machines, to include CADD,CAM, CIM, digital media.
	(e) Work with tools and equipment.	• Selection of an appropriate range of tools, equipment and processes in order to make quality products; • make safe use of power tools and machinery; • experiment with techniques in order to improve and refine intended methods of realising a design; • demonstrate care, precision and attention to detail in the use of tools and equipment; • work to a plan in order to achieve the desired objective
	(f) Work with materials, components and appropriate technologies.	• Selection of appropriate materials, components and methods in order to make quality products; • experiment with techniques in order to improve and refine intended methods of realising a design; • demonstrate care, precision and attention to detail in the use of materials and components.

	4. Industrial and commercial practice	
	This section is about understanding various methods of production and being able to apply appropriate commercial practices in practical projects.	
	Content	Amplification
Product design	(a) The main features of manufacturing industry, including employment and commercial practices	• Principles of industrial manufacturing systems across a range of scales and levels of production to include: mass, batch, one-off and different product types; • modular/cell production systems; • staffing needs, allocation of costs, 'Just-in-Time' manufacture and commercial liability; • bought-in, standardised part assembly, sub-contracting. • the effect of production across manufacturing sites.
	(b) Manufacturing systems, including one off, batch, high volume, bought-in parts	• The use of different levels of production taking into account economic decisions; • unit/one-off (including rapid prototyping), modular/batch and high volume production.
	(c) Stages of production.	• Primary and secondary processing; • Sourcing of materials, the buying cycle, forward ordering, storage, processing, assembly, finishing, packaging/ labelling and transportation.
	(d) Detailed manufacturing methods, when preparing, combining, manipulating or processing materials	• Comparison of hand and commercial methods of preparing, shaping, cutting/wasting, joining materials, such as casting and sintering, fabrication and injection moulding; • the influence of the above on the time taken to produce the product, its quality and final cost;
	(e) Management systems for production, quality assurance, organisation of equipment and people	• Internal Quality Control (QC) and external Quality Assurance (QA) requirements; • project management systems including flow charts, GANTT charts and critical path analysis; • modern methods of labour organisation to include single craft, progressive bundle and cell. Total quality manufacturing principles.
	(f) Safe working practices, including identifying hazards and making risk assessments	• Commercial working practices and responsibilities and their application to project work; • five-step risk assessment. (Identify hazard, who might be harmed & how, evaluate potential for risk, record, review if details change); provision of equipment, signage etc.
	(g) Industrial methodology and approaches	• Use an awareness of industrial methods and approaches in their own work to design, manufacture and implement quality control procedures

	5. Product analysis and systems	
	This section is about understanding the requirements a product must satisfy, critical assessment of existing products and visualising new products in a context of past, present and future possibilities.	
	Content	Amplification
Product design	(a) The processes involved in the design and production of a range of manufactured products	• Reverse engineering, to include historical influences, technological performance and components, functional success and aesthetic detailing, or other techniques for product analysis; • performance modelling and prototyping; • the influence of equipment on product manufacture in a range of materials; • interaction of new technologies and design needs especially on material.
	(b) Form and function of different products	• Aesthetic detailing, functional and marketing constraints such as maintenance and cost of a range of manufactured products; • appreciate the relationship between products and human form and environment (ergonomics and anthropometrics) to ensure suitability and ease of use.
	(c) Trends, styles, new technical capabilities, and social, moral, political and ethical influences on the design, production and purpose of products.	• Design theory, including key historic movements/figures and their methods; • the historical influences on selected products; • comparison of 'new' products with existing types; cultural trends and differences and their effect on new product development; ethical, moral and social considerations; • the development of products through time – recognising 'design classics' or' icons' • development of a design consciousness in society; • levels of technological development (including new materials and technologies) and their influence on designing and products • global manufacturing;
	(d) Intellectual Property and International Standards	• The implications of Intellectual Property - Patents, Registered Designs, Design Right, Registered Trade Marks, Copyright; • the importance and effect of international standards on the design of products – BSI and ISO Standards.

