AS LEVEL
Design and Technology

Qualification Accredited

Oxford Cambridge and RSA

AS LEVEL
Specification

DESIGN AND TECHNOLOGY

H004 Design Engineering
H005 Fashion and Textiles
H006 Product Design
For first assessment in 2018

Version 1.2 (August 2018)

ocr.org.uk/asleveldesignandtechnology

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Disclaimer

Contents

1 Why choose an OCR AS Level 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 AS Level 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 lifetime of the specification.
- 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 AS Level qualifications offered by OCR are accredited by Ofqual, the Regulator for qualifications offered in England. The accreditation number for OCR's AS Level in Design and Technology is QN: 603/0760/2.

1b. Why choose an OCR AS Level in Design and Technology?

Design and technology is an inspiring, rigorous and practical subject. In formulating this specification, OCR has worked closely with representatives from Higher Education and industry professionals to ensure that the direction of the qualification fulfils the requirements that support progression. There has also been a focus on ensuring the content reflects authentic practice, as best as it can within the school environment, giving an insight into the way that creative, engineering and/or manufacturing industries function. Learners are thus enabled to make the connection between the knowledge, understanding and skills they develop and how this will benefit them in the future.

Learning about design and technology at AS level strengthens learners' critical thinking and problem solving skills within a creative environment, enabling them to develop and make prototypes/products that solve real-world problems, considering their own and others' needs, wants, aspirations and values. OCR's AS Level qualification requires students to identify market needs and opportunities for new products, initiate and develop design solutions, and make and test prototypes/products. Learners should acquire subject knowledge in design and technology, including how a product can be developed through the stages of prototyping, realisation and commercial manufacture.

This qualification will excite and engage learners with contemporary topics covering the breadth of this dynamic and evolving subject. It will create empathetic learners who have the ability to confidently critique products, situations and society in every walk of their lives now and in the future.

Learners will build their skills in thinking and designing to support the requirements that they will need to demonstrate when progressing to higher education or industry. In order to support the in-depth learning of different routes that learners may progress to, three subject endorsements are available, linked to design disciplines that reflect possible higher education routes and industry:

- Design Engineering
- Fashion and Textiles
- Product Design.

OCR's AS Level in Design and Technology enables learners to take every opportunity to integrate and apply their understanding and knowledge from other subject areas studied during Key Stage 4, with a particular focus on science and mathematics, and those subjects they are studying alongside AS and A Level Design and Technology. This qualification offers the opportunity to apply learners' wider learning through creativity and innovation.

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 AS Level in Design and Technology will encourage learners to:

- be open to taking design risks, showing innovation and enterprise whilst considering their role as responsible designers and citizens
- develop intellectual curiosity about the design and manufacture of products and systems, and their impact on daily life and the wider world
- work collaboratively to develop and refine their ideas, responding to feedback from users, peers and expert practitioners
- gain an insight into the creative, engineering and/or manufacturing industries
- develop the capacity to think creatively, innovatively and critically through focused research and the exploration of design opportunities arising from the needs, wants and values of users and clients
- develop knowledge and experience of real world contexts for design and technological activity
- develop a strong core knowledge and understanding of principles in design and technology enabling them to make informed decisions in broader contexts
- become independent and critical thinkers who can adapt their technical knowledge and understanding to different design situations
- develop an in-depth knowledge and understanding of materials, components and processes associated with the creation of products that can be tested and evaluated in use
- develop an experienced understanding of iterative design processes that is relevant to industry practice
- be able to make informed design decisions through an in-depth understanding of the management and development of taking a design through to a prototype/product
- be able to create and analyse a design concept and use a range of skills and knowledge from other subject areas, including mathematics and science, to inform decisions in design and the application or development of technology
- be able to work safely and skilfully to produce high-quality prototypes/products
- have a critical understanding of the wider influences on design and technology, including cultural, economic, environmental, historical and social factors
- become empathetic and successful designers, who not only consider global and local change, but also the wider social implications of products to meet multiple needs and requirements
- develop the ability to draw on and apply a range of skills and knowledge from other subject areas, including the use of mathematics and science for analysis and informing decisions in design
- develop and use key design and technology terminology to communicate effectively in future education and employment.

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

The key features of OCR's AS Level in Design and Technology for you and your learners are:

- clarity on the application of iterative design processes 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 creative designers, engineers and consumers of the future
- three endorsed titles giving access to learners with a range of future aspirations in the design and engineering industries
- content that can be co-taught alongside groups following the OCR A Level
- 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 (NEA) 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 and authentic practices developed by DOT*
- a glossary to explain key terms and clarify definitions from the specification content (see Section 5e)
- 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.

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

Designing Our Tomorrow

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

OCR Community:
http://social.ocr.org.uk/groups/design-technology

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

2 The specification overview

2a. OCR's AS Level in Design and Technology (H004, H005 and H006)

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 OCR Repository submission option, or
- components 01 and 03 for Postal submission option

in order to be awarded the OCR AS Level in Design and Technology.

The two components outlined below are set out generically to explain the structure of assessment within this qualification for all three endorsed titles.

Content Overview	Assessment Overview	
This paper is set out through five sets of questions that cover the full scope of examined content. Learners will be required to: • analyse existing products • demonstrate applied mathematical skills • apply their technical knowledge and understanding of materials, product functionality, manufacturing processes and techniques • demonstrate their understanding of design thinking and wider social, moral and environmental issues that impact on the design and manufacturing industries • demonstrate their ability to solve problems.	**Principles of...*** **(01)** 90 marks 1 hour 45 minutes Written paper	**50%** of total AS Level
Learners will be required to undertake a 'product development' in response to a given context that is open to their interpretation. Their 'product development' will be user-centred and will either deliver iterative improvements to an existing product or re-purpose a product for alternative use. Innovative approaches will be required, resulting in a final prototype that can be tested against the user and the market. Contexts released on 1 June each year.	**Product Development*** **(02, 03)** 90 marks Approx. 45 hours Non-exam assessment	**50%** of total AS Level

* 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 Sections 4a and 4d).

2b. Content of AS Level in Design and Technology (H004, H005 and H006)

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.

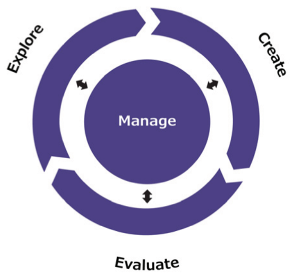

Fig. 1 Iterative Design Wheel

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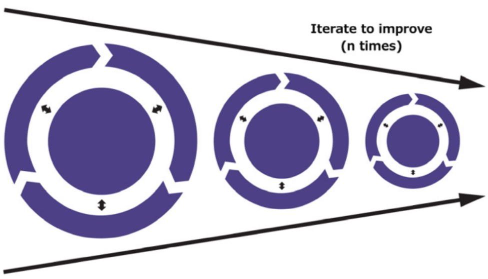

Fig. 2 Multiple iterations of design

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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 nature of this specification's content will encourage learners to make links between topics and to explore, create and evaluate a range of outcomes. It encourages a creative approach supported by subject knowledge in order to design and make prototypes that solve authentic, real-world problems and have real potential to become viable products.

The knowledge, understanding and skills that all learners must develop are underpinned by technical principles predominantly assessed in the written exam and designing and making principles predominantly in the non-exam assessment (NEA). Though there is an expectation that learning builds a holistic understanding of the subject.

There is distinct content for the exam and non-exam assessment, but this is held together through nine topic areas that shape 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.
9. Health and safety.

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. Learners should, as a result, be given increased autonomy to make decisions in order to justify their reasoning when solving problems in their own way.

The 'Product Development' is a small-scale design, make and evaluate project that allows learners to reposition or further develop an existing product in relation to a given context. The experience of this will be supported by and support their learning for the 'Principles' written exam.

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 along with prior learning in Design and Technology and other subjects offers the opportunity for learners to build on and apply their learning at Key Stage 4 and Key Stage 5.

2c. Summary of endorsed titles

The OCR AS Level in Design and Technology offers three endorsed titles listed below. The endorsed titles are to prepare learners for tertiary education and/or work-based study and training in the design, creative, engineering and/or manufacturing industries:

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- Design and Technology: Design Engineering (H004)
- Design and Technology: Fashion and Textiles (H005)
- Design and Technology: Product Design (H006)

Each of the endorsed titles relate to disciplines of Design and Technology that learners most commonly progress to at Higher Education following their AS or A level studies. Though there are naturally many similarities and overlaps in the design processes, materials and thinking that designers from each approach may take, there are also significant distinct features of each endorsed title.

Design Engineering is focused towards engineered and electronic products and systems; the analysis of these in respect of function, operation, components and materials, in order to understand their application and uses in engineered products/systems that have commercial viability.

Fashion and Textiles is focused towards fashion and textiles products and accessories in a range of applications; their analysis in respect of materials, process, trends and use in relation to industrial and commercial practices of fashion and textiles.

Product Design is focused towards consumer products and applications; their analysis in respect of materials, components, and marketability to understand their selection and uses in industrial and commercial practices of product development.

Throughout the OCR specification, we allow the distinction between the endorsed titles to be fully realised, not limiting design developments from any discipline. There could be many occasions when using textiles, using electronic or mechanical systems may be appropriate within another endorsed title.

In order to support each endorsed title, content and information have been kept separated where possible to allow identification of the specific learning requirements when following each route. The table below supports the identification of pages for individual endorsed titles.

	Design Engineering	Fashion and Textiles	Product Design
Exam content	Section 2e	Section 2f	Section 2g
NEA content	Section 2h (generic)	Section 2h (generic)	Section 2h (generic)
NEA interpretations	Section 2i	Section 2j	Section 2k
Task setting	Section 3a (generic)	Section 3a (generic)	Section 3a (generic)
Task taking	Section 3a (generic)	Section 3a (generic)	Section 3a (generic)
Required evidence	Section 3a (generic)	Section 3a (generic)	Section 3a (generic)
NEA marking criteria	Section 3f (generic)	Section 3f (generic)	Section 3f (generic)
Administration of NEA	Section 4d (generic)	Section 4d (generic)	Section 4d (generic)
Maths requirements	Section 5c (specific)	Section 5c (specific)	Section 5c (specific)
Science requirements	Section 5d (generic)	Section 5d (generic)	Section 5d (generic)

2d. Introduction to content for Principles components (H004/01, H005/01, H006/01)

The exam content is set out through an enquiry approach to support teaching and learning. The content is set out separately for each of the three endorsed titles, to ensure the focus is specific to the required learning and progression related to that field of study. There is, however, considerable comparability between many areas of learning that enables much of the content to be co-taught. This reflects the core principles in design and technology that are common to all.

