Qualification Accredited

OCR
Oxford Cambridge and RSA

GCSE (9-1)

Specification

DESIGN AND TECHNOLOGY

J310

For first assessment in 2019

Version 1.6 (February 2024)

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Contents

1 Why choose an OCR GCSE (9–1) in Design and Technology?

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1a. Why choose an OCR qualification?

Choose OCR and you've got the reassurance that you're working with one of the UK's leading exam boards. Our new OCR GCSE (9–1) in Design and Technology course has been developed in consultation with teachers, employers and Higher Education to provide learners with a qualification that's relevant to them and meets their needs.

We're part of the Cambridge Assessment Group, Europe's largest assessment agency and a department of the University of Cambridge. Cambridge Assessment plays a leading role in developing and delivering assessments throughout the world, operating in over 150 countries.

We work with a range of education providers, including schools, colleges, workplaces and other institutions in both the public and private sectors. Over 13,000 centres choose our A Levels, GCSEs and vocational qualifications including Cambridge Nationals and Cambridge Technicals.

Our Specifications

We believe in developing specifications that help you bring the subject to life and inspire your learners to achieve more.

We've created teacher–friendly specifications based on extensive research and engagement with the teaching community. They're designed to be straightforward and accessible so that you can tailor the delivery of the course to suit your needs. We aim to encourage students to become responsible for their own learning, confident in discussing ideas, innovative and engaged.

We provide a range of support services designed to help you at every stage, from preparation through to the delivery of our specifications. This includes:

- A wide range of high-quality creative resources including:
  - Delivery Guides
  - Transition Guides
  - Topic Exploration Packs
  - Lesson Elements
  - ...and much more.
- Access to Subject Advisors to support you through the transition and throughout the lifetimes of the specifications.
- CPD/Training for teachers to introduce the qualifications and prepare you for first teaching.
- Active Results – our free results analysis service to help you review the performance of individual learners or whole schools.

All GCSE (9–1) qualifications offered by OCR are accredited by Ofqual, the Regulator for qualifications offered in England. The accreditation number for OCR's GCSE (9–1) in Design and Technology is QN603/0663/4.

1b. Why choose an OCR GCSE (9–1) in Design and Technology?

Learning about Design and Technology will encourage learners to develop design and thinking skills that open up a world of possibility, giving them the tools to create the future. This specification will excite and engage learners with contemporary topics covering the breadth of this dynamic and evolving subject. It will generate empathetic learners who have the ability to confidently critique products, situations and society in every walk of their lives now and in the future.

Design and Technology is a subject that brings learning to life, requiring learners to apply their learning to real-life situations. This qualification aims to relate authentic real-world awareness of iterative design practices and strategies used by the creative, engineering and manufacturing industries. Learners will be required to use critical thinking, leading towards invention and design innovation, to design and make prototypes that solve real and relevant problems, considering their own and others' needs, wants and values.

OCR's GCSE (9–1) in Design and Technology enables learners to progress from their learning in Key Stage 3, developing critical thinking and practical skills that will serve them well in their futures, with A Levels, Further Education, Higher Education or in the workplace.

Learners will build and develop their broad knowledge and understanding from Key Stage 3, whilst also having the freedom to focus in more depth on areas of Design and Technology that most interest them.

This qualification will give learners an opportunity to engage with creativity and innovation and understand how they can be enhanced by the application of knowledge from other disciplines across the curriculum such as mathematics, science, art and design, computing and humanities, as well as the practical and technical knowledge and understanding they will learn from Design and Technology.

OCR has a comprehensive and dynamic support package in place for the delivery and understanding of this qualification, including a range of free resources available on our website, CPD opportunities and Design and Technology Subject Advisors who are available to support teachers. This support will continuously evolve to suit the requirements of teaching and learning through the lifetime of the specification, based on continued feedback from teachers.

Aims and learning outcomes

OCR's GCSE (9–1) in Design and Technology will encourage learners to:

- develop an awareness and understanding of real-life experiences in designing and in the developments and opportunities seen in creative, manufacturing and engineering industries
- demonstrate their understanding that all design and technological activity takes place within contexts that influence the outcomes of design practice
- develop an experienced understanding of an iterative design process and the relevance of these to industry practice
- develop realistic design proposals as a result of the exploration of design opportunities and users' (and stakeholders) needs, wants and values
- use imagination, experimentation and combine ideas when designing
- develop the skills to critique and refine their own ideas whilst designing and making
- communicate their design ideas and decisions using different media and techniques, as appropriate for different audiences at key points in their designing
- develop decision making skills, including the planning and organisation of time and resources when managing their own project work
- develop a broad knowledge of materials, components and technologies and practical skills to develop high quality, imaginative and functional prototypes
- become independent and critical thinkers who can adapt their technical knowledge and understanding to different design situations
- be ambitious and open to explore and take design risks in order to stretch the development of design proposals, avoiding clichéd or stereotypical responses
- consider the costs, commercial viability and marketing of products
- demonstrate safe working practices in Design and Technology
- use key Design and Technology terminology including those related to: designing, innovation and communication; materials and technologies; making, manufacture and production; critiquing, values and ethics
- engage learners with routes that are open to them when progressing to a GCE qualification, apprenticeship or in a future career in the field.

1c. What are the key features of this specification?

The key features of OCR's GCSE (9–1) in Design and Technology for you and your learners are:

- clarity on the application of iterative designing to support teaching and learning
- a specification that encourages creative thinking leading to design innovation, by using authentic and contemporary design strategies and techniques that are centred around iterative design processes of 'explore/create/evaluate', thus preparing learners to become critical and innovative designers, engineers and consumers of the future
- a flexible, dynamic and engaging support package for teachers developed through listening to teachers' needs and working with industry and educational professionals to ensure relevance. The support package is designed to evolve to support teachers' delivery and continuing CPD and keep teachers and learners up-to-date with contemporary practice and research in design, technology and engineering
- freedom in approaches towards designing and making so as not to limit the possibilities of project work or the materials and processes being used
- clear marking criteria for non-exam assessment that supports internal marking and preparatory teaching and learning, rewarding iterative design processes, problem solving and creative thinking
- examined assessment that supports both a practical and exploratory approach to learning, keeping all assessment relevant and purposeful to industry and learners' design interests
- supported by research, authentic practices and contextual challenges developed by DOT*
- a specification that offers clear progression from Key Stage 3 through to AS and A Level qualifications in Design and Technology
- a glossary to explain key terms and clarify definitions from the specification content (see Section 5e).

* OCR have drawn on research and authentic practices of an initiative called Designing Our Tomorrow (DOT), from University of Cambridge.

Designing Our Tomorrow

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1d. How do I find out more information?

If you are already using OCR specifications you can contact us at: www.ocr.org.uk

If you are not already a registered OCR centre then you can find out more information on the benefits of becoming one at: www.ocr.org.uk

If you are not yet an approved centre and would like to become one go to: www.ocr.org.uk

Want to find out more?

Contact a Subject Advisor:
Email: D&T@ocr.org.uk
Phone: 01223 553998

Explore our teacher support: http://www.ocr.org.uk/qualifications/by-subject/design-and-technology/

Join our communities:
Twitter: @OCR_DesignTech
Visit our Online Support Centre at support.ocr.org.uk

Check what CPD events are available:
www.cpdhub.ocr.org.uk

2 The specification overview

2a. OCR's GCSE (9–1) in Design and Technology (J310)

There are two submission options for the non-exam assessment (NEA). These options determine the entries, but do not signify different routes through the qualification. Learners must take either:

- components 01 and 02 for moderated upload submission option, or
- components 01 and 03 for moderated postal submission option

in order to be awarded the OCR GCSE (9–1) in Design and Technology.

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Content Overview	Assessment Overview	
This component brings together the learners 'core' and 'in-depth' knowledge and understanding. • '**Core**' knowledge of Design and Technology principles demonstrates learners' broad understanding of principles that all learners should have across the subject. • '**In-depth**' knowledge allows learners to focus more directly on **at least one** main material category, or design engineering. The question paper is split into two sections. A minimum of 15% of the paper will assess learners' mathematical skills as applied within a design and technology context.	**Principles of Design and Technology* (01)** 100 marks 2 hours Written paper	**50%** of total GCSE (9–1)
This component offers the opportunity for learners to demonstrate understanding of and skills in iterative designing, in particular: • the interrelated nature of the processes used to identify needs and requirements (explore) • creating solutions to meet those needs (create) • evaluating whether the needs have been met (evaluate). As an outcome of their challenge, learners will produce a chronological portfolio and one final prototype(s). It is through the iterative processes of designing that learners draw on their wider knowledge and understanding of Design and Technology principles. Contextual challenges will be released on 1 June each year.	**Iterative Design Challenge* (02, 03)** 100 marks Approx. 40 hours Non-exam assessment	**50%** of total GCSE (9–1)

* Indicates inclusion of synoptic assessment (see Section 3g).

Learners who are retaking the qualification may carry forward their result for the non-exam assessment component, See Section 4d.

2b. Content of GCSE (9–1) in Design and Technology (J310)

Central to the content of this qualification is the requirement for learners to understand and apply processes of iterative designing in their design and technology practice. They will need to demonstrate their knowledge, understanding and skills through interrelated iterative processes that 'explore' needs, 'create' solutions and 'evaluate' how well the needs have been met.

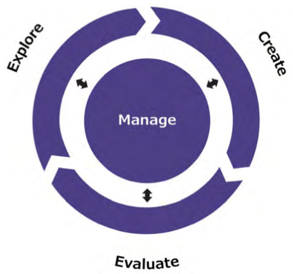

Fig. 1 Iterative Design Wheel

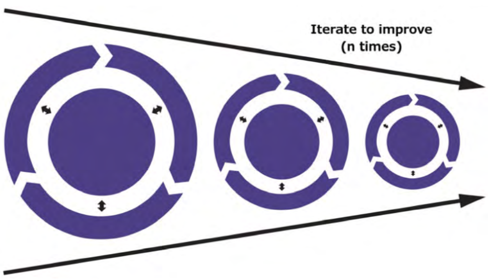

Fig. 2 Multiple iterations of design

At the centre of any iterative process is the need to develop critical-creative thinking skills to manage and organise opportunities that are identified. This learning will equip learners with life-long skills of problem spotting and problem solving, and enable them to apply their learning to different social, moral and commercial contexts.

The enquiry based nature of this specification will encourage learners to make meaningful connections between explore, create and evaluate. It facilitates a creative approach supported by subject knowledge in order to design and make prototypes that solve authentic, real-world problems.

The knowledge, understanding and skills that all learners must develop are underpinned by technical principles and principles of designing and making.

Technical principles will predominantly be assessed in the written exam and designing and making principles predominantly in the non-exam assessment (NEA). There is an expectation for learners to reflect on their understanding of all of the principles of design and technology in both components. This is outlined further in Section 3g of this specification.

The content of the qualification has been divided up to identify the requirements of examined and non-exam assessment. There are eight topic areas to guide both components and give clarity, these are:

1. Identifying requirements
2. Learning from existing products and practice
3. Implications of wider issues
4. Design thinking and communication
5. Material considerations
6. Technical understanding
7. Manufacturing processes and techniques
8. Viability of design solutions.

Experiencing learning through practical activity (both designing and technical principles) is fundamental to the delivery of this specification, as is the importance of the contextual relevance of design and technology practice. To prepare learners to successfully complete the 'Iterative Design Challenge', they should increasingly be given autonomy to make decisions in order to justify their reasoning when solving problems in their own way.

The content does not restrict learners' approaches to the qualification in terms of the materials and process they can use, but it does set out minimum requirements. Centres should use their discretion to allow learners to approach areas of designing and making that are appropriate to the facilities and resources available to them, whilst ensuring the right level of challenge.

Design and Technology requires learners to apply mathematical skills and understand related science. This reflects the importance of Design and Technology as a pivotal STEM subject. This specification requires learners to build on their prior learning in Design and Technology and other subjects at Key Stage 3 in order to develop their understanding of this importance.

2c. Content of Principles of Design and Technology (J310/01)

The specification content is set out through an enquiry approach to support teaching and learning. In addition, 'core' and 'in-depth' principles are highlighted throughout the content to demonstrate the required levels of knowledge, understanding and application that learners should develop in relation to each part of the content.

The '**core**' principles of Design and Technology offer a broad set of principles that all learners must know regardless of their specific practical experiences. These principles are required so that learners are able to make informed choices as a designer and demonstrate their fundamental knowledge and understanding of the subject. The 'core' content of the exam draws and builds on prior knowledge covered in the Key Stage 3 curriculum of study.

Where learners are required to demonstrate their '**in-depth**' knowledge, understanding and design development skills, this will relate to the specific experiences they have pursued throughout their Design and Technology learning. When designing and/or making, learners will build an in-depth toolkit of knowledge, understanding and skills in relation to materials or systems they have worked with and have an interest in, this can be drawn upon to support written responses.

Learners should build in-depth knowledge, understanding and design development skills that relate to one or more of the following main categories of materials:

- papers and boards
- natural and manufactured timber
- ferrous and non-ferrous metals
- thermo and thermosetting polymers
- natural, synthetic, blended and mixed fibres, and woven, non-woven and knitted textiles.

Alternatively some learners may choose to follow the design engineering requirements if they have more of an interest and in-depth understanding of electronic and mechanical systems and control. This path still requires much of the same in-depth knowledge, but there will be more of a focus on parts 6.3 and 6.4 of the content.

In the written examination, all learners are required to demonstrate their mathematical skills and scientific knowledge as applied to design and technology practice. The level of mathematical and scientific knowledge within this qualification should be equivalent to Key Stage 3 learning.

The mathematical requirements and possible applications are outlined at the end of this section and in Appendix 5c. Where mathematical skills are learnt through 'in-depth' areas, learners should be able to apply this learning to other broader contexts. The scientific knowledge is integrated into the content and outlined in Appendix 5d.

Symbols are used to clearly identify examples where mathematics and/or science could be considered relevant:

 = Maths

 = Science

The subject content should be underpinned by understanding and applying it to a range of contextual approaches that allow learners to develop their skills, knowledge and understanding through iterative designing, innovation and communication; studying materials and technologies; working with materials and technologies; considering manufacture and production methods; critiquing; exploring existing products and considering values and ethics.

The content has two columns to indicate with a tick (✔) whether the content relates to 'core' principles or 'in-depth' principles to support appropriate levels of teaching and learning.

Where content is listed using a Roman numeral bullet e.g. (i), it denotes content that **must** be taught and may be directly assessed in the examination. Where content is listed using bullet points '•' or '○' or follows an e.g., this content is illustrative only and does not constitute an exhaustive list. A direct question will not be asked about the examples listed but learners will need to draw on such examples when responding to questions in the examination.