Product design	(e)	The use and detailed design of systems and sub-systems for manufacturing and management	• The fundamental characteristics of a system in terms of Input, Process and Output; • the applications of systems for manufacture and management; • designing and making of systems;
	(f)	Detailed design of control systems: loops, feedback, control functions to achieve desired purposes	• The extension of simple systems, using feedback and loops, to enhance the system's performance; • the importance of reliable data in feedback.
	(g)	The use of ICT by industry in the design and manufacture of products	• Examining the current use of ICT by industry in designing and manufacturing including:- • CADD - Computer Aided Drawing and Design; • CAM - Computer Aided Manufacture; • CIM – Computer Integrated Manufacture; • PPC – Production Planning and Control – production plans, quantity planning, quality assurance, ordering; • CAA – Computer Aided Administration – personnel, marketing, sales, order processing, procurement, stock control, costing, accounting; • retail stock control, distribution scheduling, customer / supplier relationships - JIT - 'Just-in-Time'.
	(h)	Consider a range of issues when designing	• Take into account the characteristics and features of existing products when designing.
	(i)	Systems Analysis	• Use a systems approach to analyse problems; • identify key features of a problem; • devise strategies to meet the needs and model detailed aspects of a solution.
	(j)	Use ICT when planning	• Produce block, flow and systems diagrams to formulate solutions; • use ICT appropriately for planning and data handling; • work to devised plans.
	(k)	Use ICT when designing and making	• Use ICT appropriately for communicating, modelling, controlling and manufacturing.

	6. Human responsibility	
	This section is about acquiring the knowledge and understanding needed to support design activities through an increased awareness of the designer's social, moral, ethical and legal responsibilities. It also allows learners to explore the environmental and consumer factors which impact on designers and which might affect the final nature of a product.	
	Content	Amplification
Product design	(a) Service to the customer, including legal requirements, availability of resources	• Appreciate the need to offer product support and customer services; • take account of consumer group opinions in a competitive market; • understand the effect of legislation/regulations related to product design; • consumer protection.
	(b) How to find information on the regulatory and legislative frameworks related to product design	• How to find relevant information related to a product's design and use, from documents such as Health and Safety legislation, BS and COSHH.
	(c) Standard risk assessment procedures in product design	• The identification of risks to the consumer in using a product, making risk assessments, reduction of risks.
	(d) The values (technical, economic, aesthetic, social, environmental and moral) implicit in product design solutions.	• Needs, wants and acceptability to consumers; • concept of quality by designers and to consumers; • client profiles; • identifying target markets; • the effect of product life cycles; • sustainable design issues when making design choices; • manufacturing and the environment; • conservation of raw materials.

Product design	(e)	The forms of energy used by industry, its impact on design, manufacturing and the environment	• The benefits and limitations of various sources of energy, to include, fossil fuels, nuclear fuels, solar, hydro and wind generation; • the efficient use of energy in manufacturing • green/environmental issues (implications of the industrial/technological age) • sustainability issues- influencing the future, resource management. • energy conservation, including re-cycling/green issues; • the effect of energy costs on the final product; • appropriate technology.
	(f)	Consider appropriate issues and responsibilities when designing	• Design for economic and environmentally friendly manufacture; • consider product maintenance and life cycle when designing; • design for safe use by the consumer; • appreciate the needs of specific consumers, such as young children, the elderly or those with special physical needs.
	(g)	Quality in terms of the product: • fitness for purpose; • meeting the criteria of the specification; • accuracy of production; • appropriate use of technology; • aesthetic aspects.	• Manage and use control systems in quality assurance and quality control; • generate criteria and specifications required to judge quality: material testing.
	(h)	Quality in terms of the human process of designing and making	• Recognise the importance of quality in the personal processes of designing and making, production systems, attention to detail.

	7. Public interaction – marketing and research	
	This section is about product design and its place in the market, for example how a design idea may be transformed into a marketable product. It seeks to examine the many factors influencing product design, market research techniques and their influence on producing innovative products. Learners should develop an appreciation of the effects of social, economic, cultural and ethical issues in addition to material and manufacturing technologies.	
	Content	Amplification
Product design	(a) Innovation in the market	• Needs and demands of consumers, technology-push and market-pull; • the totally new (radical) product and the product which has been subjected to improvements over time (incremental); • marketing strategies and how market research is conducted.
	(b) Researching the market	• The process of market research and its place in the process of innovation; • the market environment, who buys, lifestyle changes, market segmentation; • technological trends and how market research is conducted; • the importance of the target audience and market trends.
	(c) Selling the product	The four Ps: • Product life cycle; • Price and how it is determined; • Place and how products are distributed; • Promotion, which considers different ways in which products are presented to their market. • how the digital world affects the four P's; • enterprise and how products are brought to the market place.
	(d) Diffusion of products	• Factors influencing the success of products such as criteria which are important in purchasing decisions made by consumers (target audience; market penetration, who buys products).
	(e) Clarify tasks, by analysing and researching market/client needs: producing quantifiable performance specifications.	• Identify user needs, the nature of the problem to be solved and the target audience. Adopt strategies to produce design specifications which inform and guide decision making, seeking specialist advice and information as appropriate; • develop initial design briefs for performance manufacturing, maintenance and product life.
	(f) Use appropriate measurements to determine product marketability.	• Assess the success of existing products; the effectiveness of a product using social, economic and moral parameters.
	(g) Evaluate products.	• Use personal sources and external sources – target audience, specialists, when evaluating products against performance specification.