In order to make clear whether the principles refer to design or technical principles, these are also highlighted down the left-hand side of the content.

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.

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 higher tier GCSE (9–1) learning.

It is a requirement that 15% of the marks within the written exam for Fashion and Textiles and Product Design assess the use of mathematical skills at a level of demand which is not lower than that expected at higher tier GCSE (9–1) Mathematics. Within Design Engineering this requirement is 25%, this extra 10% covering the specific mathematical skills associated with scientific engineering formulae.

Learners are permitted to use a scientific or graphical calculator for their written exam. Calculators are subject to the rules in the document *Instructions for Conducting Examinations* published annually by JCQ (www.jcq.org.uk).

The scientific knowledge is integrated into the content and outlined in Appendix 5d.

Within Appendix 5c and 5d there are formulae that learners are expected to be able to recall when responding to mathematical questions in the written examination. Those in Appendix 5d are only relevant to learners following the Design Engineering endorsed title.

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

 = Maths

 = Science

The subject content of this component 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; making; consideration of manufacture and production; critiquing; reviewing values and ethics.

2e. Principles of Design Engineering (H004/01)

The subject content of this component is focused towards electronics and engineered products and systems and their analysis in respect of:

- materials and components, and their selection and uses in products/systems
- wider issues affecting design decisions.

It is important that materials, components and systems are studied from the perspective of analysing modern engineered products. Learners should gain practical experience of using materials, components and systems and, where possible, the content which follows should be learned through applied practical activities, set within realistic design scenarios.

The aim of the component is to give them a framework for analysing existing products/systems that enables learners to make considered selections of appropriate materials, components, systems and manufacturing processes when designing.

The component brings together the knowledge, understanding and skills acquired in the NEA.

1. Identifying requirements

DESIGNING PRINCIPLES

Considerations	*Maths & Science*
1.1 What can be learnt by exploring contexts that design solutions are intended for?	
a. Understand that all design practice is context dependent and that investigations are required to identify what makes a context distinct in relation to: i. environment and surroundings ii. user requirements iii. economic and market considerations iv. product opportunities.	
1.2 What can be learnt by undertaking stakeholder analysis?	
a. Demonstrate an understanding of methods used for investigating stakeholder requirements, such as: • user-centred design and stakeholder analysis • SWOT analysis • focus groups • qualitative observations • market research to identify gaps for new products or opportunities to update existing products.	

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TECHNICAL PRINCIPLES

Considerations	*Maths & Science*
1.3 How can usability be considered when designing prototypes?	
a. Learners should be able to analyse and evaluate factors that may need consideration in relation to the user interaction of a design solution, including: i. the impact of a solution on a user's lifestyle ii. the ease of use and inclusivity of products iii. ergonomic considerations and anthropometric data to support ease of use iv. aesthetic considerations.	
b. Demonstrate an understanding of the ergonomic factors that may need considering when developing engineered products, including: i. anthropometric data to help define design parameters associated with the human body ii. user comfort, layout of controls, software user-interface.	

2. Learning from existing products and practice

DESIGNING PRINCIPLES

Considerations	*Maths & Science*
2.1 Why is it important to analyse and evaluate products as part of the design and manufacturing process?	
a. Analyse and evaluate the features and methods used in existing products and design solutions, to inform opportunities and constraints that may influence design decisions to offer product enhancement, including: i. the context of the existing product and the context of future design decisions ii. the multiple materials and components used iii. methods of construction and manufacture iv. how functionality is achieved v. the ease of use, including; ergonomic and anthropometric considerations vi. inclusivity of products and appropriate considerations of application to a wide variety of users vii. fitness for purpose viii. the impact on user lifestyles ix. the effect of trends, taste and/or style x. the effect of marketing and branding xi. the considerations of how to get a product to market.	
2.2 Why is it important to understand technological developments in design engineering?	
a. Be able to critically evaluate how new and emerging technologies influence and inform the evolution and innovation of products and systems in both contemporary and potential future scenarios, including consideration of blue sky and incremental innovation.	

	Considerations	*Maths & Science*
2.3 Why is it important to understand both past and present developments in design engineering?		
a.	Recognise how past and present design engineers, technologies and design thinking have influenced the style and function of products from different perspectives, including: i. the impact on industry and enterprise ii. the impact on people in relation to: lifestyle, culture and society iii. the impact on the environment iv. consideration of sustainability.	
b.	Understand how key historical movements and figures and their methods have had an influence on future developments.	
2.4 What can be learnt by examining lifecycles of products?		
a.	Demonstrate an understanding of a product's marketing lifecycle from initial launch to decline in popularity, such as: • consideration of initial demand, growth in popularity and decline over time • methods used to create more demand and maintain a longer product popularity.	

3. Implications of wider issues

DESIGNING PRINCIPLES

TECHNICAL PRINCIPLES

	Considerations	*Maths & Science*
	3.1 What factors need to be considered when designing and manufacturing products to overcome possible conflicts between moral and commercial factors?	
a.	Understand how social, ethical and environmental issues have influenced and been impacted by past and present developments in design practice and thinking, including: i. the source and origin of materials; and the ecological and social footprint of materials ii. the depletion and effects of using natural sources of energy and raw materials iii. planned obsolescence iv. buying trends v. environmental incentives and directives.	
	3.2 What energy factors need to be considered when developing design solutions?	
a.	Understand wider issues relating to the selection of energy sources, storage, transmission and utilisation in order to appropriately select them for use.	
	3.3 How can skills and knowledge from other subject areas, including mathematics and science, inform decisions in design engineering?	
a.	Demonstrate an understanding of the need to incorporate knowledge from other experts and subjects to inform design and manufacturing decisions, including the areas of science and mathematics.	
b.	Understand how undertaking primary and secondary research and being able to interpret technical data and information from specialist websites and publications supports design development.	

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4. Design thinking and communication

TECHNICAL PRINCIPLES

DESIGNING & MAKING PRINCIPLES

	Considerations	*Maths & Science*
4.1 How do designer engineers use annotated 2D and 3D sketching and digital tools to graphically communicate ideas?		
a.	Demonstrate an understanding of how to use annotated sketching and digital tools to graphically communicate ideas and sketch modelling to explore possible improvements, in terms of physical requirements, such as: • function, usability, construction, movement, stability, composition, strength • aesthetic qualities • manufacturing processes • suitability of materials and components.	
b.	Demonstrate an understanding of methods used to represent systems and components to inform third parties, such as: • constructional diagrams/working drawings • digital visualisations • circuit and system diagrams • flowcharts with associated symbols • prototypes and models.	
4.2 How do industry professionals use digital design tools to support and communicate the exploration, innovation and development of design ideas?		
a.	Demonstrate an understanding of how digital design software, including CAD and CAE are used during product development, such as: • visual presentation, rendering and photo-quality imaging • product simulation and systems simulation • scientific analysis of real-world physical factors to determine whether a product will break or work the way it was intended.	
4.3 How do design engineers use different approaches to design thinking to support the development of design ideas?		
a.	Awareness of different strategies, techniques and approaches to explore, create and evaluate design ideas, including: • iterative designing • user-centred design • circular economy • systems thinking.	
b.	The importance of collaboration to gain specialist knowledge from across subject areas when delivering solutions in the design and manufacturing industries.	
c.	Understand how design engineers use system design processes to define and develop systems that satisfy specified requirements of users using the three sub-tasks of: i. user-interface design ii. data design iii. process design.	

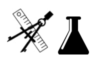
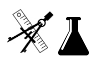
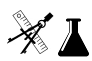
5. Material and component considerations

Considerations	*Maths & Science*
5.1 What factors influence the selection of materials that are used in engineered products?	
a. Understand that the selection of materials and components is influenced by a range of factors, including: i. functional performance ii. aesthetics iii. cost and availability iv. properties and characteristics v. environmental considerations vi. social, cultural and ethical factors.	
5.2 What materials and components should be selected when designing and manufacturing products and prototypes in Design Engineering?	
a. Understand that most products consist of multiple materials and that design engineers are required to discriminate between them appropriately for their use, including: i. ferrous, non-ferrous and alloy metals, such as: ○ mild steel, aluminium and brass. ii. thermo softening and thermosetting polymers, such as: ○ HIPS, ABS and polyester resin, epoxy resin and polyimides. iii. timbers and manufactured boards, such as: ○ oak, plywood and MDF. iv. textiles used for reinforcement and coverings, such as: ○ geotextiles used in civil engineering and construction. v. composite materials, such as: ○ fibre-reinforced plastics, glass-reinforced plastics (GRP) and carbon fibre (CFRP). vi. smart materials, such as: ○ shape memory alloy, motion control gel, self-healing materials, thermochromic, photochromic and electrochromic materials. vii. modern materials, such as: ○ sandwich panels, e-textiles, rare earth magnets, high performance alloys and super-alloys, graphene and carbon nanotubes.	
5.3 Why is it important to consider the properties/characteristics of materials when designing and manufacturing engineered products?	
a. Understand the characteristics and properties of materials that are significant in Design Engineering, such as: • density, tensile strength, strength to weight ratio, hardness, durability, thermal and electrical conductivity, corrosion resistance, stiffness, elasticity, plasticity, impact resistance, malleability and ductility, machinability.	
b. Understand how the available forms, costs and properties of materials contribute to the decisions about suitability of materials when developing and manufacturing their own products.	