1. Identifying requirements

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Considerations	*Core*	*In-depth*
1.1 How can exploring the context a design solution is intended for inform decisions and outcomes?		
a. Considerations for exploring a context should include: i. where and how the product or system is used ii. identifying primary user and wider stakeholder requirements iii. how the investigation of social, cultural, moral and economic factors to identify opportunities and constraints can influence the design process.	✓	✓
1.2 Why is usability an important consideration when designing prototypes?		
a. Considerations in relation to user interaction with design solutions, including: i. the impact of a solution on a user's lifestyle ii. the ease of use and inclusivity of design solutions iii. ergonomic considerations and anthropometric data to support ease of use iv. aesthetic considerations.	✓	

2. Learning from existing products and practice

D & M PRINCIPLES / TECHNICAL PRINCIPLES

Considerations	*Core*	*In-depth*
2.1 What are the opportunities and constraints that influence design and making requirements?		
a. Exploration and critique of existing designs, systems and products to identify features and methods, considerations should include: i. the materials, components and processes that have been used ii. the influence of fashion, trends, taste and/or style iii. the influence of marketing and branding iv. the impact on society v. the impact on usability vi. the impact on the environment; lifecycle assessment vii. the work of past and present professionals and companies in the area of Design and Technology.	✓	
2.2 How do developments in Design and Technology influence design decisions and practice?		
a. Critical evaluation of how new and emerging technologies influence and inform design decisions, considering both contemporary and potential future scenarios from the perspectives, such as: • ethics • the environment • product enhancement.	✓	

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3. Implications of wider issues

	Considerations	*Core*	*In-depth*
3.1 What are the impacts of new and emerging technologies when developing design solutions?			
a.	Exploration of the impacts within different contexts on: i. industry and enterprise, such as the circular economy ii. people, in relation to lifestyle, culture and society iii. the environment iv. sustainability.	✓	
3.2 How do designers choose appropriate sources of energy to make products and power systems?			
a.	The generation of electricity and how energy is stored and transferred.	✓	
b.	The appropriate use in products and systems of renewable and non-renewable sources including: i. fossil fuels, nuclear fuel, bio-fuel ii. wind, hydro-electricity, tidal and solar.	✓	
3.3 What wider implications can have an influence on the processes of designing and making?			
a.	Consideration of environmental, social and economic influences, including: i. environmental initiatives ii. fair trade iii. social and ethical awareness iv. global sustainable development.	✓	

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4. Design thinking and communication

	Considerations	*Core*	*In-depth*
4.1 How can design solutions be communicated to demonstrate their suitability to a third party?			
a.	The use of graphical techniques to communicate ideas, modifications, constructional and technical considerations, such as: • clear 2D and 3D sketches with notes • sketch modelling • exploded drawings • mathematical modelling • flow charts.		✓
4.2 How do designers source information and thinking when problem solving?			
a.	Awareness of different design approaches, including: i. user-centred design ii. systems thinking.	✓	
b.	The importance of collaboration to gain specialist knowledge from across subject areas when delivering solutions in design and manufacturing industries.	✓	

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5. Material considerations

Considerations	*Core*	*In-depth*
5.1 What are the main categories of materials available to designers when developing design solutions?		
Understanding that products are predominantly made from multiple materials. An overview of the **main categories** of materials as follows: a. papers and boards, including: i. papers, e.g. layout and cartridge, different weights and coatings ii. card, e.g. carton board, bleached card and corrugated card iii. boards/sheets, e.g. foam board, Styrofoam and polypropylene sheet iv. laminated layers, e.g. reflective surfaces. b. natural and manufactured timber, including: i. hardwoods, e.g. oak, birch and teak ii. softwood, e.g. pine, cedar and spruce iii. manufactured boards, e.g. MDF, plywood and block board. c. ferrous and non-ferrous metals, including: i. ferrous metals, e.g. iron, mild steel and stainless steel ii. non-ferrous metals, e.g. aluminium, copper and tin iii. alloys, e.g. brass, pewter and tin/lead solder. d. thermo and thermosetting polymers, including: i. thermo polymers, e.g. PET, HDPE, PVC, LDPE, PS, PP, ABS, acrylic and TPE ii. thermosetting polymers, e.g. silicone; epoxy resin and polyester resin. e. textile fibres and fabrics, including: i. natural fibres, e.g. cotton, wool and silk ii. synthetic fibres, e.g. nylon, polyester and acrylic iii. mixed/blended fibres, e.g. cotton/polyester iv. woven, non-woven and knitted fabrics.	✓	
f. Awareness of developments in: i. modern and smart materials such as graphene, super alloys, biopolymers and nano-materials ii. composite materials and their purpose in relation to contrasting applications iii. technical textiles used in different types of products dependent on context.	✓	
5.2 What factors are important to consider when selecting appropriate materials and/or system components when designing?		
a. The characteristic properties of the **main categories** of materials (5.1 a–e, not the specific materials) and why this makes them appropriate for different uses, such as: • density, strength, hardness, durability, strength to weight ratio, stiffness, elasticity, impact resistance, plasticity, corrosive resistance to chemicals and weather, flammability, absorbency, thermal and electrical conductivity.	✓	

Considerations	*Core*	*In-depth*
b. The physical and working properties of **specific materials** and/or **system components**, with consideration of: i. how easy they are to work with ii. how well they fulfil the required functions of products in different contexts.		✓
c. Other factors that influence the selection of materials and/or components, including; i. required functionality of the design solution ii. aesthetic attributes iii. environmental considerations iv. availability and cost of stock forms v. social, cultural and ethical considerations		✓
5.3 Why is it important to understand the sources or origins of materials and/or system components?		
a. The sources and origins of **specific materials** and/or **system components**.		✓
b. An overview of the processes used to extract and/or convert the source material into a workable form.		✓
c. Consideration of the ecological, social and ethical issues associated with processing **specific materials** and/or **system components** to convert them into workable forms, such as: • mining, harvesting, manufacturing, transporting.		✓
d. The lifecycle of **specific materials** and/or **system components** when used in products.		✓
e. Consideration of recycling, reuse and disposal of **specific materials** and/or **system components**, such as: • recycling and sustainability schemes • eco-materials • upcycling.		✓
5.4 Why is it important to know the different available forms of specific materials and/or systems components?		
a. Awareness of commonly available forms and standard units of measurement of **specific materials** and/or **system components** when calculating costs and quantities, including: i. weights and sizes ii. stock forms, such as: ○ lengths, sheets, pellets, reels, rolls, rods. iii. standard components, such as: ○ paper and boards, e.g. clips, fasteners, bindings ○ timber, e.g. hinges, brackets, screws ○ metals, e.g. bolts, rivets, hinges ○ polymers, e.g. caps, fasteners, bolts ○ fibres and fabrics, e.g. zips, buttons, poppers ○ system components, e.g. resistors, capacitors, diodes, transistors and drivers, microcontrollers ○ mechanical components, e.g. gears and cams, pulleys and belts, levers and linkages.		✓

6. Technical understanding

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Considerations	*Core*	*In-depth*
6.1 What gives a product structural integrity?		
a. How and why **specific materials** and/or **system components** need to be reinforced or stiffened to withstand forces and stresses.		✓
b. Awareness of the processes that can be used to ensure the structural integrity of a product, such as: • triangulation • use of boning, darts and layering in textile products • plastic webbing • reinforcing.		✓
6.2 How can materials and products be finished for different purposes?		
a. The processes used for finishing and adding surface treatments to materials and products for specific purposes, including: i. function, such as: durability and added resistance to overcome environmental factors ii. aesthetics.		✓
6.3 How do we introduce controlled movement to products and systems?		
a. An overview of different sorts of movement and types of motion, including: i. rotary ii. linear iii. oscillating iv. reciprocating.	✓	
b. The effect of forces on the ease of movement, including: i. load ii. effort iii. fulcrum.	✓	
c. How different mechanical devices are used to change the magnitude and direction of motion or forces, including consideration of: i. cams ii. gears iii. pulleys and belts iv. levers and linkages.	✓	
6.4 How do electronic systems provide functionality to products and processes?		
a. How sensors and control devices respond to a variety of inputs, including: i. sensors including light dependent resistors (LDR), infra-red sensors ii. switches including tilt switches, push-to-make switches and time-delay switches.	✓	
b. How devices are used to produce a range of outputs, including: i. light-emitting diodes (LED) to produce light ii. speakers and buzzers to produce sound iii. motors to produce motion.	✓	
c. The use of programmable components such as microcontrollers, to embed functionality into products in order to enhance and customise their operation.	✓	

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7. Manufacturing processes and techniques

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Considerations	*Core*	*In-depth*
7.1 How can materials and processes be used to make iterative models?		
a. The processes and techniques used to produce early models and/or toiles to support iterative designing.		✓
7.2 How can materials be manipulated and joined in different ways in a workshop environment when making final prototypes?		
a. The use of specialist techniques, hand tools and equipment used to shape, fabricate, construct and assemble high quality prototypes, with exemplification of the following processes: i. wastage, such as: ○ paper and boards, e.g. cutting and punching ○ timber, e.g. sawing, drilling and turning ○ metals, e.g. sawing, drilling, sheering and turning ○ polymers, e.g. sawing and drilling ○ fibres and fabrics, e.g. cutting and shearing ○ design engineering, e.g. etching*. ii. addition, such as: ○ paper and boards, e.g. adhesion and laminating ○ timber, e.g. adhesion, joining and laminating ○ metals, e.g. adhesion, welding/brazing and riveting ○ polymers, e.g. adhesion and heat welding ○ fibres and fabrics, e.g. sewing, bonding and laminating ○ design engineering, e.g. soldering*. iii. deforming and reforming, such as: ○ paper and boards, e.g. perforating and folding ○ timber, e.g. steaming and pressing ○ metals, e.g. pressing, bending and casting ○ polymers, e.g. moulding, vacuum forming and line bending ○ fibres and fabrics, e.g. heat treatments, pleating and gathering ○ design engineering, e.g. moulding*. * *and other processes appropriate to the materials or components being used in design engineering.*		✓
7.3 How do designers and manufacturers ensure accuracy when making prototypes and products?		
a. The use of appropriate and accurate marking out methods, including: i. measuring and use of reference points, lines and surfaces ii. templates, jigs and/or patterns iii. working within tolerances iv. understanding efficient cutting and how to minimise waste.		✓

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Considerations	*Core*	*In-depth*
7.4 How do industry professionals use digital design tools when exploring and developing design ideas?		
a. The use of 2D and 3D digital technology and tools are used to present, model, design and manufacture solutions, such as: • rapid prototyping • image creation and manipulation software • digital manufacture • interpretation of plans, elevations of 3D models • CAD, CAM, CAE.		✓
7.5 How do processes vary when manufacturing products to different scales of production?		
a. The methods used for manufacturing at different scales of production, including: i. one-off, bespoke production ii. batch production iii. mass production iv. lean manufacturing and just-in-time (JIT) methods.		✓
b. Awareness of manufacturing processes used for larger scales of production, such as: • paper and boards, e.g. offset lithography, screen process printing, digital printing, vinyl cutting, die cutting • timber, e.g. CNC routers, sawing and steam bending machines and lathes • metals, e.g. CNC milling, turning, sheet metal folding, pressing and stampings, and die casting • polymers, e.g. compression moulding, injection moulding, vacuum forming, rotational moulding, extrusion and blow moulding • fibres and fabrics, e.g. band saw cutting, flatbed and rotary screen printing, digital lay planning, industrial sewing machines and overlockers, automated presses and steam dollies • design engineering, e.g. laser cutting, rapid prototyping and 3D printing.		✓
7.6 How do new and emerging technologies have an impact on production techniques and systems?		
a. Critical evaluation of the benefits and implications of incorporating new and emerging technologies into production processes, such as: • consideration of economies of scale • how disruptive technologies such as 3D printing and robotics are changing manufacturing.	✓	

8. Viability of design solutions

Considerations		*Core*	*In-depth*
8.1 How can cost and availability of specific materials and/or system components affect their selection when designing?			
a.	The significance of the cost of **specific materials** and/or **system components** in relation to commercial viability, different stakeholder needs and marketability.		✓
b.	How to calculate the quantities, cost and sizes of materials and/or system components required in a design or product, being able to apply this to different applications.		✓

Mathematical skills in the Principles exam

It is a requirement of this qualification that a minimum of 15% of the written exam assesses the use of mathematical skills at a level of demand which is not lower than that expected at Key Stage 3.

The required mathematical skills to be tested in the examination are listed in the tables below. In order to support the application of these skills, examples of how the skills may be applied to design and technology and may be assessed in an exam are provided. The examples given are not exhaustive. The content in the specification with the Maths symbols also indicates and supports possible content for application.

Where mathematical skills are learnt through 'in-depth' areas, learners should be able to apply this learning to other broader contexts.

Learners are permitted to use a scientific or graphical calculator for this written examination. Calculators are subject to the rules in the document *Instructions for Conducting Examinations* published annually by JCQ (www.jcq.org.uk). However, it is expected that how a calculation was reached should be shown by a learner in their responses.

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M1 Arithmetic and numerical computation	
Required skills	*Examples of application to Design and Technology*
a. Recognise and use expressions in decimal and standard form.	• Understand the standard application of metric units used in Design and Technology and apply these appropriately using standard form (also be aware that some measurements commonly retain the use of imperial units). • Use decimal and standard form appropriately when using units of mass, length, time, money and other measures. • Use and apply standard form when calculating quantities of materials, cost and sizes.
b. Use ratios, fractions and percentages.	• Understand and use ratios in the scaling of drawings. • Understand and apply fractions and percentages when analysing data, survey responses and user questionnaires given in tables and charts. • Calculate percentages e.g. with profit, waste saving calculations or comparing measurements.
c. Calculate surface area and volume.	• Calculate the surface area to determine quantities of materials (where dimensions are given). • Calculate the volume of cuboids, simple and composite shapes (where dimensions are given). • Apply tolerances to material dimensions and quantities.
M2 Handling data	
a. Presentation of data, diagrams, bar charts and histograms.	• Construct and interpret frequency tables, pie charts and bar charts from given data sources. • Present given information to accurately represent performance over time.