2.3 Designing and making principles

Designing and making principles **Develop and apply core knowledge, understanding and skills**	
This section is designed to develop learners' knowledge, understanding 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. Additionally, whilst not being required within the written examination to undertake design and make activity, or evaluate their own prototypes from the NEA, learners' knowledge and understanding of these designing and making principles will be assessed in Component 1 'Design and Technology in the 21st Century'.	
Content	**Amplification**
1. User-centred design: the investigation and analysis of a problem within a context, and the needs, wants and values of users, to define a design opportunity or problem leading to the production of a design brief and specification to direct, inform and evaluate their design practice	• Identify the needs and wants of the end user. • Explore and investigate existing products and situations before deciding whether there is a need for the product and to inform possible specification points for designing. • Primary research data: collecting new data and using this information to explore and aid possible design outcomes. • Secondary research data: collecting existing data and using these data to explore and aid possible design outcomes. • Define a design opportunity or problem leading to the production of a design brief and specification to direct, inform and evaluate their design practice.
2. Design theory, including key historic movements/figures and their methods	• Analyse key historic movements/figures and their methods to support the development of a chosen problem/brief and/or inform, refine and modify a design.

3. The application of knowledge and understanding in a product development process to design, make and evaluate prototypes/products	• Review and apply an understanding of product development to design, make and evaluate prototypes/products.
	• Communicate and develop designs, using appropriate techniques such as:
	  • Formal and informal 2D and 3D drawing.
	  • Section drawings or partial sectioned drawings.
	  • System and schematic diagrams.
	  • Annotated sketches.
	  • Exploded diagrams.
	  • Flow diagrams.
	  • Models.
	  • Presentations.
	  • Written notes.
	  • Working drawings.
	  • Schedules.
	  • Audio and visual recordings.
	  • Mathematical modelling.
	  • Computer-based tools.

4. How the appraisal of technological developments, both current and historic, needs to take into consideration social, moral and ethical factors and how these can impact on the work of designers and technologists	• Designing should not take place in isolation but there are wider needs to be consider: • Technological developments, both current and historic. • Moral and ethical factors. • How these factors can impact on the work of designers and technologists

5. How to critically analyse and evaluate their own ideas and decisions whilst using iterative design and make processes	• Using the process of iteration learners should:
	  • Know the importance of testing, analysing and evaluating ideas.
	  • Continuously review and critically analyse their work as they develop to improve their final outcome**.**
	  • Refine and modify their design ideas based upon their own decisions and consideration of the work of others.

6. In relation to the subject endorsement, how to select and safely use a range of specialist tools, techniques, processes, equipment and machinery appropriate to the design and manufacture of domestic, commercial and industrial products and systems	• Select and safely work with appropriate machinery, tools, materials and components to realise their chosen prototype. • Understand that when making the final outcome all Health and Safety regulations needs to be applied, appropriate to the environment they are working in.

7. How to measure, determine, and apply the degree of accuracy and precision required for products to perform as intended	• Work accurately and with precision when marking out and making prototypes.
	• Consider how to minimise waste and make allowances for effective cutting methods.
	• Marking methods:
	  • Measuring and use of reference points.
	  • Use templates, jigs and/or patterns.
	Work within tolerances.

8. How to evaluate their prototypes/products taking into account the views of potential users, customers or clients	• Respond thoughtfully and make informed judgements when evaluating their own prototype. • 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.
9. A range of strategies, techniques and approaches to explore, create and evaluate design ideas, such as user-centred design, circular economy, and systems thinking	• Use design strategies to explore, create and evaluate: • User-centred design - Contexts, Requirements, Design solutions; Evaluate; Iteration. • Circular economy: (make, use, dispose) to keep resources in use for as long as possible, extract the maximum value from them, then recover and regenerate products and materials at the end of each service life • Systems thinking.

10. Approaches to project management, such as critical path analysis, scrum or six sigma	• Be aware of and, where appropriate, apply project management approaches such as:
	  • Critical path analysis
	  • Scrum
	  • Six sigma

11. Design for manufacture, including planning for accuracy and efficiency when making prototypes and making recommendations for small, medium and large scale production	• Plan the stages of manufacture of a prototype. • Consider accuracy in manufacture when designing. • Consideration of scales of production - one off, batch and mass production.