2

TECHNICAL PRINCIPLES

6. Technical Understanding

Considerations	*Maths & Science*
6.1 What considerations need to be made about the structural integrity of a design solution?	
a. Learners should understand how and why some materials and/or system components need to be reinforced or stiffened to withstand forces and stresses to fulfil the structural integrity of products.	
b. Learners should understand processes that can be used to ensure the structural integrity of a product, such as: • triangulation • reinforcing.	
6.2 How do mechanisms provide functionality to products and systems?	
a. Demonstrate an understanding of the functions that mechanical devices offer to products, providing different types of motion, including: i. rotary ii. linear iii. reciprocating iv. oscillating.	
b. Demonstrate an understanding of devices and systems that are used to change the magnitude and direction of forces and torques, including: i. gears, cams, pulleys and belts, levers, linkages, screw threads worm drives, chain drives and belt drives ii. epicyclic gear systems iii. bearings and lubrication iv. efficiency in mechanical systems.	
6.3 What forces need consideration to ensure structural and mechanical efficiency?	
a. Demonstrate an understanding of static and dynamic forces in structures and how to achieve rigidity, including: i. tension, compression, torsion and bending ii. stress, strain and elasticity iii. mass and weight iv. rigidity v. modes of failure.	
6.4 How can electronic systems offer functionality to design solutions?	
a. Demonstrate an understanding of how electronic systems provide input, control and output process functions, including: i. switches and sensors, to produce signals in response to a variety of inputs ii. programmable control devices iii. signal amplification iv. devices to produce a variety of outputs including light, sound, motion.	

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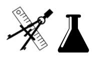
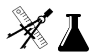
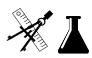
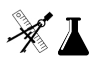
TECHNICAL PRINCIPLES

	Considerations	*Maths & Science*
b.	Demonstrate an understanding of the function of an overall system, referring to aspects, including: i. passive components: resistors, capacitors, diodes ii. inputs: sensors for position, light, temperature, sound, infra-red, force, rotation and angle iii. process control: programmable microcontroller iv. signal amplification: MOSFET, driver ICs v. outputs: LED, sounder, solenoid, DC motor, servo motor vi. analogue and digital signals and conversion between them vii. open and closed loop systems including feedback in a system and how it affects the overall performance viii. sub-systems and systems thinking.	
c.	Demonstrate an understanding of what can be gained from interfacing electronic circuits with mechanical and pneumatic systems and components, such as: • the ability to add electronic control as an input to mechanical or pneunamitc output • the use of flow restrictors to control cylinder speed • the use of sensors to measure rotational speed, strain/force, distance.	
d.	Demonstrate an understanding of networking and of communication protocols, such as: • wireless devices, such as: RFID, NFC, Wi-Fi, bluetooth • embedded devices • smart objects • networking electronic products to exchange information.	
e.	Demonstrate an understanding of the basic principles of electricity, including: i. voltage ii. current iii. ohms law iv. power	
6.5 How can programmable devices and smart technologies provide functionality in system design?		
a.	Demonstrate an understanding of how smart materials change the functionality of engineered products, such as: • colour changes, shape-shifting, motion control, self-cleaning and self-healing.	
b.	Demonstrate an understanding of how programmable devices are used to add functionality to products, relating to coding of and specific applications of programmable components, such as: • how they incorporate enhanced features that can improve the user experience and solve problems in system design • how they use basic techniques for measuring, controlling, storing data and displaying information in practical situations • electronic prototyping platforms and interated development environments (IDE) for simulation in virtual environments • the use of programmable components and microcontrollers found in products and systems such as robotic arms or cars • creating flowcharts to describe processes and decisions within a process to control input and output components.	

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DESIGNING & MAKING PRINCIPLES

TECHNICAL PRINCIPLES

7. Manufacturing processes and techniques

Considerations		*Maths & Science*
7.1 How can materials and processes be used to make iterative models?		
a.	Understand that 3D iterative models can be made from a range of materials and components to create block models and working prototypes to communicate and test ideas, moving parts and structural integrity.	
b.	Demonstrate an understanding of simple processes that can be used to model ideas using hand tools and digital tools such as rapid prototyping, or digital simulation packages.	
7.2 How can materials and processes be used to make final prototypes?		
a.	Understand how to select and safely use of common workshop tools, equipment and machinery to manipulate materials by methods of: i. wasting/subtraction processes such as cutting, drilling, turning, milling ii. addition processes such as soldering, brazing, welding, adhesives, fasteners iii. deforming and reforming processes such as bending, vacuum forming.	
b.	Demonstrate an understanding of the role of computer-aided manufacture (CAM) and computer-aided engineering (CAE) to fabricate parts, such as: • additive manufacturing (3D printing) to fabricate a usable part • subtractive CNC manufacturing such as laser/plasma cutting, milling, turning and routing.	
c.	Demonstrate an understanding of measuring instruments and techniques used to ensure that products are manufactured accurately or within tolerances as appropriate.	
d.	Understand how the available forms, costs and working properties of materials contribute to the decisions about suitability of materials when developing and manufacturing their own products.	

TECHNICAL PRINCIPLES

2

Considerations	*Maths & Science*
7.3 How can materials and processes be used to make commercial products?	
a. Demonstrate an understanding of the industrial processes and machinery used for manufacturing component parts in various materials, including: i. polymer moulding methods, such as injection moulding, blow moulding, compression moulding and thermoforming ii. metal casting methods such as sand casting and die casting iii. sheet metal forming methods using equipment such as punches, rollers, shears and stamping machines.	
b. Demonstrate an understanding of the industrial methods used for assembling electronic products, such as: • surface mount technology (SMT): PCB assembly using solder stencils, pick-and-place machines and reflow soldering ovens.	
c. 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.	

8. Viability of design solutions

	Considerations	*Maths & Science*
DESIGNING & MAKING PRINCIPLES	**8.1 How can design engineers assess whether a design solution meets its stakeholder requirements?**	
	a. Critically evaluating how a design solution has met its intended requirements, including: i. functionality ii. ease of use and inclusivity of the solution iii. user needs.	
	b. Demonstrate an understanding of the needs and methods for testing design solutions with stakeholders throughout the design development, and when testing the success of a product or system.	
	c. Demonstrate an understanding of the importance of testing the feasibility of getting a product to market including considerations of cost, packaging and appeal.	
TECHNICAL PRINCIPLES	**8.2 How can design engineers assess whether a design solution meets the criteria of technical specifications?**	
	a. Demonstrate an understanding of the methods and importance of undertaken physical testing on a product to ensure it meets the criteria it is meant to fulfil, including: i. functionality ii. accuracy iii. performance.	

9. Health and safety

	Considerations	*Maths & Science*
TECHNICAL PRINCIPLES	**9.1 How can safety be ensured when working with materials in a workshop environment?**	
	a. Demonstrate an understanding of safe working practices in the workshop situation, including: i. understanding the need for risk assessments ii. identifying hazards and implementing control measures to minimise risks.	
MAKING PRINCIPLES	b. Demonstrate an understanding of how to work safely with specialist tools, techniques, processes, equipment and machinery during the design and manufacture of products.	

2f. Principles of Fashion and Textiles (H005/01)

The content of this component is focused towards fashion and textiles products and applications and their analysis in respect of:

- materials, components and their selection and uses in fashion and textiles
- industrial and commercial practices
- wider issues affecting design decisions.

It is essential that materials and components are studied from the perspective of analysing modern consumer products that are designed to meet identified consumer needs, their design and manufacture, and taught within the context of product development and industrial and commercial practices.

Learners should be familiar with a range of materials and components used in the manufacture of commonly available products, and are able to make critical comparisons between them. The aim of this component is to give learners a framework for analysing existing products that enables them to make considered selections of appropriate materials and manufacturing processes when designing.

The component brings together the knowledge, understanding and skills acquired in the NEA.

2

1. Identifying requirements

DESIGNING PRINCIPLES

Considerations	*Maths & Science*
1.1 What can be learnt by exploring contexts that design solutions are intended for?	
a. Understand that all design practice is context dependent and that investigations are required to identify what makes a context distinct in relation to: i. environment and surroundings ii. user requirements iii. economic and market considerations iv. product opportunities.	
1.2 What can be learnt by undertaking stakeholder analysis?	
a. Demonstrate an understanding of methods used for investigating stakeholder requirements, such as: • user-centred design and stakeholder analysis • SWOT analysis • focus groups • qualitative observations • market research to identify gaps for new products or opportunities to update existing products • use of forecasting companies to identify technological and fashion trends.	

TECHNICAL PRINCIPLES

Considerations	*Maths & Science*
1.3 How can usability be considered when designing prototypes?	
a. Learners should be able to analyse and evaluate factors that may need consideration in relation to the user interaction of a design solution, including: i. the impact of a solution on a user's lifestyle ii. the ease of use and inclusivity of products iii. ergonomic considerations and anthropometric data to support ease of use iv. aesthetic considerations.	
b. Demonstrate an understanding of the ergonomic factors that may need considering when developing fashion and textiles products, including: i. anthropometric data and clothes sizes to help define design parameters associated with the human body ii. user comfort and ease of use.	

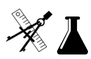
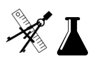
2. Learning from existing products and practice

DESIGNING PRINCIPLES

Considerations	*Maths & Science*
2.1 Why is it important to analyse and evaluate products as part of the design and manufacturing process?	
a. Analyse and evaluate the features and methods used in existing products and design solutions, to inform opportunities and constraints that may influence design decisions to offer product enhancement, including: i. the context of the existing product and the context of future design decisions ii. the multiple materials and components used iii. methods of construction and manufacture iv. how functionality is achieved v. the ease of use, including; ergonomic and anthropometric considerations vi. inclusivity of products and appropriate considerations of application to a wide variety of users vii. fitness for purpose viii. the impact on user lifestyles ix. the effect of trends, taste and/or style x. the effect of marketing and branding xi. the considerations of how to get a product to market.	
2.2 Why is it important to understand technological developments in fashion and textiles?	
a. Be aware of and able to critically evaluate how new and emerging technologies in fashion and textiles influence and inform the function and design of products, such as: • military textiles • nano fibres • medical textiles • conductive dyes • functional sportswear.	

DESIGNING PRINCIPLES	*Considerations*	*Maths & Science*
	2.3 Why is it important to understand both past and present developments in fashion and textiles?	
	a. Recognise how past and present designers, technologies and design thinking have influenced the style and function of products from different perspectives, including: i. the impact on industry and enterprise ii. the impact on people in relation to: lifestyle, culture and society iii. the impact on the environment iv. consideration of sustainability.	
	b. Understand how key historical movements and figures and their methods have had an influence on future developments in fashion and textiles design.	
	2.4 What can be learnt by examining lifecycles of products?	
	a. Demonstrate an understanding of a product's marketing lifecycle from initial launch to decline in popularity, such as: • consideration of initial demand, growth in popularity and decline over time • methods used to create more demand and maintain a longer product popularity.	