M3 Graphs	
Required skills	*Examples of application to Design and Technology*
a. Plot draw and interpret appropriate graphs.	• Plot or draw graphs from given information such as performance data and client survey responses. • Analysis graphs to interpret and extract information.
b. Translate information between graphical and numeric form.	• Extract information from technical specifications and graphical sources to understand instructions or requirements.
M4 Geometry and trigonometry	
a. Use angular measures in degrees.	• Know the basic properties of isosceles, equilateral and right angle triangles. • Understand the basic rules of angular calculations and trigonometry to support accurate marking out. • Demonstrate accuracy in measurement and marking out of angles. • Understand symmetry to create tessellated patterns to minimise waste.
b. Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects.	• Graphical presentation of designs to communicate intentions to others. • Transfer information from 3D objects with given dimensions into accurate 2D representations. • Interpret information to accuratey present isometric drawings.
c. Calculate areas of triangles and rectangles.	• Calculate areas to determine quantities of materials (where not all dimensions are given). • Calculate area to determine area scale factor application.
d. Calculate the surface area and volumes of cubes.	• Calculate the overall surface area of cuboids to determine quantities of material. • Calculate the volume of cuboids to determine suitability of objects fitting into a space (where not all dimensions are given). • Calculate the volume of cuboids to determine volume scale factor application.

Further details on the forms of assessment for examinations can be found in Section 3a.

The mathematical requirements are mapped out against the OCR GCSE (9–1) in Mathematics in Section 5c.

2d. Non-exam assessment content – Iterative Design Challenge (J310/02, 03)

The non-exam assessment for this qualification requires learners to demonstrate their ability to draw together different areas of knowledge and understanding from across the full course of study through a single 'challenge' project – the 'Iterative Design Challenge'.

At the heart of any iterative design challenge are three interrelated processes, requiring learners to:

- 'explore' needs
- 'create' solutions that demonstrate how the needs can be met
- 'evaluate' how well the needs have been met.

The above processes occur repeatedly as iterations throughout any process of designing prototyped solutions. This continual system of designing ensures constantly evolving iterations that build clearer needs and better solutions for a concept, so that the ideas and prototypes could be developed into successful products. Learners will be required as a result of their 'Iterative Design Challenge', to produce one final prototype or a set that work in conjunction.

Central to any iterative designing process is the thinking and management around the development of the processes (centre circle in Fig. 3). This requires learners to manage competing problems to prioritise requirements in order to progress with their challenge. Taking calculated risks and managing them are an inherent part of this learning experience and should not be hidden, but encouraged as an integral and necessary aspect of iterative designing. Reflecting on problem solving through design iterations should be evidenced throughout.

The content of the non-exam assessment is laid out to clarify the iterative processes of 'explore/create/evaluate' and to highlight how the content requirements are not restricted to a single part/stage of an iterative designing challenge.

Learners are required to demonstrate their understanding that design and technology activity exists in contexts that influence the outcomes. Three different contextual challenges will be set by OCR each year in order for learners to explore a challenge that they can relate to. The challenges will:

- offer a broad range of real-world contexts, representing contemporary issues and concerns
- be open-ended, avoiding predetermining the materials or processes to be used to achieve a design solution
- focus on needs, wants and values of different groups, leading learners to address problems and/or opportunities
- be accessible and relevant to all learners regardless of areas they may have covered 'in-depth'.

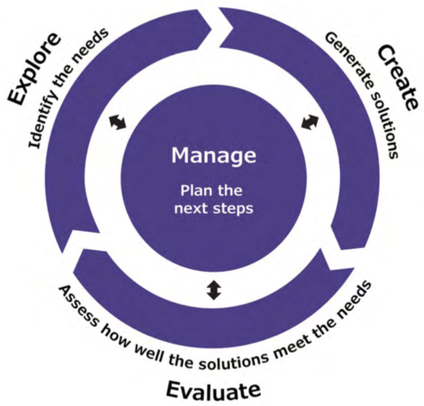

Fig. 3 Iterative Design Wheel showing key activities

2

2

Explore (AO1)

Exploring is about systematically understanding the need(s), known as requirements, of the stakeholder(s). The requirements should be described in a way that stimulates the 'create' stage of design development and forms the basis of measurable evaluation criteria in the 'evaluation' stage of the process. The requirements can be derived by exploring the following questions:

- *Who* are the stakeholders? e.g. using personas.
- *What* do stakeholders do and *when* do they do it? e.g. using task analysis.
- *Where* do stakeholders do it? e.g. through primary and secondary research that helps understand the physical, organisational, social and cultural environments.
- *Why* do stakeholders do what they do? e.g. establishing what stakeholders want to achieve.
- What is the impact of what stakeholders do on society (people), the environment (planet) and economics (profit)?

Create (AO2)

Creating focuses on the cognitive processes that are associated with creative thought. Creative ideas/ products have to be both *novel* and *appropriate* (or functional in design terms). In order to be *novel,* ideas must go beyond clichéd or stereotypical responses-something known as [design] fixation. Recognising fixation and understanding the conceptual processes that help avoid it, is crucial to creative thought. For example, the process of conceptual combination, which is the merging of two or more concepts to form a *novel* idea, which, if *appropriate*, is by definition creative.

Suitable communication and presentation techniques are essential to record and share creative thoughts clearly to a third party. Initially, the focus is on the generation of a wide variety of ideas, using quick methods of communication such as freehand sketching. There is absolutely the freedom for learners to approach their designing in the way they feel most appropriate, e.g. with the use of digital technology or rudimentary models. Working up rough prototypes of ideas using readily available materials allows evaluation for future iterations. The presentation of later iterations may include techniques such as detailed sketches, more substantive models and photos of models with annotations of technical requirements and general thoughts. Learners' final design solutions can similarly be presented in any medium, but should be drawn with enough skill and detail to show relevant technical details, projections and rendering, resulting in a final prototype(s) that resembles the intended iterative design solution for presentation and evaluation. The final design solution will also be required to be presented through the making of a final functioning and quality prototype(s).

Ideas in the form of sketches, models and annotations as described as part of the 'create' stage should be tested and evaluated as described as part of the 'evaluate' stage. In this way, the learner's creative journey is recorded naturally and clearly communicates their creative and critical thought processes and an understanding of how 'explore', 'create', and 'evaluate' are interrelated.

Evaluate (AO3)

Evaluation establishes whether the need(s) of the user(s) and stakeholder(s) have been met. Ideas (sketches and models) generated and developed within 'create' are used to test and systematically evaluate their *appropriateness* against the stakeholder requirements identified as part of 'explore'. Where needs have not been satisfactorily met, more exploration and creating of ideas will be required. New or developed ideas will need to be systematically evaluated.

This iterative process is repeated until all user and stakeholder needs have been met in line with stakeholder requirements. Each evaluation informs the next iteration and should be evident throughout the learner's challenge project. In order to do this, learners should select from a variety of suitable techniques that will help them to systematically and objectively test the solutions developed to meet the identified stakeholder requirements.

NEA content requirement

The column on the left indicates where learners may consider mathematical skills or science knowledge.

The 'explore', 'create' and 'evaluate' columns have different size dots, not only to indicate their interrelationship, but also their significance within any topic strand.

In order to undertake their Iterative Design Challenge, learners should: 1. Identify requirements			Explore	Create	Evaluate	Maths & Science
D & M PRINCIPLES	a.	Understand that all design and technological practice takes place within contexts that inform outcomes. Learners should be able to identify and prioritise problems and opportunities that are relevant to their chosen context. These issues should be reflected on throughout their project.	⬤	●	●	
	b.	Be able to write a design brief in response to a contextual challenge that considers the stakeholders that could have an interest in the potential outcome.	●	•	•	
	c.	Investigate the needs, wants and interests of primary users and other stakeholders to identify and understand the requirements for designing, through collecting, analysing and presenting their findings from primary and secondary data.	⬤	•	•	
2. Learning from existing products and practice						
D & M PRINCIPLES	a.	Investigate and analyse relevant existing products, understanding how they are used within their physical, organisational, social and/or cultural environments, using methods such as disassembly and systems thinking in order to make informed and reasoned decisions.	●	•	•	
	b.	Investigate and analyse the wider work of professionals and companies in order to stimulate their own design thinking.	●	•	•	

3. Implications of wider issues			Explore	Create	Evaluate	Maths & Science
D & M PRINCIPLES	a.	Investigate factors, such as environmental, social and economic challenges, in order to identify opportunities and constraints that might influence the process of iterative designing and making, such as taking into consideration the ecological and social footprint of materials.	●	•	•	
4. Design thinking and communication						
D & M PRINCIPLES	a.	Demonstrate an ability to identify and formulate appropriate requirement lists and specifications, reflecting on their own investigations and considering stakeholder needs, including: • requirements that cover stakeholder needs and wants • requirements that cover technical needs • technical specifications that outline the specific requirements needed to support the design solution being made into a final prototype.	●	●	●	
	b.	Be able to use different design strategies and approaches such as collaboration, user-centred design and systems thinking when generating and developing innovative design ideas that avoid design fixation.	•	⬤	•	
	c.	Be able to design and develop at least one prototype that responds to needs and/or wants and is fit for purpose, demonstrating functionality, aesthetics and marketability.	•	⬤	•	
	d.	Apply techniques in order to communicate and record design ideas suitable to the stage of development in order to justify their own thinking and present their thinking and intentions to a third party, such as: • informal 2D and 3D sketching and modelling to communicate initial ideas • system and schematic diagrams, annotated sketches, exploded diagrams, models and written notes, to communicate development iterations • audio and visual recordings to share thinking, explorations and the functionality of ideas • formal 2D and 3D working drawings to outline specification requirements; 3D illustrations, mathematical modelling and computer-based tools to present final design solutions; schedules and flow charts to deliver planning • presentations and real-time evidence to communicate throughout the project.	•	⬤	•	

		5. Material considerations	Explore	Create	Evaluate	Maths & Science
TECHNICAL PRINCIPLES	a.	Develop and apply in-depth knowledge by selecting and working with appropriate materials and components when developing their ideas, early models and producing their final prototype(s).	•	●	•	
6. Technical understanding						
TECHNICAL PRINCIPLES	a.	Apply technical principles appropriately to ensure functional requirements are achieved when developing a design solution.	•	•	•	
	b.	Be able to use surface treatments and finishes for functional and aesthetic purposes.	•	•	•	
7. Manufacturing processes and techniques						
D & M PRINCIPLES	a.	Be able to use specialist techniques and processes to shape, fabricate, construct and assemble at least one high quality prototype, including techniques such as wastage, addition, deforming and reforming, as appropriate to the materials and/or system components being used.	•	⬤	•	
	b.	Be able to use specialist tools and equipment, appropriate to the materials or system components used (including hand tools, machinery, digital design and manufacture), to create models and prototypes.	•	⬤	•	
	c.	Be able to use appropriate and accurate marking out methods including: measuring and use of reference points, lines and surfaces; use templates, jigs and/or patterns where appropriate; work within tolerances; understand efficient cutting and how to minimise waste.	•	⬤	•	
8. Viability of design solutions						
D & M PRINCIPLES	a.	Be able to test, critically analyse and evaluate their design solutions against the identified stakeholder requirements, design opportunities and constraints in order to refine and improve future iterations.	•	•	●	
	b.	Be able to make informed and reasoned decisions throughout the iterative design process, responding to feedback as appropriate to identify the potential next steps of further development.	•	•	●	
	c.	Be able to respond to feedback given by others about their prototype(s) in order to identify the potential for further development and suggest how modifications could be made through design optimisation.	•	●	●	

Further details on the requirements for undertaking the non-exam assessment (NEA) can be found in Section 3a.

Guidance on assessment of the NEA, including the marking criteria is outlined in Section 3f.

Administration requirements of the NEA are outlined in Section 4d.

Health and safety is not an assessment requirement of this qualification, however, there will always be a requirement of Health and Safety standards to be met in any workshop environment and the learners should be fully aware of relevant regulations and requirements.

Mathematical skills in the NEA

In order to support the mathematical skills that are required to be assessed in the examined assessment (NEA), there is an expectation within this specification that learners will continue to demonstrate appropriate mathematical skills. The application of these skills should not be used artificially, but used appropriately as opportunities arise, not only to demonstrate accuracy through practical skills, but also an ability to use mathematical skills to solve problems, support investigations and analyse findings. See Section 5c for further information.

Within the NEA the following skills could be drawn on:

- appropriate use of measurements using metric units to ensure accuracy and minimise waste
- calculations of material and component costs and quantities considering appropriate tolerances and resourcefulness
- utilising and interpreting appropriate data to support the development of design iterations
- use appropriate methods to present performance data, survey responses and information on design decision, including the use of frequency tables, graphs and bar charts
- accurate graphical communication to deliver design and manufacturing intentions to others.

2e. Prior knowledge, learning and progression

Learners in England who are beginning this GCSE (9–1) course are likely to have followed a Key Stage 3 programme of study in Design and Technology. Though no prior knowledge or understanding of the subject is required, earlier learning that considers progression to this qualification will greatly support learning at all levels.

GCSEs are qualifications that enable learners to progress to further qualifications, either vocational or general. This qualification provides the ideal foundation for learners to progress to either an OCR Cambridge Technical in Engineering, or to OCR AS or A Level Design and Technology with endorsed titles in Design Engineering, Fashion and Textiles or Product Design. The OCR Design and Technology qualifications have been designed specifically with this progression in mind, and to support the further progress in learning to degree level or equivalent.

There are links to mathematics and science content within this specification. Where this is to be assessed, the standard level will be equivalent to the learning that expected at the end of Key Stage 3.

Find out more at www.ocr.org.uk

3 Assessment of GCSE (9–1) in Design and Technology

3a. Forms of assessment

OCR's GCSE (9–1) in Design and Technology is a linear qualification with 50% external assessment by examination and 50% through non-exam assessment (NEA) internally assessed by the centre and externally moderated by OCR. Learners must take both components.

Principles of Design and Technology (01) written examination

This is a single examination component with questions covering both 'core' and 'in-depth' content. The component is externally assessed.

3

<table>
<tr><th colspan="2">Principles of Design and Technology</th></tr>
<tr>
<td>50% of GCSE (9–1)

2 hours

Drawn and written paper

100 marks

'Core' principles equate to approximately 60% and 'In-depth' principles equate to approximately 40% of the exam.</td>
<td>This paper covers the full extent of the examined content. The questions offer full access to all learners regardless of their practical experiences in the subject. When learners are required to demonstrate their 'in-depth' knowledge, understanding and skills, sufficient optionality will be offered to ensure each of main material categories and design engineering can all be accessed.

The paper is split into two sections.

Section A (55 marks)

This section of the paper consists of three sets of wider questions that predominantly require learners to demonstrate their 'core' knowledge, however, there may be some questions that rely on learners ability to drawn on their 'in-depth' toolkit of knowledge.

• Learners will be required to answer all questions.
• There will be a mixture of different levels of questions.
• There will be one extended response question.