12. The environmental factors affecting disposal of waste, surplus materials, components and by-products, sustainability, and costs	• Designing should not take place in isolation but there are wider needs to be considered:
	  • Ergonomics
	  • Anthropometrics
	  • Environmenta l- disposal of waste, surplus materials and by-products
	  • Sustainability
	  • Costs.

13. The application of relevant standards to their design tasks including those published by the British Standards Institute (BSI) and the International Organisation for Standardisation (ISO) specific to the subject	• The application of BSI and ISO standards, as relevant to the design and make project undertaken.
14. The stages of a product life cycle	• The product life cycle and its application in everyday products.

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 and outline design possibilities to address needs and wants

AO2
Design and make prototypes that are fit for purpose

AO3
Analyse and evaluate –
- design decisions and outcomes, including for prototypes made by themselves and others
- wider issues in design and technology

AO4
Demonstrate and apply knowledge and understanding of –
- technical principles
- design and making 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
Component 1	-	-	10%	40%	50%
Component 2	15%	25%	10%		50%
Overall weighting	**15%**	**25%**	**20%**	**40%**	**100%**

The table shows that AO3 is split between the two components. Component 1 assesses learners' ability to analyse and evaluate wider issues in design technology. Component 2 assesses learners' ability to analyse and evaluate design decisions and outcomes including for prototypes made by themselves and others.

3.2 Arrangements for non-exam assessment

Assessment criteria for the design and make project

The assessment criteria for learners' sustained design and make project are summarised in the table below and shown in detail in Appendix A.

Assessment Criteria		Marks	Assessment objective
(a)	Identifying and investigating design possibilities	15	AO 1
(b)	Developing a design brief and specification	15	
(c)	Generating and developing design ideas	25	AO 2
(d)	Manufacturing a prototype*	25	
(e)	Analysing and evaluating design decisions and prototypes	20	AO 3
	Total	100	

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

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

Context for the design and make project

Unlike for GCSE and AS, for A level design and technology WJEC does **not** set a contextual challenge.

Learners are required to complete **one** sustained design and make project, based on a design brief developed by the learner. Approximately 80 hours should be devoted to this project. 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 project, the learner will be required to produce the following evidence:

- a design brief developed by the learner
- a final prototype (or prototypes) based on that design brief, and
- additional evidence as necessary, including a design folio, to enable the assessment of the learner's attainment in each of the categories (a) to (e) in the table above.

Supervision

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

The design and make project 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 approximately 80 hours of assessment time, but their portfolios must be compiled within the school or college environment so that assessors can confidently authenticate the work.

Each learner must produce their final prototype or prototypes (though not necessarily their portfolio) 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 learners limited guidance during the design and make project 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 requirements of the design and make project i.e. design folio of evidence, models, times etc;
- ensure that the learner's choice of project has the potential to address the requirements of the marking criteria;
- enable the learner to feel comfortable in using the iterative process within the design and make project;
- 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 or college environment, the teacher must monitor 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 **teachers 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,
- correct or modify the work of a learner;
- give specific direction to the learner to achieve higher marks;
- 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. No credit should be given for work or decisions that learners have not made by themselves.

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 project

The design and make project 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 project to each of the five sets of criteria (targeting AO1, AO2 and AO3) 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.

Application of a 'best fit' approach is holistic and assessors should view the band as a whole when considering learners' work. It is not simply a case of adding up the number of bullet points within a band that the learner meets and awarding marks within the band on that basis. This is because the descriptors linked to each bullet point do not necessarily represent an equal amount of work or demand.

The assessment criteria are presented as a series of five bands, describing achievement from the lowest level worthy of a mark, to that which is worthy of full marks for the relevant set of criteria. In addition to applying the best-fit approach described above, assessors need to take into account the complexity of the candidate's design and make project and the method of manufacture.

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

Assessors need to consider the quality achieved in the context of the demands of the prototype. Also, the means of manufacture needs to be taken into account: a component produced by 3D-printing, for example, may have an excellent finish, but will have been straightforward to achieve.

Outcomes do not need to be perfect to achieve full marks, but should reflect the standard expected at GCE A level.

Internal moderation/standardisation

Where there is more than one assessor in a centre, the assessment of learners’ design and make projects must be standardised internally. This is to ensure that the final assessment accurately reflects a single agreed standard for all A level design and technology learners 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 project 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 projects 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.