3. Implications of wider issues

	Considerations	*Maths & Science*
DESIGNING PRINCIPLES	**3.1 What factors need to be considered whilst investigating design possibilities?**	
	a. Understand how social, ethical and environmental issues have influenced and been impacted by past and present developments in design practice and thinking, including: i. the source and origin of fibres; and the ecological and social footprint of materials ii. the depletion and effects of using natural sources of energy and raw materials iii. planned obsolescence iv. buying trends v. environmental incentives and directives.	
	3.2 How can skills and knowledge from other subject areas, including mathematics and science, inform decisions in fashion and textiles?	
TECHNICAL PRINCIPLES	a. Demonstrate an understanding of the need to incorporate knowledge from other experts and subjects to inform design and manufacturing decisions, including the areas of science and mathematics.	
	b. Understand how undertaking primary and secondary research and being able to interpret technical data and information from specialist websites and publications supports design development.	

2

4. Design thinking and communication

TECHNICAL PRINCIPLES

DESIGNING & MAKING PRINCIPLES

Considerations		*Maths & Science*
4.1 How do fashion and textiles designers use annotated 2D and 3D sketching and digital tools to graphically communicate ideas?		
a.	Demonstrate an understanding of how to use annotated sketching and digital tools to graphically communicate ideas and sketch modelling to explore possible improvements, in terms of physical requirements, such as: • function, usability, construction, movement, stability, composition, strength • aesthetic qualities • manufacturing processes • suitability of materials and components.	
b.	Demonstrate an understanding of methods used to communicate the construction of design solutions to inform third parties, such as: • working/technical drawings • digital visualisations • pattern drafting with relevant cutting and construction symbols • economical lay plans • prototypes and toiles.	
4.2 How do industry professionals use digital design tools to support and communicate the exploration, innovation and development of design ideas?		
a.	Demonstrate an understanding of how digital design software is used during product development, such as: • visual presentation, rendering and photo-quality imaging • product simulation.	
4.3 How do fashion and textiles designers use different approaches to design thinking to support the development of design ideas?		
a.	Awareness of different strategies, techniques and approaches to explore, create and evaluate design ideas, including: • iterative designing • user-centred design • circular economy • systems thinking.	
b.	The importance of collaboration to gain specialist knowledge from across subject areas when delivering solutions in the design and manufacturing industries.	

TECHNICAL PRINCIPLES

5. Material considerations

Considerations	*Maths & Science*
5.1 What factors influence the selection of materials that are used in products?	
a. Understand that the selection of materials and components is influenced by a range of factors, including: i. functional performance ii. aesthetics iii. cost and availability iv. properties and characteristics v. environmental considerations vi. social, cultural and ethical factors.	⚗
5.2 What materials should be selected when designing and manufacturing products and prototypes in fashion and textiles?	
a. Understand that most products consist of multiple materials and that fashion and textiles designers are required to discriminate between them appropriately for their use, including: i. natural and synthetic textiles ii. polymers used in component parts, blended textiles iii. metals used for jewellery, component parts and conductive threads iv. wood used for component parts v. rubber used for performance and functionality.	⚗
b. Demonstrate an understanding of the classification and source of textile fibres and materials, including: i. natural animal textiles, such as: ○ wool, silk, cashmere ii. natural plant textiles, such as: ○ cotton and flax iii. natural mineral textiles, such as: ○ glass fibre iv. synthetic textiles, such as: ○ nylon, polyester and acrylic.	⚗
c. Demonstrate an understanding of the classification of different yarns, including: i. single fibre spun yarns ii. mixed blended fibre spun yarns, such as cotton/polyester and wool/acrylic iii. filament yarns iv. fancy yarns, such as boucle, chenille and lurex v. bulked and textured yarns.	⚗
d. Demonstrate an understanding of the classification of different structures of fabrics, including: i. knitted fabrics, including weft, warp and pile knits through hand and machine knitting	

Considerations	*Maths & Science*
ii. structured fabrics, such as knotted and braided fabrics/structures, 3D novel structures iii. woven fabrics, such as brocades, jacquards, plaid, tartans and crêpe iv. non-woven fabrics, such as felt and heated, mechanical and adhesive bonded fabrics v. microfibres.	
5.3 Why is it important to consider the properties/characteristics of materials when designing and manufacturing products?	
a. Understand why the characteristics and properties of the above fibres, yarns and fabrics make them suitable for use in a variety of products dependent on the contextual application, including: tensile strength, softness, texture, durability, resilience, weight, stiffness, elasticity, flammability, absorbency, washability, breathability, thermal and electrical conductivity, resistance to decay, biodegradable.	
b. Understand how the available forms, costs and properties of materials contribute to the decisions about suitability of materials when developing and manufacturing their own products.	

6. Technical Understanding

Considerations	*Maths & Science*
6.1 What considerations need to be made about the structural integrity of a design solution?	
a. Learners should understand how and why some materials and/or system components need to be reinforced or stiffened to withstand forces and stresses to fulfil the structural integrity of products.	
b. Understand how constructional solutions can be used to make fabrics suitable for purpose, including: i. the difference between whole garment knitting and fully fashioned panels ii. shaping through the addition of boning for structural integrity iii. reduction of fullness according to the design; darts, gathers, elastic, pleats iv. quilting to add thermal insulation.	
c. Understand how a variety of components fulfil functional requirements through their application in the manufacture of a textiles product, including: i. fastenings, such as: ○ button and buttonholes, zips, poppers, velcro, hooks and eyes, parachute clips, eyelets and ties and toggles ii. decorative components, such as: ○ appliquéd motifs, ribbon, lace, braid, beads, sequins and piping iii. constructional components, such as: ○ shoulder pads, cuffing and interfacing.	

TECHNICAL PRINCIPLES

Considerations	*Maths & Science*
6.2 How can products be designed to function effectively within their surroundings?	
a. Demonstrate an understanding of surface finishes, decorative techniques and surface pattern technology that can be used to enhance the aesthetic qualities of products, including: i. printing and dyeing techniques, such as screen, block, roller and discharge printing, and methods of resist and vat dyeing. ii. biological techniques, such as the use of natural enzymes to create stone wash effects on jeans iii. embroidery and apliqué techniques iv. mechnical process, such as embossing and heat setting used on thermo polymer fabrics to shape or create pleats. v. digital technolgies used to print, embose and cut designs, such as dye sublimation printing and use of a laser cutter.	
b. Understand how materials and products can be finished in different ways to prevent corrosion or decay, or enhance their performance for their intended purpose, including: i. methods of laminating to strengthen fabrics ii. chemicals finishes used to improve a fabrics performance such as; water repellence, stain resistance, flame resistance, antistatic, moth-proofing, anti-pilling, rot proofing, anti-felting, hygienic (sanitised) iii. breathable coatings for high performance wear iv. transparent coatings on fine fabrics.	
6.3 What opportunities are there through using smart materials, e-textiles and technical textiles within products?	
a. Demonstrate an understanding of how smart materials change the functionality of products, such as: • colour changes using thermochromic, photochromic and electrochromic fibres • shape-shifting such as shape memory alloy • breathable membranes like Gore-Tex.	
b. Understand and recognise how e-textiles are innovative, wearable textiles that incorporate conductive fibres or elements directly into the textile itself, integrating functional performance into products. Consider developments, such as: • conductive pigments • fibretronics • use of programmable microcontrollers with sensors and actuators.	
c. Understand how technical textiles are developed for a range of industry sectors including: • geotextiles used in civil engineering, coastal engineering and the construction industry • the development of fabrics for hi-tech clothing, such as superfabric.	

2

DESIGNING & MAKING PRINCIPLES

TECHNICAL PRINCIPLES

7. Manufacturing processes and techniques

Considerations	*Maths & Science*
7.1 How can materials and processes be used to make iterative models?	
a. Understand that iterative models can be made from a range of materials to create samples, toiles and other modelled concepts to communicate and test ideas, fit and structural integrity.	
b. Demonstrate an understanding of how to develop iterative models using pattern making, pattern drafting and toiles to be able to test garments and form of other textiles products.	
c. Understand the use of both hand tools and digital tools such as rapid prototyping, or digital simulation packages to support the creation of iterative developments.	
7.2 How can materials and processes be used to make final prototypes?	
a. Recognise the order of assembly for different fashion and textiles products, including: i. assembly of fabric pieces including lining ii. addition of working parts such as zips and fastenings iii. reduction of fullness according to the design; darts, gathers, elastic, pleats iv. adding embellishment v. adding functional details; pockets and quilting.	 
b. Demonstrate an understanding of the tools, processes and machinery required to accurately manufacture fashion and textiles products in a workshop environment, including: i. dyeing processes ii. hand and digital printing processes such as, screen, roller and transfer printing methods iii. transferring pattern markings using tailor's chalk, tailor's tacks and tracing wheel iv. cutting fabrics using fabric shears or a cutting wheel v. joining fabrics using a sewing machine, overlocker, needles and pins vi. finishing fabrics and garments using a steam iron.	
c. Understand how digital technology, including the use of computer-aided design (CAD) and computer-aided manufacture (CAM) can be used in the making of final prototypes.	
d. Understand how the design of templates and patterns can ensure quality and accuracy when making a final prototype.	
e. Understand how the available forms, costs and working properties of materials contribute to the decisions about suitability of materials when developing and manufacturing their own prototypes.	

DESIGNING & MAKING PRINCIPLES	*Considerations*	*Maths & Science*
	7.3 How can materials and processes be used to make commercial products?	
	a. Recognise the tools, processes and machinery required to complete a range of textiles products in industry, including: i. dyeing and printing processes such as, screen and roller printing methods ii. transferring pattern markings using thread markers, drills and hot notchers iii. cutting fabrics using multi-ply fabric cutting computer-controlled knives, lasers, water jets, plasma or ultra sound to cut fabric and prevent fraying iv. joining fabrics using lockstitch, overlocker, seamcover, linking, automatic buttonhole and computer-controlled sewing machines v. finishing fabrics and garments using pressing units, ironing and sleeve boards, steam dollys, tunnel finishers and flatbed presses for trousers.	Maths, Science
	b. 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.	