Section B (45 marks)

This section of the paper will predominantly assess 'in-depth' knowledge. Learners will be able to choose a product within a situational context in order to demonstrate their deeper understanding of materials and/or systems and the developments and manufacture of prototypes and products in relation to their main area of learning.

• Learners will be required to answer all questions.
• There will be a mixture of different levels of questions.
• The questions will have a main focus on the in-depth knowledge within Sections 5, 6 and 7 of the exam content.
• There will be one extended response question.

A minimum of 15% of the paper will assess learners' mathematical skills as applied within a design and technology context.

Use of calculators is permitted in the written examination as outlined in Section 2c.</td>
</tr>
</table>

Iterative design challenge (02, 03) non-exam assessment (NEA)

The Iterative Design Challenge is a single task component, worth 100 marks and covering 50% of the qualification. The Iterative Design Challenge gives learners the opportunity to demonstrate their knowledge, understanding and skills over time in order to realise a valid outcome that reflects real-world design considerations. This component is internally assessed and externally moderated.

The content to be considered in the 'Iterative Design Challenge' is outlined in Section 2d.

Guidance on assessment, including the marking criteria is outlined in Section 3f.

Administration requirements for completing the NEA are outlined in Section 4d.

The following sub-headings give further clarity on the setting of the challenge, what is required by teachers and learners when the challenge is being taken and an outline of the required evidence to support learner's challenges for assessment.

Setting of the challenge

Contextual challenges will be released by OCR on 1 June in the year prior to which the learner wishes to be awarded the qualification. OCR will release three open-ended and real-world challenges at this time that are open for learners to interpret and respond to as they see fit. These challenges are not defined by the materials or processes used to make a prototype, learners are also not required to connect the challenge directly to their in-depth learning for the written examination.

A contextual challenge will need to be selected by the learner, offering an authentic starting point to explore and consider in relation to their subject interests and the problems and the opportunities they identify within the context(s).

Prior to undertaking the challenge, it is important that learners have experienced learning and practical activity that not only prepares them for demonstrating their ability to undertake an iterative challenge, but also to have confidence in their own decision-making when dealing with a given context, to avoid having pre-conceived ideas about desired outcomes. To complete a successful 'Iterative Design Challenge', it is expected that learners are able to fully explore a context and only narrow down their approach through an on-going iterative process of improvement and refinement.

The 'Iterative Design Challenge' must be selected from the contextual challenges set by OCR, however, it is expected that prior to selecting a contextual challenge the teacher and learner(s) may undertake general collaborative discussions and initial explorations to consider the broader possibilities that may exist. Once the chosen challenge has been selected by the learner, this constitutes the start of undertaking the challenge.

Learners will have approximately 40 hours in which to complete the whole 'Iterative Design Challenge'. This time allowance is for guidance only and does not constitute a maximum or minimum requirement, but it should be noted that excessive time spent on this component could be detrimental to the level of the learner's work if it were to lose relevance and focus to the context and brief.

Further guidance about the nature of advice can be found in the *JCQ Instructions for conducting non-examined assessment.*

Taking the challenge

The 'Iterative Design Challenge' requires learners to design and make a prototype(s) through iterations of exploring, creating and evaluating that constantly respond to stakeholder needs, wants and interests. This process should be followed and evidenced to demonstrate an accurate account of their progress.

Throughout the challenge it is essential that the teacher can authenticate that the learner's work is their own.

Developing a brief

Learners are required to write their own design brief as a response to their chosen contextual challenge set by OCR. Prior to writing a design brief, it is essential that a learner has fully explored the contextual challenge(s) they are considering. When exploring the contextual challenge(s), the following should be considered:

- that the learner may want to explore the contextual challenge outside of the centre
- when the opinions of others have been used, these must be recorded and acknowledged as part of their design process.

The design brief should outline the approach a learner has chosen to take to respond to the set challenge. Writing the design brief is an essential part of outlining how the learner will approach the 'Iterative Design Challenge'. To ensure it is delivered appropriately the following should be considered:

- all learners must develop a unique design brief that responds to their own interpretation of the chosen 'contextual challenge'
- learners should have prior awareness of their centre's facilities and resources to fully consider their own approach
- where a centre has had to offer additional support, the centre must ensure all learners have a unique design brief
- if changes need to be made to a learner's design brief, this must be fully justified by the learner in response to their iterative design process and remain true to their chosen 'contextual challenge'.

Outlining requirements

Learners are required to follow iterative design processes determined by the opportunities, requirements and problems they encounter. Whenever **stakeholder requirements** are identified that cover specific needs, wants and interests, they should be outlined and presented accordingly to support the thinking within the design process.

Generating initial ideas

There are various techniques and design approaches that can be taken to conceive initial ideas, but all ideas should be focused on responding to identified problems and requirements and offering innovative challenge. Designing starts from a position of many initial ideas, but a minimum of ten should be delivered appropriately within the design process. When initial ideas have been generated through interaction with others, leaners should:

- acknowledge who generated the idea and when
- use ideas generated by others only when supported by a reflection of why they are considered appropriate.

Design developments

When developing designs, the focus is on narrowing down and improving ideas through more detailed iterations that give deeper consideration to resolving identified requirements technically and conceptually.

It is likely that technical and design problems may be identified, some of which may be seen as mistakes. Recognising and solving these issues through the demonstration of thought processes and practical activity should be clearly evidenced.

Design developments are assessed through the level of detail offered and quality and range of skills used to find suitable solutions, therefore the quantity of developments is very much dependent on this level of thinking. Two design developments should always be considered a minimum regardless of the quality of the outcome.

Developing a final design solution

When developing a design solution to be made into a final prototype(s), learners should consider the solution as it would look and function if sold as a product. This should include experimentation of processes and techniques through modelling and testing.

Digital design and manufacture **must** be used either throughout the development of the final design solution or when making the final prototype(s).

Delivering technical specification

Learners are required to justify and present their final design solution through **technical specification** that deliver specific written and graphical information to outline how the final design solution meets the stakeholder requirements and will support accurate production. The specification should offer justification and a suitable level of information so that a third party would know exactly what the final prototype(s) should look like.

3

Producing a final prototype

When learners are producing their final prototype(s) this must be completed under the required level of **guidance and supervision** within the centre (see opposite). This is to ensure that each learner is witnessed producing their own outcome(s) so it can be authenticated and the learner's safety can be assured.

It is possible that the most suitable materials or machinery are not available in the centre's workshop. It is permissible to use the most suitable alternative in order to clearly demonstrate the intentions of the final prototype(s) and to deliver high quality outcomes.

Analysing validity of the final prototype

In order to make an appropriate evaluation of the final prototype(s), analysing stakeholders' opinions will be required. This should be sought from meaningful sources rather than superficially within the teaching group. It may be necessary to analyse the final prototype(s) in the situation it is designed for. If taking this approach centres **must** ensure that:

- the required photographic and/or video evidence **must** be taken prior to the prototype(s) being taken from the centre to ensure a valid assessment can be made should anything happen to the prototypes(s) whilst out of the centre.

Guidance and supervision requirements

Authenticating the making of the learner's final prototype(s) is of great importance as this is the only activity that cannot be fully recorded in the design process.

It is expected that the production of the final prototype(s) will take place during normal lesson time, using workshop and IT facilities as appropriate. Learners must be under direct teacher and/or technician supervision during this time. They must complete all of their work under these supervised conditions and the teacher must set the tone for this element of the NEA.

To make best use of supervised time, it is important that learners are prepared for and plan their activity in advance. It is also important for learners to write a report of their progress through the making process to evidence the on-going activity in their portfolio. The writing of this report does not need to be under direct supervision.

Another reason for this supervised activity is so that the teacher can authenticate the level of guidance and support given through the making of the learner's final prototype(s). Any support that is given to assist a learner during production should be recorded by the supervisor concerned, whether it is direct assistance or due to health and safety requirements in the centre. The level of assistance given should be reflected in the assessment of the learner's NEA.

All practical work should be securely stored in the centre throughout the design and make process and distributed to the learner at the start of any supervised time. If for any reason practical work needs to be taken outside of the normal workshop or IT facilities before it is fully complete, the learner and final prototype(s) should at all times be accompanied by a member of centre staff and this activity should be relevant to the design process and explained in the learner's portfolio.

Learners should not have access to their work between supervised sessions or once the NEA has been submitted for assessment. It should be securely retained within the centre until results are issued and it is certain that no Result Enquiry or Appeal procedure is required.

Teacher marking and feedback

Although the 'Iterative Design Challenge' is to be assessed internally once the project has been submitted, there may be requirements in some centres for learners to receive feedback and/or grades to inform them of their progress. Therefore, it is important to consider what is acceptable.

Teachers can only give generic feedback on learners' work in progress and return it for re-drafting. Once handed in for final assessment, teachers may not return any work to learners for further adjustment. Any feedback given by the teacher must be framed in such a way as to enable the learner to take the initiative in developing their own work further.

Teachers cannot give detailed advice and specific suggestions as to how the work may be improved in order to meet the marking criteria. This includes indicating errors or omissions and personally intervening to improve the content of the work.

Teachers must reflect any assistance given throughout the 'Iterative Design Challenge' when marking learners' work. Provided that advice remains at a general level, this does not constitute intervention.

Both the teacher and learner will be required to confirm the authentication of the learners' work using the Candidate Declaration Form as outlined in Section 4d.

Required evidence

There are **three** forms of evidence required to support the authentication of learners' work and enable the consideration of each learner's level of attainment against the marking criteria, which is set out to differentiate between each learner's performance.

Portfolio of evidence

Learners should produce a chronological portfolio (refer to Section 4d) supported by real-time evidence that demonstrates their complete challenge. This evidence should clearly demonstrate the learner's design brief written in response to their chosen contextual challenge set by OCR. It should also be in the order each activity is undertaken, outlining iterations as they occur or are developed rather than as they may be best presented.

Portfolio evidence can be supported by different digital files (see Section 5f), photographs, video and audio recordings. All evidence must be contained in a single digital folder for each learner, clearly labelled and signposted by the learner to indicate when evidence was completed and to ensure everything is easily identifiable through both internal marking and external moderation. A clear list of content will help to support this.

Final Prototype

The final prototype(s) based on the learner's design brief must be clearly evidenced by the learner in their portfolio through the use of photography and video. All moving parts and perspectives should be appropriately visible to ensure it offers suitable evidence to any third party, enabling accurate assessment without the artefact being present.

The final prototype(s) must be kept securely in the centre during production. Photographs and videos should be taken as soon as production is complete to ensure all evidence is captured before any risk of damage or loss.

Observations

Teachers are the most appropriate individuals to evidence a learner's progress and the level of support given or independence demonstrated. Evidence of this nature can only be accepted in conjunction with the portfolio and final prototype(s).

Observed evidence is supporting evidence that should be recorded on the 'Candidate Record Form' and should reflect the wider evidence and support the internal marking.

Authenticity

Learners must clearly and unambiguously indicate and acknowledge work in their portfolio which is not their own and distinguish it from their own. Only the work of the learner, which can include managing the input from other sources, must be assessed. This should also be acknowledged on their Candidate Declaration Form.

3

3b. Assessment objectives (AO)

There are four Assessment Objectives in the OCR GCSE (9–1) in Design and Technology. These are detailed in the table below.

Learners are expected to demonstrate their ability to:

<table>
<tr><th colspan="2">Assessment Objective</th></tr>
<tr><td>AO1</td><td>Identify, investigate and outline design possibilities to address needs and wants</td></tr>
<tr><td>AO2</td><td>Design and make prototypes that are fit for purpose</td></tr>
<tr><td>AO3</td><td>Analyse and evaluate –
• design decisions and outcomes, including for prototypes made by themselves and others
• wider issues in design and technology</td></tr>
<tr><td>AO4</td><td>Demonstrate and apply knowledge and understanding of –
• technical principles
• designing and making principles</td></tr>
</table>

The assessment objective relate directly to iterative processes of 'explore/create/evaluate' as follows:
AO1 = Explore, AO2 = Create, AO3 = Evaluate.

AO weightings in OCR GCSE (9–1) Design and Technology

The relationship between the Assessment Objectives and the components are shown in the following table:

<table>
<tr><th rowspan="2">Component</th><th colspan="4">% of overall GCSE (9–1) in Design and Technology (J310)</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>AO4</th></tr>
<tr><td>Principles of Design and Technology (J310/01)</td><td>0</td><td>0</td><td>10</td><td>40</td></tr>
<tr><td>Iterative Design Challenge (J310/02 or 03)</td><td>10</td><td>30</td><td>10</td><td>0</td></tr>
<tr><td>Total</td><td>10%</td><td>30%</td><td>20%</td><td>40%</td></tr>
</table>

3c. Total qualification time

Total qualification time (TQT) is the total amount of time, in hours, expected to be spent by a learner to achieve a qualification. It includes both guided learning hours and hours spent in preparation, study, and assessment. The total qualification time for GCSE (9-1) in Design and Technology is 140 hours. The total guided learning time is 120-140 hours.

3d. Qualification availability outside of England

This qualification is available in England. For Wales and Northern Ireland please check the Qualifications in Wales Portal (QIW) or the Northern Ireland Department of Education Performance Measures / Northern Ireland Entitlement Framework Qualifications Accreditation Number (NIEFQAN) list to see current availability.

3e. Language

This qualification is available in English only. All assessment materials are available in English only and all candidate work must be in English.

3f. Assessment availability

There will be one examination series available each year in May/June to **all** learners.

The examined component must be taken in the same examination series as the non-exam assessment.

This specification will be certificated from the June 2019 examination series onwards.

3g. Retaking the qualification

Learners can retake the qualification as many times as they wish. Learners must retake all examined components but they can choose to either retake the non-exam assessment (NEA) or carry forward (re-use) their most recent result (see Section 4a).

3h. Assessment of extended response

The assessment materials for this qualification provide learners with the opportunity to demonstrate their ability to construct and develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. Marks for extended responses are integrated into the marking schemes.

3i. Internal assessment of non-exam assessment (NEA)

There are different stages in the production of the non-exam assessment (NEA), the task setting, task taking and required evidence are outlined in Section 3a, this section outlines the marking and final submission of the centre's entries.

3

Internal assessment

Marking should be positive, rewarding achievement rather than penalising failure or omissions. The awarding of marks must be directly related to the marking criteria.

Teachers should use their professional judgement in selecting the band descriptors that best describes the work of the learner to place them in the appropriate band.

Teachers should use the full range of marks available to them and award all the marks in any mark band for which work fully meets that descriptor.