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.

Where learners wish to re-sit the qualification, all components must be re-taken.

There are two endorsed titles within this qualification:

- WJEC Eduqas A level Design and Technology (Fashion and Textiles)
- WJEC Eduqas A level Design and Technology (Product Design)

Learners may enter for one endorsed title only during a single examination series.

The entry codes are:

- Design and Technology (Fashion and Textiles) A601QS
- Design and Technology (Product Design) A602QS

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

4.2 Grading, awarding and reporting

A level qualifications are reported as a grade from A* to E. Results not attaining the minimum standard for the award will be reported as U (unclassified).

APPENDIX A

The assessment criteria for learners' sustained design and make project in *fashion and textiles;* and *product design* 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 criteria.

Assessment Criteria		Marks	Assessment objective
(a)	Identifying and investigating design possibilities	15	AO 1
(b)	Developing a design brief and specification	15	
(c)	Generating and developing design ideas	25	AO 2
(d)	Manufacturing a prototype	25	
(e)	Analysing and evaluating design decisions and prototypes	20	AO 3
	Total	100	

AO1 Identify, investigate and outline design possibilities to address needs and wants	
Definitions used in AO1	
Identify	looking at areas and opportunities in which designs can take place
Investigate	pursuing ideas and gathering information relating to a context
	identify and investigate are interdependent - the processes work together and take place in no particular order
Outline	to produce a design brief and specification to inform AO2

(a) Identifying and investigating design possibilities [AO1] *The candidate has:*	**Band**
13 – 15 marks • considered in detail a range of design strategies, techniques and approaches and undertaken highly effective identification of opportunities for the development of designs • undertaken perceptive, relevant research and investigation, including detailed consideration of the work of other designers or practitioners, with evidence this has clearly influenced decisions • undertaken a comprehensive and highly effective analysis of information, clearly reflecting the needs, wants and values of potential users • identified a range of highly challenging problems/opportunities which clearly inform the development of possible design briefs • considered in detail relevant approaches to project management, within the constraints of the time and resources available	**5**
10 – 12 marks • considered a range of design strategies, techniques and approaches and undertaken effective identification of opportunities for the development of designs • undertaken relevant research and investigation, including consideration of the work of other designers or practitioners, with evidence this has influenced decisions • undertaken an effective analysis of information, reflecting the needs, wants and values of potential users • identified a range of challenging problems/opportunities which inform the development of possible design briefs • considered relevant approaches to project management, within the constraints of the time and resources available	**4**
7 – 9 marks • considered some design strategies and techniques and undertaken broadly effective identification of opportunities for the development of designs • undertaken relevant research and investigation including some consideration of the work of other designers or practitioners, but which has had limited influence on decisions • undertaken a mostly effective analysis of information, mostly reflecting the needs, wants and values of potential users • identified a range of problems/opportunities which partially inform the development of possible design briefs • briefly considered approaches to project management, within the constraints of the time and resources available	**3**

4 – 6 marks • considered some design strategies and identified opportunities for the development of designs • undertaken limited research and investigation with superficial consideration of the work of other designers or practitioners • undertaken a partially effective analysis of information, partly reflecting the needs, wants and values of potential users • identified problems/opportunities which have limited influence on the development of possible design briefs • noted some approaches to project management, within a general context	**2**
1 – 3 marks • identified one opportunity for the possible development of designs • undertaken little research and investigation • undertaken a superficial analysis of information, with little or no consideration of the needs, wants or values of potential users • identified one problem/opportunity and developed a design brief with basic reference to their investigations • demonstrated little consideration of project management	**1**
0 marks • produced no work that is worthy of a mark	

(b)	**Developing a design brief and specification** [AO1] *The candidate has:*	**Band**
	13 – 15 marks • demonstrated an excellent understanding of the task ahead and the precise requirements which have to be met, to fully satisfy the needs, wants and values of potential users • generated a clear and precise design brief, based upon a comprehensive and highly effective analysis of their research and investigation • produced a detailed, relevant specification, including a comprehensive range of objective and measurable criteria, and the application of relevant standards, to direct and inform the design and manufacture of a prototype	**5**
	10 – 12 marks • demonstrated a very good understanding of the task ahead and the requirements which have to be met, to satisfy the needs, wants and values of potential users • generated a clear, well-structured design brief, based upon an effective analysis of their research and investigation • produced a relevant specification, including mostly objective and measurable criteria, to direct and inform the design and manufacture of a prototype	**4**
	7 – 9 marks • 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 values of potential users • generated a clear design brief, based upon a general analysis of their research and investigation • produced a satisfactory specification, including some objective and measurable criteria to inform the design and manufacture of a prototype	**3**
	4 – 6 marks • demonstrated a satisfactory understanding of the task ahead and one or two requirements have been identified to satisfy some of the needs, wants and values of potential users • generated a design brief, based upon a simple analysis of their research and investigation • produced a basic specification, including some key points, to inform the design and manufacture of a prototype	**2**
	1 – 3 marks • demonstrated a limited understanding of the task ahead, with little or no consideration of the needs, wants or values of potential users • generated a design brief with limited reference to their research and investigation • produced a small number of specification points which have limited potential to inform the design and manufacture of a prototype	**1**
	0 marks • produced no work that is worthy of a mark	