8. Viability of design solutions

	Considerations	*Maths & Science*
DESIGNING & TECHNICAL PRINCIPLES	**8.1 How can designers assess whether a design solution meets its stakeholder requirements?**	
	a. Critically evaluating how a design solution has met its intended requirements, including: i. functionality ii. ease of use and inclusivity of the solution iii. user needs.	Maths
	b. Demonstrate an understanding of the needs and methods for testing design solutions with stakeholders throughout the design development, and when testing the success of a product.	Maths
	c. Demonstrate an understanding of the importance of testing the feasibility of getting a product to market, including: considerations of cost, packaging and appeal.	Maths
TECHNICAL PRINCIPLES	**8.2 How can fashion and textiles designers assess whether a design solution meets the criteria of technical specifications?**	
	a. Demonstrate an understanding of the methods and importance of undertaken physical testing on a product to ensure it meets the criteria it is meant to fulfil, including: i. functionality ii. accuracy iii. performance.	Science

9. Health and safety			
		Considerations	*Maths & Science*
TECHNICAL PRINCIPLES		**9.1 How can safety be ensured when working with materials in a workshop environment?**	
	a.	Demonstrate an understanding of safe working practices in the workshop situation, including: i. understanding the need for risk assessments ii. identifying hazards and implementing control measures to minimise risks.	
MAKING PRINCIPLES	b.	Demonstrate an understanding of how to work safely with specialist tools, techniques, processes, equipment and machinery during the design and manufacture of products.	

2g. Principles of Product Design (H006/01)

The content of this component is focused towards products and applications and their analysis in respect of:

- materials, components and their selection and uses in products/systems
- industrial and commercial practices
- wider issues affecting design decisions.

It is essential that materials and components are studied from the perspective of analysing modern consumer products that are designed to meet identified consumer needs, their design and manufacture, and taught within the context of product development and industrial and commercial practices.

Learners should be familiar with a range of materials and components used in the manufacture of commonly available products, and be able to make critical comparisons between them. The aim of the component is to give learners a framework for analysing existing products that enables them to make considered selections of appropriate materials and manufacturing processes when designing.

The component brings together the knowledge, understanding and skills acquired in the NEA.

2

1. Identifying requirements

DESIGNING & MAKING PRINCIPLES

Considerations	*Maths & Science*
1.1 What can be learnt by exploring contexts that design solutions are intended for?	
a. Understand that all design practice is context dependent and that investigations are required to identify what makes a context distinct in relation to: i. environment and surroundings ii. user requirements iii. economic and market considerations iv. product opportunities.	
1.2 What can be learnt by undertaking stakeholder analysis?	
b. Demonstrate an understanding of methods used for investigating stakeholder requirements, such as: • user-centred design and stakeholder analysis • SWOT analysis • focus groups • qualitative observations • market research to identify gaps for new products or opportunities to update existing products • use of forecasting companies to identify technological and fashion trends.	

2

TECHNICAL PRINCIPLES

Considerations	*Maths & Science*
1.3 How can usability be considered when designing prototypes?	
a. Learners should be able to analyse and evaluate factors that may need consideration in relation to the user interaction of a design solution, including: i. the impact of a solution on a user's lifestyle ii. the ease of use and inclusivity of products iii. ergonomic considerations and anthropometric data to support ease of use iv. aesthetic considerations.	
b. Demonstrate an understanding of the ergonomic factors that may need considering when developing engineered products, including: i. anthropometric data to help define design parameters associated with the human body ii. user comfort, layout of controls, software user-interface.	

DESIGNING & MAKING PRINCIPLES

2. Learning from existing products and practice

Considerations	*Maths & Science*
2.1 Why is it important to analyse and evaluate products as part of the design and manufacturing process?	
a. Analyse and evaluate the features and methods used in existing products and design solutions, to inform opportunities and constraints that may influence design decisions to offer product enhancement, including: i. the context of the existing product and the context of future design decisions ii. the multiple materials and components used iii. methods of construction and manufacture iv. how functionality is achieved v. the ease of use, including; ergonomic and anthropometric considerations vi. inclusivity of products and appropriate considerations of application to a wide variety of users vii. fitness for purpose viii. the impact on user lifestyles ix. the effect of trends, taste and/or style x. the effect of marketing and branding xi. the considerations of how to get a product to market.	
2.2 Why is it important to understand technological developments in product design?	
a. Be able to critically evaluate how new and emerging technologies influence and inform the evolution and innovation of products in both contemporary and potential future scenarios.	

2

DESIGNING PRINCIPLES

Considerations	*Maths & Science*
2.3 Why is it important to understand both past and present developments in product design?	
a. Recognise how past and present product designers, technologies and design thinking have influenced the style and function of products from different perspectives, including: i. the impact on industry and enterprise ii. the impact on people in relation to: lifestyle, culture and society iii. the impact on the environment iv. consideration of sustainability.	
b. Understand how key historical movements and figures and their methods have had an influence on future developments in product design.	
2.4 What can be learnt by examining lifecycles of products?	
a. Demonstrate an understanding of a product's marketing lifecycle from initial launch to decline in popularity, such as: • consideration of initial demand, growth in popularity and decline over time • methods used to create more demand and maintain a longer product popularity.	

3. Implications of wider issues

DESIGNING & MAKING PRINCIPLES

TECHNICAL PRINCIPLES

Considerations	*Maths & Science*
3.1 What factors need to be considered whilst investigating design possibilities?	
a. Understand how social, ethical and environmental issues have influenced and been impacted by past and present developments in design practice and thinking, including: i. the source and origin of materials; and the ecological and social footprint of materials ii. the depletion and effects of using natural sources of energy and raw materials iii. planned obsolescence iv. buying trends v. environmental incentives and directives.	Maths, Science
3.2 How can skills and knowledge from other subject areas, including mathematics and science, inform decisions in product design?	
a. Demonstrate an understanding of the need to incorporate knowledge from other experts and subjects to inform design and manufacturing decisions, including the areas of science and mathematics.	Maths, Science
b. Understand how undertaking primary and secondary research and being able to interpret technical data and information from specialist websites and publications supports design development.	Maths

2

4. Design thinking and communication

TECHNICAL PRINCIPLES

	Considerations	*Maths & Science*
4.1 How do product designers use annotated 2D and 3D sketching and digital tools to graphically communicate ideas?		
a.	Demonstrate an understanding of how to use annotated sketching and digital tools to graphically communicate ideas and sketch modelling to explore possible improvements, in terms of physical requirements, such as: • function, usability, construction, movement, stability, composition, strength • aesthetic qualities • manufacturing processes • suitability of materials and components.	
b.	Demonstrate an understanding of methods used to communicate the construction of design solutions to inform third parties, such as producing: • working/technical drawings • digital visualisations • schematic diagrams and lay plans if appropriate • flowcharts with associated symbols • prototypes and models.	
4.2 How do industry professionals use digital design tools to support and communicate the exploration, innovation and development of design ideas?		
a.	Demonstrate an understanding of how digital design software is used during design development, such as: • visual presentation, rendering and photo-quality imaging • product simulation • scientific analysis of real-world physical factors to determine whether a product will break or work the way it was intended.	
4.3 How do product designers use different approaches to design thinking to support the development of design ideas?		
a.	Awareness of different strategies, techniques and approaches to explore, create and evaluate design ideas, including: • iterative designing • user-centred design • circular economy • systems thinking.	
b.	The importance of collaboration to gain specialist knowledge from across subject areas when delivering solutions in the design and manufacturing industries.	

DESIGNING & MAKING PRINCIPLES

5. Material and component considerations

Considerations	*Maths & Science*
5.1 What factors influence the selection of materials that are used in products?	
a. Understand that the selection of materials and components is influenced by a range of factors, including: i. functional performance ii. aesthetics iii. cost and availability iv. properties and characteristics v. environmental considerations vi. social, cultural and ethical factors.	
5.2 What materials should be selected when designing and manufacturing products and prototypes in product design?	
a. Understand that most products consist of multiple materials and that product designers are required to discriminate between them appropriately for their use, including: i. hardwoods and softwoods, such as: ○ oak, teak and beech; pine, spruce and fir. ii. manufactured boards, such as: ○ plywood, MDF and block board. iii. ferrous and non-ferrous metals, such as: ○ cast iron, mild steel and stainless steel; aluminum, copper. iv. metal alloys, such as: ○ brass, bronze and tungsten. v. thermoplastics and thermosetting polymers, such as: ○ PET, HDPE, PVC, LDPE, polypropylene, polystyrene and ABS; urea formaldehyde, epoxy resin and polyester resin. vi. natural and synthetic fibres, such as: ○ cotton, wool and silk; polyester and nylon. vii. textile fabrics, such as: ○ woven, non-woven, knitted and blended textiles. viii. composite materials, such as: ○ fibre-reinforced plastics, glass-reinforced plastics (GRP) and carbon fibre (CFRP). ix. modern materials, such as: ○ e-textiles, super-alloys, graphene, bioplastics and nanomaterials. x. smart materials, such as: ○ thermochromic, photochromic and electrochromic materials; shape memory alloy and shape memory polymers; conductive paints and e-textiles.	

2

TECHNICAL PRINCIPLES

	Considerations	*Maths & Science*
5.3 Why is it important to consider the properties/characteristics of materials when designing and manufacturing products?		
a.	Understand why the characteristics and properties of the materials in 5.2a. make them suitable for use in a variety of products dependent on the contextual application, including: density, strength, hardness, toughness, durability, strength to weight ratio, stiffness, elasticity, impact resistance, plasticity, malleability and ductility, corrosive resistance to chemicals and weather, flammability, absorbency, washability, thermal and electrical conductivity, resistance to decay, biodegradable.	
b.	Understand how the available forms, costs and properties of materials contribute to the decisions about suitability of materials when developing and manufacturing their own products.	