To select the most appropriate mark in the band descriptor, teachers should use the following guidance to locate the best-fit:

- where the learner's work *convincingly* meets the statement, the highest mark should be awarded
- where the learner's work a*dequately* meets the statement, the most appropriate mark in the middle of the range should be awarded
- where the learner's work *just* meets the statement, the lowest mark should be awarded.

The statements in each mark band are balanced in terms of their significance to help assessors judge the overall 'best-fit' within an assessment strand.

There should be clear evidence that work has been attempted and some work produced. If a learner submits no work for a component then the learner should be indicated as being absent from that component. If a learner completes any work at all for the component then the work should be assessed according to the marking criteria and the appropriate mark awarded, which may be zero.

As learners can deliver their e-portfolios using a variety of formats, there are no specific limits to the amount of evidence produced, however, any iterative design process should remain relevant to the contextual challenge. A guide here would be the equivalent of 24 A3 pages, but this is not a restriction so long as communication is relevant and concise.

It is essential that marking fully reviews and considers all material. It is the learner's responsibility to ensure all files function properly. If files do not open or function properly, this work cannot be considered in evidence.

Teachers must clearly show how the marks have been awarded in relation to the marking criteria on the Candidate Record Form.

The following approaches to indicate how marks have been awarded should be adopted:

- be clear and unambiguous
- be appropriate to the aims and objectives of the work
- facilitate the standardisation of marking in the centre
- enable the moderator to check the application of the marking criteria to the marking.

There are 'Candidate Record Forms' for individual learners that can be found on the qualification page on the OCR website.

Final submission

Work submitted for the GCSE level components should reflect the standard expected for a learner after a full GCSE (9−1) level course of study.

Centres must carry out internal standardisation to make sure that marks awarded by different teachers are accurate and consistent across all learners entered by the centre. To help set the standard of marking, centres should use exemplar material provided by OCR, and, where available, work from that centre from the previous year. Where work has been marked by more than one teacher in a centre, standardisation of marking should normally be carried out according to one of the following procedures:

- **either** a sample of work that has been marked by each teacher is re-marked by the teacher who is in charge of internal standardisation
- **or** all the teachers responsible for marking a component exchange some marked work (preferably at a meeting led by the teacher in charge of internal standardisation) and compare their marking standards.

Where standards are found to be inconsistent, the relevant teacher(s) should make an adjustment to their marks or re-mark all learners' work for which they were responsible.

If centres are working together in a consortium they must carry out internal standardisation of marking across the consortium. Centres should retain evidence that internal standardisation has been carried out.

Once the final portfolio is submitted by the learner for assessment it must not be revised. Adding any material to the work or removing any material from it after it has been presented by a learner for final assessment would constitute malpractice. If a learner requires additional assistance in order to demonstrate aspects of the assessment, the teacher must submit a mark which represents the learner's unaided achievement.

Where the learner's evidence of their final prototype(s) is insufficient to demonstrate the marks that have been submitted by the centre, it is permitted for additional photography and/or video evidence to be taken to support the marking. This evidence should remain separate from the learner's work.

Each learner's work should be stored in a folder on a secure area on the centre's network, or if completed on paper, in a secure location. Prior to submitting the work to OCR, the centre should add the 'Candidate Record Form'.

For further guidance on portfolios and how to submit work refer to Section 4d. Work should be saved using the candidate's name and centre name as reference.

Exams directory: www.ocr.org.uk

Iterative Design Challenge (02, 03) – Marking criteria

The marking criteria are set out over the following pages to outline how learners are to be assessed following completion of their own iterative design process that reflects their thinking, creative and practical skills and abilities through designing and making a prototype(s).

The marking criteria covers four mark bands to clearly differentiate learners' work and are delivered through five strands of assessment, rewarding two distinct considerations:

- the thinking and design **process** of the 'Iterative Design Challenge' through explore/create/ evaluate is assessed in strands 1, 2 and 5
- the quality of design **outcomes** in relation to design communication and the final prototype(s) are assessed in strands 3 and 4.

These are outlined in more detail below.

The marking criteria follow a 'best-fit' approach as outlined in more detail earlier in this section. The layout of the assessment strands is to support internal application of the criteria, using the statements and marks at the bottom of each strand to support 'best-fit' allocation.

The marking criteria for the 'Iterative Design Challenge' should be considered together with the non-exam assessment content (NEA) in Section 2d to ensure appropriate coverage of content.

Guidance on the delivery and required evidence for the 'Iterative Design Challenge' are set out in Section 3a.

When completing internal assessment, the marking criteria should be considered together with the administrative requirements of the NEA in Section 4d.

Assessment of process

The three process strands (1, 2 and 5) of the marking criteria follow an iterative design process with strands that cover 'explore', 'create' and 'evaluate'. Effective management of the interrelationship between the strands of the iterative design process is also assessed within these strands.

The assessment of 'process' is the process that each individual learner has undertaken. The evidence of the process will be given through the learner's chronological e-portfolio.

Assessment of outcomes

The two outcome strands (3 and 4) of the marking criteria are an opportunity for assessment of the graphical and practical outcomes delivered throughout the learner's design processes. This is the assessor's judgement of:

- the quality of design communication
- the quality of the final prototype(s).

The assessment of 'outcomes' can only be made against what is evidenced in the learner's chronological e-portfolio.

Further guidance on the collection and presentation of evidence can be found earlier in this section, in Section 3a and Section 4d.

Strand 1 – Explore (AO1)

	Mark Band 1 (1–5)	Mark Band 2 (6–10)	Mark Band 3 (11–15)	Mark Band 4 (16–20)
Investigations of the context	Superficial investigations indentify little or no problems and/or opportunities for further consideration.	Investigations are of sufficient quality to indentify some problems and/or opportunities for further consideration.	Investigations offer a good level of detail and indentify a breadth of problems and opportunities for further consideration.	Comprehensive investigations indentify a breadth of challenging problems and opportunities for further consideration.
Design brief	Limited relevance to the context and little or no identification of a primary user or other stakeholders.	Some relevance to the context and identification of a primary user and/or other stakeholders.	Mostly has relevance to the context offering scope for challenge and identification of a primary user and other stakeholders.	Clear and full relevance to the context offering scope for challenge and a focused identification of a primary user and other stakeholders.
Investigations of user and stakeholder needs and wants and the outlining of stakeholder requirements (non-technical specification)	Superficial consideration of primary user(s) needs and wants with little or no consideration of other stake-holders. Little or no requirements have been identified and are outlined with limited scope to support the future design process.	Some relevant consideration of primary user(s) needs and wants and some consideration of other stakeholders. Some requirements are identified that offer some scope to support the design process.	Informed consideration of primary user and other stakeholders needs and wants. A range of requirements with a good level of detail are identified that offer scope to support the design process.	Full and objective consideration of primary user and other stakeholders needs and wants. A range of comprehensive requirements are identified that offer scope to support the design process.
Investigations of existing products and design practices	Little or no information or sources of inspiration are identified to offer support to design iterations and thinking.	Some information and/or sources of inspiration are idenfified that may not always be relevant but do offer some influence on design iterations and thinking.	Good amount of relevant information and sources of inspiration are identified to influence design iterations and thinking when required throughout the design process.	Comprehensive and relevant information and sources of inspiration are identified to influence on design iterations and thinking when required throughout the design process.
Exploration of materials and possible technical requirements	Superficial consideration of materials and/or possible technical requirements.	Some relevant consideration of materials and possible technical requirements.	Informed consideration of materials and possible technical requirements when required throughout the design process.	Full and objective consideration of materials and possible technical requirements when required throughout the design process.
Technical specification	Inaccurate, outlines basic details and/or is incomplete making it difficult for a third party to understand.	Generally accurate, outlines details that communicate some requirements to a third party.	Good levels of accuracy, outlines details that communicate most requirements to a third party.	High levels of accuracy, outlines details that clearly communicate all requirements to a third party.
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20

0 marks – No response or no response worthy of credit

Strand 2 – Create: Design Thinking (AO2)

	Mark Band 1 (1–6)	Mark Band 2 (7–12)	Mark Band 3 (13–18)	Mark Band 4 (19–24)
Generation of initial ideas	Limited use of different design approaches that lead to ideas that do not always reflect the requirements and may appear stereotypical.	Some different design approaches that lead to some ideas that avoid design fixation and generally reflect the requirements.	Different and relevant design approaches that lead to ideas that mostly avoid design fixation, offer scope for challenge and reflect requirements.	Different and relevant design approaches that lead to ideas that fully avoid design fixation, offer scope for challenge and fully reflect requirements.
Design developments	Limited developments are superficial and/or are not iterative.	Iterative developments are generally progressive and respond to some identified next-steps of development.	Iterative developments are progressive, incorporating technical requirements and respond to most identified next-steps of development.	Iterative developments are comprehensive and progressive, incorporating all technical requirements and fully respond to identified next-steps of development.
Development of final design solution(s)	Little or no progression seen from earlier developments and little or none of the identified opportuntites and requirements have been met.	Some progression seen from earlier developments and some of the identified opportunities and requirements have been met.	Clear progression from earlier developments and most of the identified opportunities and requirements have been met.	Clear and comprehensive progression from earlier developments and all of the identified opportunities and requirements have been met.
Critical thinking	Superficial responses when problems are identified. Little or no evidence of innovation* throughout the design process.	Effective responses to some identified problems. Some evidence of innovation* throughout the design process.	Effective responses to most identified problems. Clear evidence of innovation* throughout the design process.	Systematic and effective responses to all identified problems. Clear and systematic evidence of innovation* throughout the design process.
	1 2 3 4 5 6	7 8 9 10 11 12	13 14 15 16 17 18	19 20 21 22 23 24

0 marks – No response or no response worthy of credit

* Innovation in this context refers to learners considering new methods or ideas to improve and refine their design solutions and meet the needs of their intended market and/or primary user.

Strand 3 – Create: Design Communication (AO2)

	Mark Band 1 (1–4)	Mark Band 2 (5–8)	Mark Band 3 (9–12)	Mark Band 4 (13–16)
Quality of chronological progression	Design iterations are not always clear and/or chronological, with little or no support from real-time evidence.	Design iterations are sometimes clear and predominantly chronological, some support from real-time evidence.	Design iterations are clear and chronological, mostly supported by real-time evidence.	Design iterations are systematic and chronological, fully supported by real-time evidence.
Quality of initial ideas	Informal graphical and modelling skills are limited and rarely clear enough to appropriately communicate initial thinking.	Informal graphical and modelling skills are sufficient, but are not consistent in appropriately communicating initial thinking.	Informal graphical and modelling skills are good and are consistent in appropriately communicating initial thinking.	Informal graphical and modelling skills are excellent and are effective and consistent in appropriately communicating initial thinking.
Quality of design developments	The range of communication techniques* used are limited and rarely clear enough to appropriately develop or communicate design concepts.	The range of communication techniques* used are sufficient, but are not consistent in appropriately developing or communicating design concepts.	The range of communication techniques* used are good and are consistent in appropriately developing or communicating design concepts.	The range of communication techniques* used are excellent and are effective and consistent in appropriately developing or communicating design concepts.
Quality of final design solution(s)	Formal presentation of the final design solution(s) is limited making it difficult for a third party to understand.	Formal presentation of the final design solution(s) is sufficient and provides some clarity to a third party.	Formal presentation of the final design solution(s) is good and provides appropriate clarity to a third party.	Formal presentation of the final design solution(s) is excellent and provides impact and appropriate clarity to a third party.
	1 2 3 4	5 6 7 8	9 10 11 12	13 14 15 16

0 marks – No response or no response worthy of credit

* Refer to Strand 4 when assessing digital design and manufacture.

Strand 4 – Create: Final Prototype(s) (AO2)

	Mark Band 1 (1–5)	Mark Band 2 (6–10)	Mark Band 3 (11–15)	Mark Band 4 (16–20)
Quality of planning for making the final prototype(s)	Offers little or no support to the making process.	Generally supports the management of the making process with some relevant requirements identified from the technical specification.	Good level of detail and relevance, covering most requirements identified from the technical specification to manage the making process.	Comprehensive and relevant, covering all requirements identified from the technical specification to effectively manage the making process.
Quality of final prototype(s)	Inaccurate and/or basic standards demonstrated. Finishing may not be appropriate and/or the outcome would not present well to a stakeholder.	Sufficient standard demonstrated through a generally accurate outcome. Finishing is appropriate but the outcome could be better presented to stakeholders.	Good standard and levels of accuracy demonstrated. Finishing is appropriate and the outcome will present well to a stakeholder.	Excellent standard, demonstrating high levels of accuracy. Finishing is appropriate and the outcome will present well and provide impact to a stakeholder.
Use of specialist techniques and processes	Limited and rarely appropriate to materials/components being used.	Sufficient, but are not consistently appropriate to materials/ components being used.	Good and are consistently appropriate to materials/ components being used.	Excellent and are effective and consistently appropriate to materials/components being used.
Use of specialist tools and equipment	Use and selection of hand tools and/or machinery are limited and rarely appropriate. Digital design and/or manufacture* is limited and demonstrate little or no skills or knowledge.	Use and selection of hand tools and machinery are sufficient, but not always consistently appropriate. Digital design and manufacture* is not always used appropriately, but demonstrate sufficient skills and knowledge.	Use and selection of hand tools and machinery are good and consistently appropriate. Digital design and manufacture* are used appropriately to demonstrate good skills and knowledge.	Use and selection of hand tools and machinery are effective and consistently appropriate. Digital design and manufacture* are used effectively and appropriately to demonstrate excellent skills and knowledge.
Viability of the final prototype(s)	Little or no links to the technical specification and demonstrating limited potential to become a marketable product.	Meets some of the technical specification and demonstrating some potential to become a marketable product.	Meets most of the technical specification and demonstrating good potential to become a marketable product.	Meets all of the technical specification and demonstrating excellent potential to become a marketable product.
	1 2 3 4 5	**6 7 8 9 10**	**11 12 13 14 15**	**16 17 18 19 20**

0 marks – No response or no response worthy of credit

***It may not have been appropriate to use digital design and manufacture in the final prototype. Where this is the case, the statement should be assessed on the skill levels demonstrated when using digital design and manufacture through earlier modelling. This can equally be applied to the use of hand tools and machinary, all of which require appropriate evidence.