AO2 Design and make prototypes that are fit for purpose	
Definitions used in AO2	
Design	the generation and development of ideas that can be presented to a third party, and can be evaluated and tested (however, the actual analysis and evaluation forms part of AO3)
Prototype	an appropriate working solution to a need or want that is sufficiently developed to be tested and evaluated (for example, full sized products, scaled working models or functioning systems)
Fit for purpose (prototype)	in addition to being a working solution, addressing the needs/wants of the intended user
	making skills can be assessed through the designing and making of the prototype(s), as well as the nature and quality of the final prototype

(c)	**Generating and developing design ideas** **[AO2]** *The candidate has:*	**Band**
	21 – 25 marks • applied an iterative design process to generate and communicate excellent initial ideas with sophisticated detailing • clearly identified and perceptively considered environmental, sustainability, costs, social, moral and ethical factors, which are clearly relevant to the design and potential user(s) • made excellent use of modelling and testing to evolve ideas and to support decision making • developed a highly 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 • considered in detail the manufacture of the prototype, including clearly defined planning for accuracy and efficiency and, where appropriate, making perceptive recommendations for different scales of production • demonstrated sophisticated and highly effective use of skills/techniques to clearly communicate ideas and proposals to a third party	**5**
	16 – 20 marks • applied an iterative design process to generate and communicate very good initial ideas with effective detailing • identified and considered environmental, sustainability, costs, social, moral and ethical factors which are relevant to the design and potential user(s) • made very good use of modelling and testing to evolve ideas and to support decision making • developed a detailed proposal, including relevant details of materials, dimensions, finishes and production techniques, which addresses most requirements of the design brief and specification • considered the manufacture of the prototype, including planning for accuracy and efficiency and, where appropriate, making relevant recommendations for different scales of production • demonstrated effective use of skills/techniques to clearly communicate ideas and proposals to a third party	**4**

11 – 15 marks • applied an iterative design process to generate and communicate good initial ideas with some detail evident • identified environmental, sustainability, costs, social, moral and ethical factors which are generally relevant to the design and potential user(s) • made good use of modelling and testing to evolve ideas and/or to support decision making • developed a satisfactory proposal, including relevant details of materials, dimensions, finishes and production techniques, which addresses the main requirements of the design brief and specification • considered the manufacture of the prototype, including some planning for accuracy and/or efficiency and, where appropriate, making brief recommendations for different scales of production • demonstrated satisfactory use of skills/techniques to communicate ideas and proposals to a third party	**3**
6 – 10 marks • applied an iterative design process to generate and communicate basic initial ideas which limited detail • identified a number of factors from environmental, sustainability, costs, social, moral and ethical, with some attempt to relate these to the design and potential user(s) • made some use of modelling and/or testing to evolve ideas and/or to support decision making • developed a basic proposal, including some details of materials, dimensions, finishes and/or production techniques and which addresses some requirements of the design brief and specification • considered the manufacture of the prototype, including some planning for accuracy and/or efficiency • demonstrated basic use of skills/techniques to communicate ideas and proposals to a third party	**2**
1 – 5 marks • applied an iterative design process to generate and communicate undeveloped initial ideas • identified a number of factors from environmental, sustainability, costs, social, moral and ethical, though these are not closely related to the design and or potential user(s) • made little use of modelling and/or testing to evolve ideas • presented a proposal with superficial details of materials, dimensions, finishes and/or production techniques and 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)	**Manufacturing a prototype** [AO2] *The candidate has:*	**Band**
	21 – 25 marks • clearly and comprehensively communicated all relevant details of a logical sequence and achievable timeline for the stages of production and testing of the final prototype • selected and worked with appropriate materials and components to successfully complete all aspects of the manufacture of their prototype to a clearly defined schedule • consistently implemented appropriate, sophisticated making skills and processes to produce a very high quality fully-functioning prototype that meets requirements of the design specification and is fit for purpose • demonstrated an excellent, in-depth understanding of the working properties and performance characteristics of the specified materials and, where appropriate, detailed consideration of surface treatments/finishes for functional and aesthetic purposes • selected and safely used specialist tools, appropriate techniques, processes, equipment and machinery with excellent accuracy and precision to enable the prototype to perform as intended and meet the needs, wants and values of the user	**5**
	16 – 20 marks • communicated relevant details of a logical sequence and achievable timeline for the stages of production and testing of the final prototype • selected and worked with appropriate materials and components to successfully complete almost all aspects of the manufacture of their prototype to a defined schedule • implemented 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 • demonstrated very good understanding of the working properties and performance characteristics of the specified materials and, where appropriate, consideration of surface treatments/finishes for functional and aesthetic purposes • selected and safely used specialist tools, appropriate techniques, processes, equipment and machinery with very good accuracy and precision to enable the prototype to perform as intended and meet the needs, wants and values of the user	**4**