6. Technical understanding

TECHNICAL PRINCIPLES

	Considerations	*Maths & Science*
6.1 What considerations need to be made about the structural integrity of a design solution?		
a.	Learners should understand how and why some materials and/or system components need to be reinforced or stiffened to withstand forces and stresses to fulfil the structural integrity of products.	
b.	Learners should understand processes that can be used to ensure the structural integrity of a product, such as: • triangulation • reinforcing.	
6.2 How can products be designed to function effectively within their surroundings?		
a.	Understand how surface finishes and coatings can be used to enhance the appearance of products and the methods of preparing different surfaces to accept finishes to deliver a decorative, colourful and quality outcome.	
b.	Understand how materials and products can be finished in different ways to prevent corrosion or decay in the environment they are intended for, such as: • paints, varnishes, sealants, preservatives, anodising, plating, coating, galvanisation, cathodic protection and electroplating.	
6.3 What opportunities are there through using smart and modern technologies within products?		
a.	Demonstrate an understanding of how smart materials change the functionality of products, such as: • colour changes, shape-shifting, motion control, self-cleaning and self-healing • smart materials used in medical procedures to act in a way that conventinonal materials and processes would not previously have permitted.	
b.	Understand how modern technologies can support the function of products, such as: • programmable components that can be built into a product and coded to respond to inputs that command an action.	

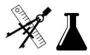
7. Manufacturing processes and techniques

DESIGNING & MAKING PRINCIPLES

TECHNICAL PRINCIPLES

	Considerations	*Maths & Science*
	7.1 How can materials and processes be used to make iterative models?	
a.	Understand that 3D iterative models can be made from a range of materials and components to create block models and working prototypes to communicate and test ideas, moving parts and structural integrity.	
b.	Demonstrate an understanding of simple processes that can be used to model ideas using hand tools and digital tools such as rapid prototyping, or digital simulation packages to support the creation of iterative developments.	
	7.2 How can materials and processes be used to make final prototypes?	
a.	Understand methods of joining similar and dissimilar materials within products to fulfill the following functions: i. permanently joining materials to include constructional joints ii. temporarily/semi-permanently joining materials iii. adhesion and heat iv. using standard components and fixings.	
b.	Demonstrate an understanding of a variety of processes, tools and machinery used to accurately manufacture final prototypes in the workshop made from wood, metal and polymers, including: i. wasting techniques such as drilling, sawing, shaping, abrading ii. moulding methods such as thermoforming and vacuum forming iii. milling metals and turning woods iv. casting of metals such as lost wax casting, sand casting, low temperature and resin casting v. forming and lamination vi. bending, rolling and forming sheet material.	
c.	Understand how digital technology, including the use of computer-aided design (CAD) and computer-aided manufacture (CAM) can be used in the making of final prototypes.	
d.	Understand how the design of templates, jigs, formers and moulds can ensure quality and accuracy when making a final prototype.	
e.	Understand how the available forms, costs and working properties of materials contribute to the decisions about suitability of materials when developing and manufacturing their own prototypes.	

TECHNICAL PRINCIPLES

	Considerations	*Maths & Science*
	7.3 How can materials and processes be used to make commercial products?	
a.	Understand commercial production processes and machinery used to manufacture products to different scales of production, including: i. moulding methods such as injection, rotational, compression, extrusion and blow ii. thermoforming; vaccum forming iii. die casting and sand casting iv. sheet metal forming and stamping v. automated material handling systems vi. robotic arms to stack, assemble, join and paint parts.	
b.	Understand how the design of jigs, fixtures, presses, formers and moulds in commercial production are used to ensure consistent accuracy and quality and different scales of production methods.	
c.	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.	

8. Viability of design solutions

DESIGNING & MAKING PRINCIPLES

	Considerations	*Maths & Science*
	8.1 How can designers assess whether a design solution meets its stakeholder requirements?	
a.	Critically evaluating how a design solution has met its intended requirements, including: i. functionality ii. ease of use and inclusivity of the solution iii. user needs.	
b.	Demonstrate an understanding of the needs and methods for testing design solutions with stakeholders throughout the design development, and when testing the success of a product.	
c.	Demonstrate an understanding of the importance of testing the feasibility of getting a product to market including considerations of cost, packaging and appeal.	

TECHNICAL PRINCIPLES

	8.2 How can product designers assess whether a design solution meets the criteria of technical specifications?	
a.	Demonstrate an understanding of the methods and importance of undertaken physical testing on a product to ensure it meets the criteria it is meant to fulfil, including: i. functionality ii. accuracy iii. performance.	

9. Health and safety		
	Considerations	*Maths & Science*
TECHNICAL PRINCIPLES	**9.1 How can safety be ensured when working with materials in a workshop environment?**	
	a. Demonstrate an understanding of safe working practices in the workshop situation, including: i. understanding the need for risk assessments ii. identifying hazards and implementing control measures to minimise risks.	
MAKING PRINCIPLES	b. Demonstrate an understanding of how to work safely with specialist tools, techniques, processes, equipment and machinery during the design and manufacture of products.	

2h. Introduction to non-exam assessment (NEA) content – Product Development (H004/02, H005/02, H006/02)

The non-exam assessment for this qualification requires learners to demonstrate their ability to critically analyse a current product in relation to a given context and propose realistic improvements or adaptations in response to the needs of stakeholders.

Through first-hand interaction with a product, learners should see themselves as part of the iterative design process, to design and develop further iterations of it, enabling them to fully appreciate how the lifecycle of a product is reviewed, developed and extended for the commercial market place.

The structure of this component allows learners the opportunity to formalise an understanding of how decisions and compromises are made in bringing a product to market. Central to this is the critical analysis of current products, and detailed discussions with stakeholders throughout the iterative process to determine where the most pertinent improvements might be targeted.

At the heart of any product development is the need for an iterative design approach, which will allow for three key 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, whether in two or three dimensions. 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 can be developed into successful products in the future.

Central to any iterative designing process is the thinking and management around the development of the processes, which is sometimes very complex, requiring learners to manage competing problems to progress their improvements. Mistakes are an inherent part of this learning experience and should not be hidden, but rather evidenced, analysed and either solved or dismissed against a set criteria.

The content of the NEA is laid out to clarify the interrelationships of 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 process.

Learners are required to demonstrate their understanding that design and technology activity exists in contexts that influence the outcomes.

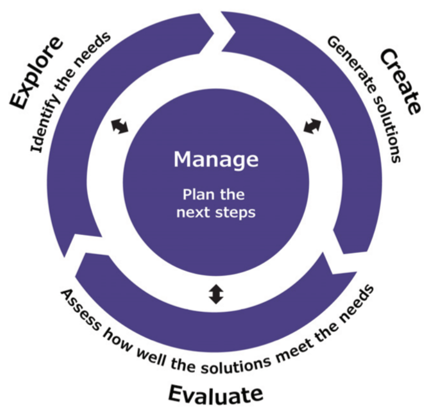


Fig. 3 Iterative Design Wheel showing key activities

In order to facilitate this component, three contexts will be set by OCR each year from which learners should set their own 'product development' challenge. The 'contexts' will:

- be open-ended, avoiding predetermining the materials or processes to be used in the analysis of a product
- be accessible and relevant to the full range of endorsed titles for learners own interpretations.

Explore (AO1)

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

- *Who* are the stakeholders? e.g. using personas with an interest in the product.
- *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 investigation that helps understanding of the physical, organisational, social and cultural environments.
- *Why* do stakeholders do what they do? e.g. establishing what stakeholders want to achieve by using/promoting the product.
- *What* is the impact of stakeholders 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 to develop the product should 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 absolute 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 final prototype(s) that resembles the intended iterative design solution for presentation and evaluation.

The final design solution will be required to be presented through the making of a final functioning and quality prototype. This does not need to be made to full scale or using industrial techniques, but learners should understand the manufacturing processes used to develop a working product.

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.

2

Evaluate (AO3)

Evaluation establishes whether the need(s) of the user(s) and stakeholder(s) have been met. Ideas 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, further 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 product development. 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 right indicates where learners may consider mathematical skills or knowledge from wider subjects including science.

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 Product Development NEA, learners should:						
1.	**Identifying requirements**		**Explore**	**Create**	**Evaluate**	**Maths & Science**
	a.	Understand methods of investigating and analysing contexts in order to identify problems and opportunities that offer potential for an innovative design solution.	⬤	•	•	
	b.	Be able to develop and prioritise specific issues identified for attention in order to produce a design brief and determine the next steps for design development.	⬤	●	•	
	c.	Understand the central importance of obtaining and taking account of the needs, wants, values and views of users and stakeholders throughout the iterative design processes.	●	•	●	
	d.	Be able to identify user and stakeholder requirements in a form that will direct, inform and offer the opportunity for reflection of their designing and making progress throughout the design process.	⬤	•	●	
2.	**Learning from existing products and practice**					
	a.	Be able to to critically analyse relevant existing products, understanding how investigations can be used to inform design thinking and delivery solutions to technical requirements that could be utilised within their own design solutions.	●	•	●	
	b.	Investigate existing products’ fitness for purpose, with reference to aesthetics, ergonomics and anthropometrics, to identify key areas for consideration when designing and creating prototypes.	●	•	●	
	c.	Understand and apply relevant design theory, including how key historic movements or figures and their methods may influence or inspire their own designing.	●	•	●	
3.	**Implications of wider issues**					
	a.	Understand the impact of social, moral, and ethical factors when investigating and analysing existing products, systems and technologies, and appraising technological developments in order to consider and apply these principles when designing and creating prototypes.	•	●	•	
	b.	Be able to draw on and apply skills and knowledge from other subject areas, including mathematics and science, to inform and support decisions when designing or when developing technological aspects of their product.	•	●	•	 

4.	Design thinking and communication	Explore	Create	Evaluate	Maths & Science
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 making of a final prototype.	•	●	●	
b.	Select and use appropriate methods of communication with stakeholders and users, understanding and applying the principles of user-centred design and other relevant design approaches throughout the iterative design process.	•	●	●	
c.	Understand how to use communication skills throughout a project utilising a range of media and presentation techniques appropriate to the project which clarify, record and explain their thinking, and enable others to understand their decisions and intentions.	•	●	●	
d.	Apply digital and non-digital skills and techniques that are suitable to the stage of development and record real-time progress throughout an iterative design process, 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 flowcharts to deliver planning • writing reports and/or summaries to record the thinking process • presentations and real-time evidence to communicate throughout the project.	•	●	●	
e.	Be able to develop and use production plans to ensure practical activities are managed efficiently.				
5.	**Material considerations**				
a.	Be able to select and work with appropriate materials and components when designing and making prototypes, understanding the role of different materials and material combinations when analysing and considering them for use within their own design solutions.	•	•	•	