Strand 5 – Evaluate (AO3)

	Mark Band 1 (1–5)	Mark Band 2 (6–10)	Mark Band 3 (11–15)	Mark Band 4 (16–20)
Analysis and evaluation of primary and/or secondary sources	Limited analysis and evaluation of investigated sources of information from stakeholders, existing products and/or wider issues, offering little or no support to inform the design process.	Sufficient analysis and evaluation of investigated sources of information from stakeholders, existing products and wider issues, offering some support to inform the design process.	Good level of analysis and evaluation of investigated sources of information from stakeholders, existing products and wider issues, offering clear support to inform the design process.	Comprehensive and systematic analysis and evaluation of investigated sources of information from stakeholders, existing products and wider issues, offering clear and focused support to inform the design process.
Ongoing evaluation to manage design progression	Superficial evaluations with little or no reflection on requirements or feedback. Little or no reviews to identify any problems and/or next-steps for future iterations resulting in limited support to design progression.	Some critical evaluations with sufficient reflection on requirements and feedback. Infrequent reviews to identify some problems and/or next-steps for future iterations that are not always consistent in supporting design progression.	Mostly critical evaluations with good reflection on requirements and feedback. Ongoing and clear reviews to identify problems and next-steps for future iterations to consistently support design progression.	Full and critical evaluations with focused reflection on requirements and feedback. Ongoing, clear and comprehensive reviews to identify problems and next-steps for future iterations to effectively and consistently support design progression.
Feasibility of the design solution	Limited with little or no methods used to appropriately analyse and test whether the design solution is fit for purpose.	Sufficient with some appropriate methods used to analyse and test whether the design solution is fit for purpose.	Good level of detail with mostly appropriate methods used to analyse and test whether the design solution is fit for purpose.	Comprehensive with fully appropriate methods used to analyse and test whether the design solution is fit for purpose.
Evaluation of the final prototype(s)	Superficial evaluation of strengths and/or weaknesses with little or no suggestions for modification and/or consideration of possible design optimisation presented.	Sufficient critical evaluation of strengths and/or weaknesses with some suggestions for modification and/or consideration of possible design optimisation presented.	Good critical evaluation of strengths and weaknesses with detailed suggestions for modification and consideration of possible design optimisation presented.	Full and critical evaluation of strengths and weaknesses with comprehensive suggestions for modification and consideration of possible design optimisation presented.
	1 2 3 4 5	6 7 8 9 10	11 12 13 14 15	16 17 18 19 20

0 marks – No response or no response worthy of credit

Iterative Design Challenge (02) – Assessment Objective distribution

The table below demonstrates how the Assessment Objectives are attributed to each strand of the marking criteria and where evidence of mathematics is assessed implicitly.

Strand of Marking Criteria	% of overall Iterative Design Challenge			Total % per strand	Use of Maths Skills
	AO1	AO2	AO3		
Explore	20	0	0	20	✓
Create – Design Thinking	0	24	0	24	✓
Create – Design Communication	0	16	0	16	✓
Create – Final prototype(s)	0	20	0	20	✓
Evaluate	0	0	20	20	✓
Total	**20%**	**60%**	**20%**	**100%**	

3j. Synoptic assessment

Synoptic assessment is the learners' understanding of the connections between different elements of the subject. It involves the explicit drawing together of knowledge, skills and understanding from across the GCSE (9–1) course.

The emphasis of synoptic assessment is to encourage the understanding of Design and Technology as a whole discipline.

Synoptic assessment requires learners to make and use connections within and between all different areas of Design and Technology, for example, by:

- understanding how an iterative design process requires multiple considerations not only to 'explore/create/evaluate', but also through the application of knowledge and understanding of both 'core' and 'in-depth' designing, making and technical principles
- justifying thinking in relation to an iterative design process through the consideration of, say, the forces exerted on a joint or seam and what impact that has on the materials being used to demonstrate that it is effectively fulfilling its requirements, or the identification of stakeholder needs and fulfilling these needs through the delivery of a design solution
- stretching design challenges to not only demonstrate application of knowledge and understanding of design and technical principles, but also through the application of wider mathematical and scientific knowledge
- both components in this qualification contain an element of synoptic assessment demonstrating the links between knowledge and practical experiences.

3k. Calculating qualification results

A learner's overall qualification grade for the OCR GCSE (9–1) in Design and Technology will be calculated by adding together their marks from the two components taken to give their total weighted mark.

This mark will then be compared to the qualification level grade boundaries for the entry option taken by the learner and for the relevant exam series to determine the learner's overall qualification grade.

4 Admin: what you need to know

The information in this section is designed to give an overview of the processes involved in administering this qualification so that you can speak to your exams officer. All of the following processes require you to submit something to OCR by a specific deadline.

More information about the processes and deadlines involved at each stage of the assessment cycle can be found in the Administration area of the OCR website. OCR's *Admin overview* is available on the OCR website at http://www.ocr.org.uk/administration.

4a. Pre-assessment

Estimated entries

Estimated entries are your best projection of the number of learners who will be entered for a qualification in a particular series. Estimated entries should be submitted to OCR by the specified deadline. They are free and do not commit your centre in any way.

Final entries

4

Final entries provide OCR with detailed data for each learner, showing each assessment to be taken. It is essential that you use the correct entry code, considering the relevant entry rules and ensuring that you choose the entry option for the moderation you intend to use.

Final entries must be submitted to OCR by the published deadlines or late entry fees will apply.

All learners taking a GCSE (9–1) in Design and Technology must be entered for one of the following entry options:

Entry option		Components		
Entry code	**Title**	**Code**	**Title**	**Assessment type**
J310 A	Design and Technology A	01	Principles of Design and Technology	External assessment
		02	Iterative Design Challenge (Moderated upload)	Non-exam assessment
J310 B	Design and Technology B	01	Principles of Design and Technology	External assessment
		03	Iterative Design Challenge (Moderated postal)	Non-exam assessment
J310 C	Design and Technology C*	01	Principles of Design and Technology	External assessment
		80	Iterative Design Challenge (Carried Forward)	Non-exam assessment

*Entry option J310 C should only be selected for learners who are retaking the qualification who want to carry forward their mark for the non-exam assessment.

Collecting evidence of student performance to ensure resilience in the qualifications system

Regulators have published guidance on collecting evidence of student performance as part of long-term contingency arrangements to improve the resilience of the qualifications system. You should review and consider this guidance when delivering this qualification to students at your centre.

For more detailed information on collecting evidence of student performance please visit our website at: https://www.ocr.org.uk/administration/general-qualifications/assessment/.

4b. Special consideration

Special consideration is a post-assessment adjustment to marks or grades to reflect temporary injury, illness or other indisposition at the time the assessment was taken.

Detailed information about eligibility for special consideration can be found in the JCQ publication; *A guide to the special consideration process*.

Regulations governing examination arrangements are contained in the JCQ *Instructions for conducting examinations.*

4c. External assessment arrangements

Regulations governing examination arrangements are contained in the JCQ *Instructions for conducting examinations*.

4

4d. Admin of non-exam assessment

Regulations governing arrangements for internal assessments are contained in the JCQ *Instructions for conducting non-examination assessments*.

The contextual challenges that are set by OCR annually for this qualification will be posted on the subject page of the OCR website on the 1 June every year, from June 2018, for those learners that are entering for certification the following summer. The contextual challenges will not be posted to centres.

It should be made clear to learners that once the final e-portfolios have been submitted for assessment, no further work may take place.

Interpretation of 'challenge' tasks

The interpretation of any of the contextual challenges set by OCR forms an essential part of the learner's non-exam assessment. Prior teaching and learning should ensure learners know how to respond to a variety of contexts set in different ways. Learners should also be aware of how to modify their approach appropriately through an iterative design process, evidencing changes in the direction of a task is required.

Further information on task setting can be found in Section 3a.

Authentication of learners' work

Centres must declare that the work submitted for assessment is the learner's own by completing a centre authentication form (CCS160) for the NEA. This information must be retained at the centre and be available on request to either OCR or the JCQ centre inspection service. It must be kept until the deadline has passed for centres to request a review of results. Once this deadline has passed and centres have not requested a review, this evidence can be destroyed.

A copy of the Candidate Declaration Form, which forms part of the submission for each learner's work can be found on the OCR website www.ocr.org.uk. It is important to note that **all** learners are required to sign and complete this form, and not merely those whose work forms part of the sample submitted to the moderator.

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

Before any work towards the non-exam assessment is undertaken, the learner's attention should be drawn to the relevant JCQ *Notice to Learners*. This is available on the JCQ website www.jcq.org.uk and included in the *Instructions for Conducting Coursework/Portfolios*. More detailed guidance on the prevention of plagiarism is given in the *Plagiarism in Examinations.*

Learners' level of ability and each individual's work should be clearly identifiable and be taken under conditions which ensure that the evidence generated by each learner can be authenticated.

Investigations, explorations and design thinking can take place outside the centre as well as within the centre. Teachers need to ensure that the any work of this nature is only used to support the narrative of the NEA. Design work can be completed outside of the centre, but the centre must ensure that they have observed enough evidence to be able to confidently authenticate it as the learner's own work.

When learners are producing their final prototype(s) this is required to be made under direct guidance or supervision to ensure authenticity (refer to Section 3a for requirements for guidance and supervision). The work should be securely stored within the centre throughout this part of the design and make process. This is outlined in more detail in Section 3a.

Head of centre annual declaration

The Head of Centre is required to provide a declaration to the JCQ as part of the annual NCN update, conducted in the autumn term, to confirm that all candidates at the centre have had the opportunity to undertake the prescribed activities for this course.

Please see the JCQ publication *Instructions for conducting non-examination assessments* for further information. Any failure by a centre to provide the Head of Centre Annual Declaration will result in your centre status being suspended and could lead to the withdrawal of our approval for you to operate as a centre.

Private candidates

Private candidates may enter for OCR assessments.

A private candidate is someone who pursues a course of study independently but takes an examination or assessment at an approved examination centre. A private candidate may be a part-time student, someone taking a distance learning course, or someone being tutored privately. They must be based in the UK.

OCR's GCSE in Design and Technology requires learners to complete non-examined assessment. This is an essential part of the course and will allow learners to develop skills for further study or employment.

Private candidates need to contact OCR approved centres to establish whether they are prepared to host them as a private candidate. The centre may charge for this facility and OCR recommends that the arrangement is made early in the course.

Further guidance for private candidates may be found on the OCR website: http://www.ocr.org.uk

Internal standardisation

Centres must carry out internal standardisation to ensure that marks awarded by different teachers are accurate and consistent across all learners entered for the component from that centre. This process is outlined further in Section 3f under 'Final Submission'.

Moderation

The purpose of moderation is to bring the marking of internally-assessed components in all participating centres to an agreed standard. This is achieved by checking a sample of each centre's marking of learner's work.

Following internal standardisation, centres submit marks to OCR and the moderator. If there are fewer than 10 learners, all the work should be submitted for moderation at the same time as marks are submitted.

Once marks have been submitted to OCR and your moderator, centres will receive a moderation sample request. Samples will include work from across the range of attainment of the learners' work.

There are two ways to submit a sample:

Moderated upload – Where you upload electronic copies of the work included in the sample via our Submit for Assessment service and your moderator accesses the work from there.

Moderated postal – Is where you post the sample of work to the moderator.

The method that will be used to submit the moderation sample must be specified when making entries. The relevant entry codes are given in Section 4a.

All learners' work must be submitted using the same entry option. It is not possible for centres to offer both options within the same series.

Centres will receive the outcome of moderation when the provisional results are issued. This will include:

Moderation Adjustments Report – Listing any scaling that has been applied to internally assessed components.

Moderator Report to Centres – The external moderator feeds back on the delivery and accuracy of a centres internal assessment of their learners' work.

Preparing work for submission

Centres will be informed by OCR of the sample they are required to submit. Centres are responsible for the storage of learners' folders within a secure folder on their centre network, or if completed on paper, in a secure location.

Within each learner's folder from the sample being submitted, the following forms must be included:

1. Candidate Declaration Form
2. Candidate Record Form (CRF1).

The Candidate Record Form is used to mark learners' work with supporting evidence. This will offer centres an opportunity to share observations and evidence locations to justify how they have arrived at the mark that was given and to add additional evidence of prototype(s) if the learners' evidence is not sufficient in demonstrating the marks awarded.

All forms for submission are available to download on the subject page on the OCR website.

E-Portfolios

In order to minimise software and hardware compatibility issues it will be necessary to save learners' work using an appropriate file formats.

Learners must use formats appropriate to the evidence they are providing and appropriate to viewing for assessment and moderation purposes.

Open file formats or proprietary formats for which a downloadable reader or player is available are acceptable. Where a downloadable version is not available, the file format is not acceptable.

Evidence submitted can be through one or more formats, but it is essential that all formats are clearly labelled and signposted to offer a straightforward chronological review of the work.

Learners do not gain marks for using more sophisticated formats or for using a range of formats. All portfolio evidence should be appropriate to the actual activity being pursued. So long as evidence is clearly 'real-time' a learner who chooses to use or only has access to digital photography (as required in the specification) and word documents will not be disadvantaged by that choice.

To ensure compatibility, all files submitted must be in the formats listed in Appendix 5f. Where new formats become available that might be accepted, OCR will provide further guidance on the subject webpage. OCR advises against changing the file format that the document was originally created in. It is the centre's responsibility to ensure that the electronic work submitted for moderation are accessible to the moderator and fully represent the evidence available for each learner.

E-portfolios can be submitted through either via moderated upload (J310/02) or on a USB memory stick or DVD through moderated postal (J310/03).

Paper portfolios

Although OCR have a preference for learners to produce e-portfolios, hard copy paper portfolios are acceptable through the moderated postal option (J310/03). When submitting paper folders, all material should be securely bound together in a chronological order with a clear content page at the front.

If learners are submitting paper portfolios, it is likely that these portfolios will need to be supported by electronic files that show real-time evidence or provide the required evidence to demonstrate the functionality of the learner's final prototype(s). Learners should clearly reference any supporting electronic evidence in the appropriate part of their paper portfolio to support marking and moderation.

The centre should submit electronic evidence in acceptable formats listed in Appendix 5f, these should be on a single USB memory stick or DVD with each learner's work in a separate folder and clearly labelled.

Carrying forward non-exam assessment (NEA)

Learners who are retaking the qualification can choose to either retake the non-exam assessment – Iterative Design Challenge (02,03) or carry forward their most recent result for that component.

To carry forward the NEA component result, you must use the correct carry forward entry option (see table in Section 4a).

Learners must decide at the point of entry whether they are going to carry forward the NEA result or not.

The result for the NEA component may be carried forward for the lifetime of the specification and there is no restriction on the number of times the result may be carried forward. However, only the most recent non-absent result may be carried forward.

When the result is carried forward, the grade boundaries from the previous year of entry will be used to calculate a new weighted mark for the carried forward component, so the value of the original mark is preserved.