11 – 15 marks • communicated details of a sequence and achievable timeline for the and testing of the final prototype • selected and worked with appropriate materials and components to successfully complete most aspects of the manufacture their prototype to a defined schedule • implemented appropriate making skills and processes to produce a good quality functioning prototype that generally meets the requirements of the design specification and is fit for purpose • demonstrated a good understanding of the working properties and performance characteristics of the specified materials and, where appropriate, consideration of surface treatments/finishes • selected and safely used specialist tools, appropriate techniques, processes, equipment and machinery with good accuracy and precision; the prototype performs mainly as intended and meets most of the needs, wants and values of the user	**3**
6 – 10 marks • communicated details of a sequence for manufacture and testing of the final prototype • selected and worked with materials and components to partly complete the manufacture of the prototype generally to a defined schedule • implemented making skills and processes to produce a functioning prototype that meets only the key requirements of the design specification but which is is generally fit for purpose • demonstrated a basic understanding of the main working properties and performance characteristics of the specified materials, and, where appropriate, basic consideration of surface treatments/finishes • selected and safely used specialist tools, techniques, processes, equipment and machinery with some accuracy and precision, the prototype partially performs as intended and meets some aspects of the needs, wants and values of the user	**2**
1 – 5 marks • communicated limited details of a sequence for manufacture and/or testing of the final prototype • worked with materials and components to partly complete the manufacture of the prototype • implemented some making skills and processes to produce a partially functioning prototype, some aspects of which meet elements of the design specification • demonstrated 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 limited accuracy, the prototype only just performs or is unable to perform as intended and meets few aspects of the needs, wants and values of the user	**1**
0 marks • produced no work that is worthy of a mark	

AO3	**Analyse and evaluate** • **design decisions and outcomes, including for prototypes made by themselves and others** • **wider issues in design and technology**
Definitions used in AO3	
Analyse	Deconstructing information and/or issues to find connections and provide logical chain(s) of reasoning
Evaluate	Appraising and/or making judgements with respect to information and/or issues
	Analysis and evaluation should draw on underpinning knowledge and understanding

(e)	**Analysing and evaluating design decisions and prototypes [AO3]** *The candidate has:*	**Band**
	17 – 20 marks • undertaken a perceptive, critical, objective analysis, evaluation and testing of their ideas and decisions whilst applying iterative design processes • undertaken a perceptive, critical and objective evaluation and testing of the final prototype, drawing highly appropriate conclusions, comparing with the work of others and clearly taking into account the views of potential users • clearly identified, with detailed reference to highly relevant qualitative and quantitative criteria, how their design decisions and the final prototype could be further developed or improved to better meet the needs, wants and values of the intended users	**5**
	13 – 16 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 the final prototype, drawing appropriate conclusions, comparing with the work of others and taking into account the views of potential users • identified, with reference to mostly relevant qualitative and quantitative criteria, how their design decisions and the final prototype could be further developed or improved to better meet the needs, wants and values of the intended users	**4**
	9 – 12 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, drawing generally appropriate conclusions, with some consideration of the work of others and views of potential users • identified, with reference to aspects of qualitative and/or quantitative criteria, how their design decisions and the final prototype could be further developed or improved to better meet the needs, wants and values of the intended user	**3**

5 – 8 marks • undertaken a limited objective analysis, evaluation and/or testing of their ideas and decisions whilst applying iterative design processes • undertaken some analysis, evaluation and/or testing of the final prototype, with partial consideration of the work of others and the views of potential users • identified how their design decisions and the final prototype could be further developed or improved to better meet the needs, wants and values of the intended user	**2**
1 – 4 marks • produced a mainly subjective evaluation of their ideas and decisions • produced a limited evaluation of the final prototype, with superficial consideration of the work of others or the views of potential users • partially identified how the final prototype could be further developed or improved	**1**
0 marks • produced no work that is worthy of a mark	

APPENDIX B

Links to mathematics and science

Through their work in design and technology learners are required to apply relevant knowledge, skills and understanding from key stage 4 courses in the sciences and mathematics.