		Explore	Create	Evaluate	Maths & Science
6.	**Technical understanding**				
a.	Understand how investigations of existing products and user and stakeholder requirements can be used to understand the requirements for functionality and usability when designing and creating prototypes.	•	●	•	⚗
b.	Understand the importance of appropriate materials, components, finishes and use of technology when creating and developing functional and easy-to-use products and systems.	•	●	•	⚗
c.	Understand aesthetics, ergonomics and anthropometrics in order to ensure their design solutions are fit for purpose in meeting stakeholder and design requirements.	•	●	•	⚗
7.	**Manufacturing processes and techniques**				
a.	Use appropriate and accurate marking out methods including: consideration and use of reference/datum points; use templates, jigs and/or patterns where appropriate; working within tolerances; understanding efficient cutting and how to minimise waste. Ensuring appropriate accuracy and precision required for their product to fulfil its intended purpose.	•	●	•	📐
b.	Select and use appropriate specialist tools, equipment and machinery, both manually and digitally operated, when creating their prototypes, products and systems.	•	●	•	
c.	Investigate the suitability of techniques and processes to be used during the process of designing and making prototypes through experimentation, testing and modelling.	•	●	•	⚗
d.	Select and use appropriate processes and techniques to demonstrate practical making skills with hand, machine and digital technologies through the creation of models, simulations and final prototypes. Reflecting on the effectiveness of the processes and techniques used.	•	●	•	⚗
e.	Understand principles of quality control and quality assurance to ensure their final prototype of their design solution meets identified stakeholder requirements.	•	●	•	📐
f.	Understand the principles of Design for Manufacture and Assembly (DFMA) to develop design solutions that ensure accuracy and precision are met, and economy and efficiency are achieved.	•	●	•	📐

8.	Viability of design solutions	Explore	Create	Evaluate	Maths & Science
a.	Design and develop one final prototype or a set of prototypes that meets stakeholder requirements and is fit for purpose.	•	●	●	
b.	Test and evaluate the viability of potential design iterations against agreed requirements lists and specifications, in liaison with stakeholders and users, to inform future iterations of their design solutions.	•	●	●	 
c.	Evaluate stakeholder requirements whilst also considering commercial viability, including an understanding of cost and marketability.	•	●	●	
d.	Be able to make informed and reasoned decisions that respond to stakeholder feedback to ensure all needs and requirements are addressed and to identify the potential next-steps of further development and suggest how modifications could be made through design optimisation.	•	●	●	
9.	**Health and safety**				
a.	Be able to identify relevant hazards when creating prototypes and apply safe working practices when creating designs and prototypes.	•	•	•	

Further details on the requirements for undertaking the 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 4.

Mathematical skills in the NEA

In order to support the mathematical skills that are required to be assessed in the written examination, there is an expectation within this specification that learners will continue to demonstrate appropriate mathematical skills in their NEA. The application of these skills should be used appropriately as opportunities arise, not only to demonstrate accuracy through practical skills, but also to solve problems, support investigations and analyse findings.

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 wastage
- 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 decisions, including the use of frequency tables, graphs and bar charts
- accurate graphical communication to deliver design and manufacturing intentions to others
- the design and testing of prototypes to check they meet specific requirements and standards through the presentation of data and statistics.

In addition, **Design Engineering** learners could utilise scientific formulae to justify their design decisions and consideration of functional success of any product.

2i. Non-exam assessment interpretation – Design Engineering (H004/02, 03)

The focus of a 'Product Development' undertaken by a learner pursuing Design Engineering will have a more significant focus on the functional requirements and/or systems of a product.

Existing products may be explored through destructive or non-destructive methods of testing, but it is important to be in direct contact with a user and/or wider stakeholder that can offer meaningful feedback to support explorations and testing throughout.

User interaction with a mechanical or electronic product may be focused on the user interfacing, or more widely on how the existing product meets the user's needs. Communicating with stakeholders from the engineering industries may also support the thinking behind the product development.

Consideration of the constructional requirements of any iterative design solutions can be explored through many different ways, including initial hand drawn ideas through to models to explore effective processes and techniques. Learners are likely to benefit from the use of full-scale modelling during the iterative design process to determine ergonomic, dimensional and functional suitability in their proposed design solutions.

It is important that learners consider and incorporate their mathematical skills to demonstrate the viability of their design solutions, both economically and functionally.

The use of CAD, CAM, CAE and image manipulation software is expected to support a learner's modelling, visualisation, development, and refinement of their design solutions. Technical/working drawings will be required to demonstrate that the designs are commercially viable to a third party.

As part of their consideration of materials and components it is expected that learners will include consideration of appropriate bought-in and standardised parts for use within their design solutions, though any such applications should be appropriately thought out to ensure they will adequate fulfil the purposes they are intent for and not detract from a final prototype.

A range of hand, machine and digital technologies including CAD/CAM are expected to be used as appropriate in learners' modelling, experimenting and prototyping.

Learners are likely to benefit from the use of full-scale modelling during the iterative design process to determine ergonomic, dimensional and functional suitability in their proposed design solutions.

It is important for learners to consider evidence of the iterative developments, in particular with Design Engineering, demonstration of the functionality of the design solutions. Real-time evidence in the form of short video clips is likely to be the most effective way of demonstrating this within their chronological e-portfolio.

Being in regular direct contact with stakeholders and users will deliver non-biased opinions. Learners are expected to objectively test the prototypes developed to meet the identified stakeholder requirements. Listening and observation are key skills for the learner in iterative testing and evaluation.

2j. Non-exam assessment interpretation – Fashion and Textiles (H005/02, 03)

2

The focus of a ‘Product Development’ undertaken by a learner pursuing Fashion and Textiles will have a more significant focus on wide ranging products that predominantly utilise textile materials. The products are likely to consider fashions and/or trends and could be applied to industrial or commercial practices.

Existing products may be explored through destructive or non-destructive methods of testing such as reverse engineering garments or textiles products, but it is important to be in direct contact with a user and/or wider stakeholder that can offer meaningful feedback to support explorations and testing throughout.

The type of product being developed will determine whether a more commercial approach through consumer testing is appropriate or whether communicating with manufacturing and/or retail stakeholders will be more appropriate to support explorations of the opportunities and constraints of re-developing a product.

Consideration of the product’s relationship with users will rely on consideration of anthropometric data or data on clothes sizes, but demonstration of economic viability may also be considered.

The manipulation of fabrics and adding surface finishes including decoration, dyeing and printing can also be explored in their evolving studies.

Consideration of the constructional requirements of any iterative design solutions can be explored through many different ways, including initial hand drawn ideas through to creating their own patterns and toiles or models to explore effective processes and techniques. Learners are likely to benefit from the use of full-scale toiles or samples during the iterative design process to determine ergonomic, dimensional and functional suitability in their proposed design solutions.

It is crucial that Fashion and Textiles learners of the future utilise new and emerging technologies. This may include the laser cutter, e-textiles, sublimation printer or the 3D printer in the creation of components. The use of CAD and CAM is expected to support a learner’s modelling, visualisation, development, and/or refinement of their design solutions; however, these can be in support of designing and practical skills. Pattern drafting, lay plans and/or working drawings will be required to demonstrate that the designs are commercially viable to a third party.

A range of hand, machine and digital technologies including CAD/CAM are expected to be used as appropriate in learners’ modelling, experimenting and prototyping.

As part of their consideration of materials and components it is expected that learners will include consideration of appropriate bought-in and standardised parts, particularly if e-textiles or programmable components are being considered for use within their design solutions.

It is important for learners to consider evidence of the iterative developments, in particular with Fashion and Textiles demonstration of the performance of a product or prototype in use. Real-time evidence in the form of short video clips is likely to be the most effective way of demonstrating this within their chronological portfolio.

All portfolio evidence is to be electronic; therefore it may be necessary to either scan or photograph swatches of textile materials.

Being in regular direct contact with stakeholders and users will deliver non-biased opinions. Learners are expected to objectively test the prototypes developed to meet the identified stakeholder requirements. Listening and observation are key skills for the learner in iterative testing and evaluation.

2k. Non-exam assessment interpretation – Product Design (H006/02, 03)

The focus of a 'Product Development' undertaken by a learner pursuing Product Design will have a focus on a broad range of domestic, commercial and industrial contexts that embrace products of all types, sizes and complexities.

Disassembly, testing, and comparison of similar products, components and materials will highlight strengths and weaknesses and support technical understanding, but it is important to be in direct contact with a user and/or wider stakeholder that can offer meaningful feedback to support explorations and testing throughout.

Communicating with users and wider stakeholders will support explorations into the opportunities and constraints of developing a product. It is expected that learners give consideration to the wider functionality when designing products, for example, how they may be stored, moved or transported and maintained or adapted to achieve function and fitness for purpose.

Consideration of the constructional requirements of any iterative design solutions can be explored through many different ways, including initial hand drawn ideas through to models to explore effective processes and techniques. Learners are likely to benefit from the use of full-scale modelling during the iterative design process to determine ergonomic, dimensional and functional suitability in their proposed design solutions.

The use of CAD, CAM and image manipulation software is expected to support a learner's modelling, visualisation, development and refinement of their design solutions. Technical/working drawings will be required to demonstrate that the designs are commercially viable to a third party.

A range of hand, machine and digital technologies including CAD/CAM are expected to be used as appropriate in learners' modelling, experimenting and prototyping.

As part of their consideration of materials and components it is expected that learners will include consideration of appropriate bought-in and standardised parts for use within their design solutions.

It is important for learners to consider evidence of the iterative developments, in particular with Product Design, the demonstration of the performance of a product or prototype in use or in situ. Real-time evidence in the form of short video clips is likely to be the most effective way of demonstrating this within their chronological portfolio.

Being in regular direct contact with stakeholders and users will deliver non-biased opinions. Learners are expected to objectively test the prototypes developed to meet the identified stakeholder requirements. Listening and observation are key skills for the learner in iterative testing and evaluation.