4e. Results and certificates

Grade Scale

GCSE (9–1) qualifications are graded on the scale: 9–1, where 9 is the highest. Learners who fail to reach the minimum standard of 1 will be Unclassified (U).

Only subjects in which grades 9 to 1 are attained will be recorded on certificates.

Results

Results are released to centres and learners for information and to allow any queries to be resolved before certificates are issued.

Centres will have access to the following results information for each learner:

- the grade for the qualification
- the raw mark for each component
- the total weighted mark for the qualification.

The following supporting information will be available:

- raw mark grade boundaries for each component
- weighted mark grade boundaries for each entry option.

Until certificates are issued, results are deemed to be provisional and may be subject to amendment.

A learner's final results will be recorded on an OCR certificate. The qualification title will be shown on the certificate as:

'OCR Level 1/Level 2 GCSE (9–1) in Design and Technology'.

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4f. Post-results services

A number of post-results services are available:

- **Review of results** – If you are not happy with the outcome of a learner's results, centres may request a review of their moderation and/or marking.
- **Missing and incomplete results** – This service should be used if an individual subject result for a learner is missing, or the learner has been omitted entirely from the results supplied.
- **Access to scripts** – Centres can request access to marked scripts.

4g. Malpractice

Any breach of the regulations for the conduct of examinations and non-exam assessment may constitute malpractice (which includes maladministration) and must be reported to OCR as soon as it is detected.

Detailed information on malpractice can be found in the JCQ publication *Suspected Malpractice in Examinations and Assessments: Policies and Procedures*.

5 Appendices

5a. Accessibility

Reasonable adjustments and access arrangements allow learners with special educational needs, disabilities or temporary injuries to access the assessment and show what they know and can do, without changing the demands of the assessment. Applications for these should be made before the examination series. Detailed information about eligibility for access arrangements can be found in the JCQ *Access Arrangements and Reasonable Adjustments.*

The GCSE (9–1) qualification and subject criteria have been reviewed in order to identify any feature which could disadvantage learners who share a protected Characteristic as defined by the Equality Act 2010. All reasonable steps have been taken to minimise any such disadvantage.

5b. Overlap with other qualifications

This qualification allows for knowledge and understanding to be drawn on and applied from other qualifications such as GCSE (9–1) Art and Design, GCSE (9–1) Computer Science and GCSE (9–1) Geography, but there is no significant overlap with these qualifications.

There is content in the specification that has some overlap with GCSE (9–1) mathematics and scientific specifications. This overlap is a requirement of the qualification and in particular the mathematical skills are set out as a condition of assessment by Ofqual.

Within the content in Sections 2c and 2d of this specification the links to mathematics and science are highlighted using symbols.

 = Maths

 = Science

In addition, the mathematical skills are interpreted for each component alongside the content and further mapping is given in the next two sections to outline the links to respective GCSE (9–1) specifications in Mathematics and Science.

In addition, to the above the endorsed title of Textiles within GCSE (9–1) Art and Design can be seen to link directly to the textiles requirements in this qualification. It is, however, important to be aware that the two qualifications cover very different subjects. Learners considering taking either qualification should be made aware of these differences to ensure they are making the right choices for their futures. A review of the progression to GCE Design and Technology: Fashion and Textiles will support centres in understanding the available pathways.

5c. Use of mathematics within Design and Technology

Through their work in Design and Technology learners are required to apply relevant mathematical knowledge, skills and understanding equivalent to Key Stage 3 learning.

The table below shows the requirements for mathematical skills to be covered within the OCR GCSE (9–1) Design and Technology. These are supported with examples to demonstrate application of each skill that could be assessed in examinations.

Within OCRs GCSE (9–1) in Mathematics the content is outlined at three different levels, the first level identifying the initial learning required prior to undertaking the GCSE qualification, this being equivalent to Key Stage 3 learning. This is shown in the table below to demonstrate how the GCSE (9–1) in Mathematics can support teaching and learning in Design and Technology.

Mathematical skills requirements for Design and Technology **M1 Arithmetic and numerical computation**		OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
Required skills	*Examples of application to Design and Technology*		
a. Recognise and use expressions in decimal and standard form.	• understand the standard application of metric units used in design and technology and apply these appropriately using standard form (also be aware that some measurements commonly retain the use of imperial units) • use decimal and standard form appropriately when using units of mass, length, time, money and other measures • use and apply standard form when calculating quantities of materials, cost and sizes.	**3.02a**	Interpret and order numbers expressed in standard form. Convert numbers to and from standard form. e.g. $1320 = 1.32 \times 10^3$, $0.00943 = 9.43 \times 10^{-3}$
		3.02b	Use a calculator to perform calculations with numbers in standard form.
		2.02a	Express a simple fraction as a terminating decimal or vice versa, without a calculator. e.g. $0.4 = \frac{2}{5}$ Understand and use place value in decimals.
		2.02b	Add, subtract and multiply decimals including negative decimals, without a calculator.

Mathematical skills requirements for Design and Technology

M1 Arithmetic and numerical computation

Required skills	*Examples of application to Design and Technology*	**OCR GCSE (9–1) Mathematics ref.**	**GCSE (9–1) Mathematics specification (J560)**
		2.02c	Divide a decimal by a whole number, including negative decimals, without a calculator. e.g. $0.24 \div 6$
		10.01a	Use and convert standard units of measurement for length, area, volume/capacity, mass, time and money.
		10.01b	Use and convert simple compound units (e.g. for speed, rates of pay, unit pricing). Know and apply in simple cases: speed = distance ÷ time.
b. Use ratios, fractions and percentages.	• understand and use ratios in the scaling of drawings • understand and apply fractions and percentages when analysing data, survey responses and user questionnaires given in tables and charts • calculate percentages e.g. with profit, waste saving calculations or comparing measurements.	**2.01a**	Recognise and use equivalence between simple fractions and mixed numbers. e.g. $\frac{2}{6} = \frac{1}{3}$ $2\frac{1}{2} = \frac{5}{2}$
		2.01b	Add, subtract, multiply and divide simple fractions (proper and improper), including mixed numbers and negative fractions. e.g. $1\frac{1}{2} + \frac{3}{4}$ $\frac{5}{6} \times \frac{3}{10}$ $^{-}3 \times \frac{4}{5}$

Mathematical skills requirements for Design and Technology M1 Arithmetic and numerical computation *Required skills*	*Examples of application to Design and Technology*	OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
		2.01c	Calculate a fraction of a quantity. e.g. $\frac{2}{5}$ of £3.50 Express one quantity as a fraction of another. *[see also Ratios and fractions, 5.01c]*
		2.03a	Convert between fractions, decimals and percentages. e.g. $\frac{1}{4} = 0.25 = 25\,\%$ $1\frac{1}{2} = 150\,\%$
		2.03b	Understand percentage is ‘number of parts per hundred’. Calculate a percentage of a quantity, and express one quantity as a percentage of another, with or without a calculator.
		2.03c	Increase or decrease a quantity by a simple percentage, including simple decimal or fractional multipliers. Apply this to simple original value problems and simple interest. e.g. Add 10% to £2.50 by either finding 10% and adding, or by multiplying by 1.1 or $\frac{110}{100}$ Calculate original price of an item costing £10 after a 50% discount.
		5.01a	Find the ratio of quantities in the form $a : b$ and simplify. Find the ratio of quantities in the form $1 : n$. e.g. 50 cm : 1.5 m = 50 : 150 = 1 : 3

Mathematical skills requirements for Design and Technology		OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
M1 Arithmetic and numerical computation			
Required skills	*Examples of application to Design and Technology*		
c. Calculate surface area and volume.	• calculate the surface area to determine quantities of materials (where dimensions are given) • calculate the volume of cuboids, simple and composite shapes (where dimensions are given) • apply tolerances to given material dimensions and quantities.	**10.04a** **10.04b**	Calculate the surface area and volume of cuboids and other right prisms. Calculate the surface area and volume of spheres, cones and simple composite solids (formulae will be given).
M2 Handling Data			
a. Presentation of data, diagrams, bar charts and histograms.	• construct and interpret frequency tables, pie charts and bar charts from given data sources • present given information to accurately represent performance over time.	**12.02a**	Interpret and construct charts appropriate to the data type; including frequency tables, bar charts, pie charts and pictograms for categorical data, vertical line charts for ungrouped discrete numerical data. Interpret multiple and composite bar charts.
M3 Graphs			
a. Plot draw and interpret appropriate graphs.	• plot or draw graphs from given information such as performance data and client survey responses • analysis graphs to interpret and extract information.	**7.01a** **7.02a** **7.04a**	Work with x- and y- coordinates in all four quadrants. Use a table of values to plot graphs of linear and quadratic functions. e.g. $y = 2x + 3$ $y = 2x^2 + 1$ Construct and interpret graphs in real-world contexts. e.g. distance-time, money conversion, temperature conversion *[see also Direct proportion, 5.02a, Inverse proportion, 5.02b]*

Mathematical skills requirements for Design and Technology			OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
M3	**Graphs**			
Required skills		*Examples of application to Design and Technology*		
b.	Translate information between graphical and numeric form.	• extract information from technical specifications and graphical sources to understand instructions or requirements.	**7.01b**	Use a table of values to plot graphs of linear and quadratic functions. e.g. $y = 2x + 3$ $y = 2x^2 + 1$
			7.04a	Construct and interpret graphs in real-world contexts. e.g. distance-time, money conversion, temperature conversion *[see also Direct proportion, 5.02a, Inverse proportion, 5.02b]*
M4	**Geometry and trigonometry**			
a.	Use angular measures in degrees.	• know the basic properties of isosceles, equilateral and right angle triangles • understand the basic rules of angular calculations and trigonometry to support accurate marking out • demonstrate accuracy in measurement and marking out of angles • understand symmetry to create tessellated patterns to minimise waste.	**8.01b**	Know the terms acute, obtuse, right and reflex angles. Use the standard conventions for labelling and referring to the sides and angles of triangles. e.g. AB, ∠ABC, angle ABC, *a* is the side opposite angle A.
			8.03a	Know and use the sum of the angles at a point is 360°.
			8.03b	Know that the sum of the angles at a point on a line is 180°.
			8.03c	Know and use: Vertically opposite angles are equal alternate angles on parallel lines are equal corresponding angles on parallel lines are equal.
			8.04a	Know the basic properties of isosceles, equilateral and right-angled triangles. Give geometrical reasons to justify these properties.

Design and Technology content from this specification **M4 Geometry and trigonometry** *Required skills*	*Examples of application to Design and Technology*	**OCR GCSE (9–1) Mathematics ref.**	**GCSE (9–1) Mathematics specification (J560)**
b. Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects.	• graphical presentation of designs to communicate intentions to others • transfer information from 3D objects with given dimensions into accurate 2D representations • interpret information to accuratey present isometric drawings.	**8.06b** **9.04b** **10.01c**	Interpret plans and elevations of simple 3D solids. Enlarge a simple shape from a given centre using a whole number scale factor, and identify the scale factor of an enlargement. Use the scale of a map, and work with bearings. Construct and interpret scale drawings.
c. Calculate areas of triangles and rectangles.	• calculate areas to determine quantities of materials (where not all dimensions are given) • calculate area to determine area scale factor application.	**10.03a** **10.03b**	Know and apply the formula: area $= \frac{1}{2}$ base $\times$ height. Know and apply the formula: area $=$ base $\times$ height. [Includes area of a rectangle]
d. Calculate the surface area and volumes of cubes.	• calculate the overall surface area of cuboids to determine quantities of material • calculate the volume of cuboids to determine suitability of objects fitting into a space (where not all dimensions are given) • calculate the volume of cuboids to determine volume scale factor application.	**10.04a**	Calculate the surface area and volume of cuboids and other right prisms.

5d. Use of science within Design and Technology

Through their work in design and technology, learners are required to apply relevant science knowledge and understanding equivalent to Key Stage 3 learning.

The table below shows the requirements for science knowledge and skills to be covered within the OCR GCSE (9–1) Design and Technology. These are supported with examples to demonstrate application of each requirement within a design and technology context and where the requirements are mapped to the exam content within this specification or could be considered within non-exam assessment (NEA).

Within OCRs specification for GCSE (9–1) in Combined Science A and GCSE (9–1) Computer Science the content outlines 'underlying knowledge and understanding' which is equivalent to the requirements of Key Stage 3 learning. This is shown in the table below to demonstrate how the GCSE (9–1) in Combined Science A and GCSE (9–1) Computer Science can support teaching and learning in Design and Technology.

Scientific knowledge and skills requirements for Design and Technology **S1 Use of scientific vocabulary, terminology and definitions** *Science requirements*	*Examples applied to D&T*	OCR Design and Technology specification ref.	OCR GCSE (9–1) Combined Science ref.	GCSE (9–1) Combined Science A specification (J250) Or GCSE (9–1) Computer Science specification (J276)
a. Quantities, units and symbols.	Appropriate use of scientific terms when developing a design brief and specifications.	**2d (1)** **2d (4)**	**5d** **5e**	• Scientific quantities and corresponding units. • Apply skills in observation, modelling and problem-solving, with opportunities for these skills to be shown through links to specification content.
b. SI units (e.g. kg, g, mg; km, m, mm; kJ, J), prefixes and powers of ten for orders of magnitude (e.g. tera, giga, mega, kilo, centi, milli, micro and nano).	Calculation of quantities, measurement of materials and selection of components.	**2c (7)** **2c (8)** **2d (7)** **2d (8)**	**5d** **5e** **P1.1**	• Scientific quantities and corresponding units. • Apply them in qualitative work and calculations. • Apply skills in observation, modelling and problem-solving, with opportunities for these skills to be shown through links to specification content. • Density is affected by the state materials are in.

Scientific knowledge and skills requirements for Design and Technology **S1 Use of scientific vocabulary, terminology and definitions** *Science requirements*	 *Examples applied to D&T*	**OCR Design and Technology specification ref.**	**OCR GCSE (9–1) Combined Science ref.**	**GCSE (9–1) Combined Science A specification (J250) Or GCSE (9–1) Computer Science specification (J276)**
c. Metals and non-metals and the differences between them, on the basis of their characteristic physical and chemical properties.	Classification of the types and properties of a range of materials.	**2c (5) 2d (5)**	**5e**	• Processes and methods of science and consideration of the different types of scientific enquiry.
			C2.1	• Atomic model (Dalton).
			C3.1	• Concept of pure substances. • Substances in terms of melting point, boiling point and chromatography will also have been met before
			C5.1	• Conservation of mass, changes of state and chemical reactions.
			P1.1	• Atomic model and atoms are examples of particles. They should also know the difference between atoms, molecules and compounds. • Density is affected by the state materials are in.
			P1.2	• Matter and the similarities and differences between solids, liquids and gases. • Effect of temperature in the motion and spacing of particles and an understanding that energy can be stored internally by materials.
S2 Lifecycle assessment and recycling				
a. The basic principles in carrying out a life-cycle assessment of a material or product.	Selection of materials and components based on ethical factors, taking into consideration the ecological and social footprint of materials.	**2c (3) 2c (5) 2d (3) 2d (5)**	**B6.1**	• Ecosystems and the various ways organisms interact. • Gases of the atmosphere from Key Stage 3.
			C6.2	• Composition of the Earth, the structure of the Earth, the rock cycle, the carbon cycle, the composition of the atmosphere.