They should use the metric and International System of Units (SI) system but also be aware that some materials and components retain the use of imperial units.

Through the assessment of their knowledge and understanding of technical principles and designing and making skills learners will be required to demonstrate an understanding of the mathematical and scientific requirements shown in the following tables, in both theoretical and practical ways. The examples in the tables below are illustrative of how the mathematical skills and scientific knowledge and skills identified could be applied in design and technology.

Links to mathematics

Fashion and textiles

Learners must be able to apply the following mathematical skills

Ref	Mathematical skills requirement	Potential applications: fashion and textiles	Examples of specification content
a	Confident use of number and percentages	Calculation of quantities of materials, costs and sizes	Materials and components (i) Work with materials and components
b	Use of ratios	Pattern grading	Processes (a) Hand methods of preparing, processing and manipulating materials
c	Calculation of surface areas and/or volumes	Determining quantities of materials	Processes (a) Hand methods of preparing, processing and manipulating materials
d	Use of trigonometry	Calculation of sides and angles as part of fashion and textiles product design	Designing and innovation (m) Detail design
e	Construction, use and/or analysis of graphs and charts	Representation of data used to inform design decisions and evaluation of outcomes. Presentation of market data, user preferences, outcomes of market research	Materials and components (e) The choice of materials for specific service requirements
f	Use of coordinates and geometry	Use of datum points and geometry when setting out patterns	Designing and innovation (a) Principles of designing

g	Use of statistics and probability as a measure of likelihood	Interpret statistical analyses to determine user needs and preferences. Use data related to human scale and proportion to determine required sizes and dimensions of fashion products	Designing and innovation (d) Problem solving strategies

Product design

Learners must be able to apply the following mathematical skills

Ref	Mathematical skills requirement	Potential applications: product design	Examples of specification content
a	Confident use of number and percentages	Calculation of quantities of materials, costs and sizes	Materials and components (i) Work with materials and components
b	Use of ratios	Scaling drawings	Designing and innovation (a) Principles of designing
c	Calculation of surface areas and/or volumes	Determining quantities of materials	Processes (a) Hand methods of preparing, processing and manipulating materials
d	Use of trigonometry	Calculation of sides and angles as part of product design	Designing and innovation (m) Detail design
e	Construction, use and/or analysis of graphs and charts	Representation of data used to inform design decisions and evaluation of outcomes. Presentation of market data, user preferences, outcomes of market research	Materials and components (e) The choice of materials for specific service requirements
f	Use of coordinates and geometry	Use of datum points and geometry when setting out design drawings	Designing and innovation (a) Principles of designing
g	Use of statistics and probability as a measure of likelihood	Interpret statistical analyses to determine user needs and preferences. Use data related to human scale and proportion to determine product scale and dimensions	Designing and innovation (d) Problem solving strategies

Links to science

Fashion and textiles

Learners must be able to apply the following scientific knowledge and skills

Ref	Scientific knowledge and skills	Potential applications: fashion and textiles	Examples of specification content
a	Describe the conditions which cause degradation	Ensure products are designed to take account of potential degradation through environmental factors	Materials & components (f) The choice of finishes for specific service requirements
b	Know the physical properties of materials and explain how these are related to their uses	Understand the appropriate use of materials, including textiles, fibres, polymers, technical textiles, ceramics, and metals, based on their physical properties	Materials & components (a) Materials and their potential application.

Product design

Learners must be able to apply the following scientific knowledge and skills

Ref	Scientific knowledge and skills	Potential applications: product design	Examples of specification content
a	Describe the conditions which cause degradation	Ensure products are designed to take account of potential corrosion due to environmental factors	Materials & components (f) The choice of finishes for specific service requirements
b	Know the physical properties of materials and explain how these are related to their uses	Understand the appropriate use of materials, including glass and ceramics, polymers, composites, woods, and metals, based on their physical properties	Materials & components (a) Materials and their potential application.