Scientific knowledge and skills requirements for Design and Technology

S3 Using materials and system

Science requirements	*Examples applied to D&T*	**OCR Design and Technology specification ref.**	**OCR GCSE (9–1) Combined Science ref.**	**GCSE (9–1) Combined Science A specification (J250) Or GCSE (9–1) Computer Science specification (J276)**
a. The conditions which cause corrosion and the process of corrosion and oxidisation.	Understanding of properties of materials and how they need to be protected from corrosion through surface treatments and finishes.	**2c (5)** **2c (7)** **2d (5)** **2d (7)**	**C2.3** **C3.4** **P1.2**	• Difference between an atom, element and compound. • Ionic solutions and solids. • Effect of temperature in the motion and spacing of particles and an understanding that energy can be stored internally by materials.
b. The composition of some important alloys in relation to their properties and uses.	Selecting appropriate materials.	**2c (5)** **2d (5)**	**5e** **P1.2** **P2.3**	• Apply skills in observation, modelling and problem-solving, with opportunities for these skills to be shown through links to specification content. • Matter and the similarities and differences between solids, liquids and gases. • Forces acting to deform objects and to restrict motion.
c. The physical properties of [materials], how the properties of materials are selected related to their uses.	Knowledge of properties of materials to be applied when designing and making.	**2c (5)** **2c (7)** **2d (5)** **2d (7)**	**C6.1** **P2.3**	• Properties of ceramics, polymers and composites. • The method of using carbon to obtain metals from metal oxides. • Forces acting to deform objects and to restrict motion.

Scientific knowledge and skills requirements for Design and Technology **S3 Using materials and system** *Science requirements*	*Examples applied to D&T*	OCR Design and Technology specification ref.	OCR GCSE (9–1) Combined Science ref.	GCSE (9–1) Combined Science A specification (J250) Or GCSE (9–1) Computer Science specification (J276)
d. The main energy sources available for use on Earth (including fossil fuels, nuclear fuel, bio-fuel, wind, hydro- electricity, the tides and the Sun), the ways in which they are used and the distinction between renewable and non- renewable sources.	Understanding of how to choose appropriate energy sources.	**2c (3)** **2d (3)**	**B6.1**	• Ecosystems and the various ways organisms interact. • Gases of the atmosphere.
			C6.2	• Composition of the Earth, the structure of the Earth, the rock cycle, the carbon cycle, the composition of the atmosphere and the impact of human activity on the climate.
			P4.1	• How waves behave and how the speed of a wave may change as it passes through different media. • How sound is heard and the hearing ranges of different species.
			P4.2	• Uses of some types of radiation.
			P5.1	• Energy listed as nine types. • Be able to approach systems in terms of energy transfers and stores. • That energy can be transferred in processes such as changing motion, burning fuels and in electrical circuits. • Idea of conservation of energy and that it has a quantity that can be calculated.
			P5.2	• Transfer of energy into useful and waste energies. • Power and how domestic appliances can be compared. • Insulators and how energy transfer is influenced by temperature. • Ways to reduce heat loss in the home.
			P6.2	• Renewable and non-renewable energy resources. • Electrical safety features in the home.

Scientific knowledge and skills requirements for Design and Technology S3 Using materials and system *Science requirements*	*Examples applied to D&T*	OCR Design and Technology specification ref.	OCR GCSE (9–1) Combined Science ref.	GCSE (9–1) Combined Science A specification (J250) Or GCSE (9–1) Computer Science specification (J276)
e. The action of forces and how levers and gears transmit and transform the effects of forces.	Knowledge of the function of mechanical devices to produce different sorts of movement, changing the magnitude and direction of forces.	**2c (6)** **2d (6)**	**P2.1**	• Relationship between speed, distance and time. • Represent information in a distance-time graph. • Relative motion of objects.
			P2.2	• Contact and non-contact forces influencing the motion of an object. • Newtons and that this is the measure of force. • Force arrows and have an understanding of balanced and unbalanced forces.
			P2.3	• Forces acting to deform objects and to restrict motion. • Hooke's law and the idea that when work is done by a force it results in an energy transfer and leads to energy being stored by an object.
f. Knowledge of electronic systems through an understanding of currents (I), resistance (R) and potential difference (V); explain the design and use of circuits – including for lamps, diodes, thermistors and LDRs.	Calculate the currents, potential differences and resistances in DC series circuits; represent them with the conventions of positive and negative terminals, and the symbols that represent common circuit elements, including diodes, LDRs and thermistors.	**2c (6)** **2d (6)**	**P3.1**	• Electron transfer leading to objects becoming statically charged and the forces between them. • Existence of an electric field.
			P3.2	• Assemble series and parallel circuits and of how they differ with respect to conventional current and potential difference. • Current and resistance and the units in which they are measured.
			P3.3	• Magnets and the idea of attractive and repulsive forces. • Magnetic effect of a current and electromagnets.
			P5.1	• Energy transfer in process of electrical circuits. • Conservation of energy and that it has a quantity that can be calculated.
			P5.2	• Transfer of energy into useful and waste energies. • Power and how domestic appliances can be compared. • Insulators and how energy transfer is influenced by temperature.

5e. Glossary of terms from the specification content

Circular economy	A circular economy is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life. It aims to keep products, components and materials at their highest utility and value at all times.
Context	Circumstances that form a setting, surroundings, people, places, events that all form a setting for us to design within.
Creativity	Creativity is a phenomenon whereby something new and valuable is formed. The ability to transcend traditional ideas, rules, patterns, relationships, or the like; to create meaningful new ideas, forms, methods, interpretations, etc. originality, progressiveness, or imagination.
Critique	Critique is a method of disciplined, systematic analysis of a written or oral discourse. Although critique is commonly understood as fault finding and negative judgment, it can also involve merit recognition, and in the philosophical tradition it also means a methodical practice of doubt. It is detailed evaluation.
Design optimisation	Product design and development requires that engineers consider trade-offs between product attributes in the areas of cost, weight, manufacturability, quality and performance. It is about determining how to arrive at the best overall design, making the right compromises and not sacrificing critical attributes like safety.
Design solution	A design solution is a generic term that can be used to outline any existing products or systems, or any design development that is offered as an answer to needs, wants and requirements. This can be a fully drawn up solution, a prototype or an existing product.
Digital design	Digital design is the use of computers, graphics tablets and other electronic devices to create graphics and designs for the web, television, print and portable electronic devices. Digital designers use creativity and computer skills to design visuals associated with electronic technology.
Disruptive technology	Disruptive technology is a new emerging technology that unexpectedly displaces an established one. Recent examples of disruptive technologies include smart phones and e-commerce retailing. Clayton Christensen popularised the idea of disruptive technologies in the book "The Innovator's Dilemma" in 1997.
Disassembly	To disconnect the pieces of (something), to take things apart into smaller pieces. Used within Design and Technology to analyse and test products.
Ecological footprint	Ecological footprint is a measure human impact through supply and demand on nature. It represents the productive area required to provide renewable resources that humanity is using and to absorb its waste.
Enterprise	Relating to a progressive approach that demonstrates initiative, resourcefulness and willingness to undertake new and challenging projects.
Fixation	The state of being unable to stop thinking about something, or an unnaturally strong interest in something. We talk about this in terms of design fixation, i.e. being fixated with an idea.

Global sustainable development	Sustainable development relates to the principle of sustaining finite resources that are necessary to provide for the needs of future generations of life on the planet.
Innovation	Innovation in the context of this qualification refers to learners considering new methods or ideas to improve and refine their design solutions and meet the needs of their intended market and/or primary user.
Iterative design	Iterative design is a design methodology based on a cyclic process of prototyping, testing, analysing and refining a product or process. Within the context of this specification we refine these processes to explore/create/evaluate. In iterative design, interaction with the product or system is used as a form of investigation for informing and evolving a project. Based on the results of testing the most recent iteration of a design, changes and refinements are made.
Just-in-time (JIT)	Just-in-time (JIT) manufacturing, also known as just-in-time production or the Toyota production system (TPS), is a methodology aimed primarily at reducing flow times within production as well as response times from suppliers and to customers. A strategy companies employ to increase efficiency and decrease waste by receiving goods only as they are needed in the production process, thereby reducing inventory costs.
Lean manufacturing	Lean manufacturing or lean production, often simply “lean”, is a systematic method for the elimination of waste within a manufacturing system.
Lifecycle assessment (LCA)	Lifecycle assessment (LCA), also known as lifecycle analysis, eco-balance, and cradle-to-grave analysis is a technique to assess environmental impacts associated with all the stages of a product’s life from cradle-to-grave (from raw material extraction through materials processing, manufacture, distribution, use during its life, repair and maintenance and end of life disposal or recycling).
Need	A need is a thing that is necessary for someone to live a healthy, safe and fulfilled life. A need can imply a want, a lack, or a demand, which must be filled.
Ongoing dialogue	An exchange of ideas or opinions on a particular issue, with a view to reaching an amicable agreement or settlement.
Practical activities	Practical activities enable the student to put into practice the theory and/or skills they are studying, in a practical environment. This will involve all stages of designing and making, but also investigative, testing and analytical activities.
Primary user	The primary user is that person or group of people that are intended to practically use a product or system in their lives. Many products may have primary users that use the same product in different ways or with different purposes.
Prototype	In the context of this qualification, the term ‘prototype’ refers to a functioning design outcome. A final prototype could be a highly finished product, made as proof of concept prior to manufacture, or working scale models of a system where a full-size product would be impractical.
Real-time evidence	Evidence that demonstrates activity as it happens through whatever medium it is recorded in. Real-time evidence is gathered to support the chronological delivery of a portfolio.

Requirement	In product development a requirement is a singular physical and functional need that a particular design, product or process must be able to perform. It is a statement that identifies a necessary attribute, capability, characteristic, or quality of a system for it to have value to a customer, user, or other stakeholder.
Sketch modelling	Sketch modelling enables you to study, visualise and understand the space in 3D because it looks more real than pen and paper sketches. It can involve modelling using cheap materials and help you work out your design ideas or sketching of parts to explore the parts of a design.
Social footprint	Social footprint is linked to the carbon footprint, implying that all human actions leave a trace and sometimes our lifestyle choices have negative consequences on the environment.
Solution	A solution is a way to solve a problem or resolve a bad situation.
Stakeholder	A stakeholder is a person, group or organisation with an interest in a project; for example, parents/schools when designing products for children; the manufacturer or retailer that has an interest in a product; a regulator who needs to ensure products meet required regulations within a jurisdiction; when acting as a designer, the stakeholder that you are working for would be defined as a client.
Systems thinking	'Systems thinking' is a holistic approach to analysis that focuses on the way that a system's constituent parts interrelate and how systems work over time and within the context of larger systems.
Technical textiles	Technical textiles are materials meeting high technical and quality requirements, e.g. mechanical, thermal, electrical, durability etc., this gives them the ability to offer technical functions.
Upcycling	Upcycling, also known as creative reuse, is the process of transforming by-products, waste materials, useless and/or unwanted products into new materials or products of better quality or for better environmental value.
User-centred design	User-centred design (UCD) is a framework of processes (not restricted to interfaces or technologies) in which the needs, wants and limitations of end users of a product, service or process are given extensive attention at the stage of the design process.

5f. Accepted file formats

Further explanation of the use of formats for non-exam assessment can be found in Section 4d under 'E-portfolios'

Movie formats for digital video evidence
MPEG (*.mpg)
QuickTime movie (*.mov)
Macromedia Shockwave (*.aam)
Macromedia Shockwave (*.dcr)
Flash (*.swf)
Windows Media File (*.wmf)
MPEG Video Layer 4 (*.mp4)

Audio or sound formats
MPEG Audio Layer 3 (*.mp3)

Graphics formats including:
JPEG (*.jpg)
Graphics file (*.pcx)
MS bitmap (*.bmp)
GIF images (*.gif)

Animation formats
Macromedia Flash (*.fla)

Text formats
Comma Separated Values (.csv)
PDF (.pdf)
Rich text format (.rtf)
Text document (.txt)

Microsoft Office suite
PowerPoint (.ppt) (.pptx)
Word (.doc) (.docx)
Excel (.xls) (.xlsx)
Visio (.vsd) (.vsdx)
Project (.mpp) (.mppx)

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5g. Acknowledgements

Designing Our Tomorrow

In developing this specification, we have consulted and drawn on the research and authentic practices of an initiative called Designing Our Tomorrow, from the University of Cambridge. In particular, the content and Figures related to the iterative processes, from, namely, Explore: Create: Evaluate: Manage, used throughout this specification and shown schematically in Fig. 1, Fig. 2 and Fig. 3.

For more information about their work visit: www.designingourtomorrow.com.

Summary of updates

Date	Version	Section	Title of Section	Change
April 2018	1.1	i) Front Cover ii) 4e	i) Disclaimer ii) Results and Certificates: Results	i) Addition of Disclaimer ii) Amend to Certification Titling
August 2018	1.2	3d 4d multiple	Retaking the qualification Admin of non-exam assessment	Update to the wording for carry forward rules Amendment to ‘Centre Record Forms Reference’
January 2020	1.3	1d Covers 4d 4f	How do I find out more information? Authentication of learners’ work Post-results services	References to the Online Support Centre included Update to specification covers to meet digital accessibility standards Wording amended from ‘Enquiries about results’ to ‘Review of results’
November 2021	1.4	2c 3f	Content of Principles of Design and Technology (J310/01) Internal assessment of non-exam assessment (NEA)	Correction of typos
May 2023	1.5	2a 3c 4a 4d	OCR's GCSE (9-1) in Design and Technology Total qualification time Entries Admin of non-exam assessment	Inclusion of TQT and GLH and update to the wording of moderation submission options.
February 2024	1.6	3d, 3e 4a Checklist	Qualification availability, Language Pre-assessment	Inclusion of disclaimer regarding availability and language Update to include resilience guidance Inclusion of Teach Cambridge

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