2l. Prior knowledge, learning and progression

No prior qualification is required in order for learners to enter for an AS Level in Design and Technology, nor is any prior knowledge or understanding required for entry onto this course. Learners would, however, benefit from having completed the GCSE (9–1) in Design and Technology as a foundation to the learning at this level. Higher level GCSE (9–1) qualifications in Maths and Science will also support learners with much of the knowledge and understanding within the content. Prior experience and skills in illustration and the use digital technology would also be beneficial.

The endorsed titles within this qualification will enable learners to progress to higher, further or vocational education routes. This qualification has been designed with consideration of the entry requirements of Higher Education Institutes who offer related undergraduate degrees in engineering, fashion, manufacturing, material science, product design and textile technologies, amongst others.

As with EPQs, the substantive project work undertaken as part of this qualification will give learners valuable material to discuss in their personal statement if progressing to higher education. Learners will also have the opportunity to use much of the work undertaken throughout this qualification as part of the portfolio that many universities require when interviewing potential students.

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 4.

There are a number of Design and Technology specifications at OCR. Find out more at www.ocr.org.uk

3 Assessment of AS Level in Design and Technology

3a. Forms of assessment

OCR's AS Level in Design and Technology is a linear qualification with three endorsed titles, each of which consist of one component that is externally assessed and one component that is assessed by the centre and externally moderated by OCR. Each of these components account for 50% of the qualification and learners must take both components within the endorsed title they have entered.

Principles (01) written examination

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

Content for assessment in the examination is outlined in Section 2e-2g for each endorsed title.

Principles of 'Design Engineering, Fashion and Textiles or Product Design'	
50% of AS Level 1 hour 45 minutes Drawn and written paper 90 marks	These papers cover the full extent of the examined content for each endorsed title. • There will be sets of questions that are focused around a context or existing product. • Learners will be required to answer **all** questions. • The questions will cover a **range** of the outlined exam content. • There will be a mixture of different levels of questions. • At least **one** question will require learners to analyse an existing product. • At least **one** question will require learners to apply mathematical skills that are appropriate to design or technology. • There will be questions requiring learners to use annotated sketching to communicate the construction of a product. • There will be **two extended answer questions**. These questions will not assess spelling, punctuation and grammar, but will assess the use of subject terminology and the quality of extended response. • **One** of the extended response questions will require learners to draw on their synoptic knowledge from across the specification. (The NEA will offer opportunities to assess this further). • Use of calculators is permitted in the written examination.

Product Development (02, 03) non-exam assessment (NEA)

The Product Development component is a single task component, worth 50% of the qualification, giving 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. The component is internally assessed and externally moderated.

The content to be considered in the Product Development is outlined in Section 2h, with interpretations for each endorsed title from sections 2i to 2k.

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 requirements for teachers and learners when setting, taking and evidencing the Product Development project.

Task Setting

Contexts 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 contexts at this time that are open for learners to interpret as they see fit. From these contexts learners will be required to set a challenge through identifying a suitable product and propose realistic improvements or adaptations in order to meet their chosen context.

The same set of contexts will be offered to learners of all endorsed titles. However, a single context 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 NEA, it is important that learners have experienced learning and practical activity that not only prepares them for demonstrating their ability to undertake an iterative product development, 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 product development, 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.

Direct interaction with a range of users and stakeholders is positively encouraged as part of this component. However, learners should be evidencing and responding to all interaction as part of their on-going product development. Teachers are able to offer guidance as a stakeholder, but should not influence the direction of the learner's project.

Learners will have approximately 45 hours in which to complete the whole 'Product Development'. This time allowance is for guidance only and does not constitute a maximum or minimum requirement. It should be noted that assessment of this component is reliant on relevant lines of investigation and development, therefore time spent on this component should retain a clear focus on the context set and brief written by the learner.

The product development should not involve the complete redesign of an existing product. Identifying opportunities for it's further development, adaption or enhancement to fit within the chosen context is the intention.

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

Task Taking

The 'Product Development' requires learners to develop and make a prototype(s) through iterations of exploring, creating and evaluating that identify opportunities and 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 NEA 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 context set by OCR, identifying the challenge that they are going to pursue. Prior to writing a design brief, it is essential that a learner has fully explored the context(s) they are considering and a feasibility study of products, stakeholders and/or markets that may offer the opportunities for an innovative challenge to be pursued.

The design brief should outline the approach a learner has chosen in response to the context. Writing the design brief is an essential part of outlining the challenges involved in their 'Product Development'. 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 'context'
- learners should have prior awareness of their centre's facilities and resources to fully consider the implications of their own approach
- if changes need to be made to a learner's design brief at a later stage, this must be fully justified by the learner in response to their iterative design process and remain true to their chosen 'context'.

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 that quickly communicate and capture thinking appropriately within the design process. When initial ideas have been generated through interaction with others, learners 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, conceptually and commercially.

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 the 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.

3

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 commercial or industrial 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 a technical specification

Learners are required to justify and present their final design solution through a **technical specification** that delivers 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.

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 materials 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 or with the user group 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 e-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.

At AS Level the learner can make arrangements to produce component parts outside of the centre, but for these to be recognised as the learner's work, they must at all times be under immediate guidance and supervision from a member of staff or by an industry professional who can be trusted to authenticate that the component was solely manufactured by the learner.

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 e-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 'Product Development' 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 during the project 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 'Product Development' 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 e-portfolio (refer to Section 4d) supported by real-time evidence that demonstrates their complete 'Product Development'. This evidence should clearly demonstrate the learner's design brief written in response to their chosen content 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 this.

3

Final Prototype

The final prototype(s) based on the learner's design brief must be clearly evidenced by the learner in their e-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 e-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 work 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.

It is a requirement of the iterative project that all references and sources of information/assistance must be indexed and acknowledged in a bibliography and must be clearly identifiable at the appropriate point in the e-portfolio of evidence submitted for assessment. This includes websites, books, digital sources, and help given by teachers, technicians, and others. This should also be acknowledged on their Candidate Declaration Form.

3b. Assessment objectives (AO)

There are four Assessment Objectives in the AS Level in Design and Technology. These are detailed in the table below.

Learners are expected to demonstrate their ability to:

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

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

AO weightings in AS Level in Design and Technology

The relationship between the assessment objectives and the components are shown in the following table:

Component	% of OCR AS Level in Design and Technology (H004-H006)			
	AO1	AO2	AO3	AO4
Principles of… (component 01 of each endorsed title)	0	0	12%	38%
Product Development (component 02 or 03 of each endorsed title)	13.5%	24%	12.5%	0
Total	13.5%	24%	24.5%	38%

3c. Assessment availability

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

All components must be taken in the same examination series at the end of the course.

This specification will be certificated from the June 2018 examination series onwards.

3d. 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 4d).

3e. Assessment of extended response

3

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.

3f. 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.

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 determine 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 against one of the assessment statements then a mark of zero must be awarded. 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 context and product chosen by the learner. A guide here would be the equivalent of 30 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 webpage.

Final Submission

Where centres are covering more than one endorsed title, teachers should ensure that the standard applied to marking is consistent across each endorsed title within the Design and Technology specification.

Work submitted for the AS level component should reflect the standard expected at the end of the first year of an A level course of study.

To ensure teachers are marking to the correct standard, teachers who are delivering A level and/or AS level should ensure they use the A level or AS level marking criteria as appropriate and reference exemplar work for each level. These are available on the OCR website, www.ocr.org.uk.

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 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 e-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 has required 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. Prior to submitting the work to OCR, the centre should add the Candidate Record Form'.

For further guidance on e-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

Product Development (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). To ensure comparability of all learners undertaking the 'Product Development' component, the marking criteria set out are to be used regardless of the endorsed title they have followed.

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 'Product Development' 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, the headings on the left and the marks along the bottom of each strand to support 'best-fit' allocation.

The marking criteria for the 'Product Development' should be considered together with the non-exam content (NEA) from Section 2h and the relevant endorsed title interpretation of the NEA 2i to 2k to ensure coverage of content.

Guidance on the delivery and required evidence for the 'Product Development' are set out in Section 3a.

When completing internal assessment, the marking criteria should be considered together with the administrative requirements of the NEA outlined 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 (1–6)	Mark Band 2 (7–12)	Mark Band 3 (13–18)	Mark Band 4 (19–24)
Investigations of the context and feasibility study of potential products	Superficial investigations identify little or no problems and/or opportunities for further consideration. Little or no consideration of market potential in product choice.	Investigations are of sufficient quality to identify some problems and/or opportunities for further consideration. Some consideration of market potential in product choice.	Investigations offer a good level of detail and identify a breadth of problems and opportunities for further consideration. Informed consideration of market potential in product choice.	Comprehensive investigations identify a breadth and/or depth of challenging problems and opportunities for further consideration. Objective consideration of market potential in product choice.
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 relevant to the context offering scope for challenge and identification of a primary user and other stakeholders.	Clear and fully relevant 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 stakeholders. 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 that offer support to design iterations and thinking.	Some information and/or sources of inspiration are identified 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 21 22 23 24**

0 marks – No response or no response worthy of credit.

Strand 2 – Create: Design Thinking (AO2)

	Mark Band 1 (1–5)	Mark Band 2 (6–9)	Mark Band 3 (10–13)	Mark Band 4 (14–16)
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 mostly reflect requirements.	Different and relevant design approaches that lead to ideas that fully avoids 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 opportunities 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**

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 (1–3)	Mark Band 2 (4–6)	Mark Band 3 (7–9)	Mark Band 4 (10–12)
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 clear, 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**

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 (1–4)	Mark Band 2 (5–8)	Mark Band 3 (9–12)	Mark Band 4 (13–15)
Quality of planning for making the final prototype(s)	Offers little or no support to the making process with little or no consideration of safety.	Generally supports the management of the making process with some relevant requirements and safety considerations identified from the technical specification.	Good level of detail and relevant, covering most requirements and safety considerations identified from the technical specification to manage the making process.	Comprehensive and relevant, covering all requirements and safety considerations 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 demonstrates limited potential to become a marketable/industrial product.	Meets some of the technical specification and demonstrates some potential to become a marketable/industrial product.	Meets most of the technical specification and demonstrates good potential to become a marketable/industrial product.	Meets all of the technical specification and demonstrates excellent potential to become a marketable/industrial product.
	1 2 3 4	5 6 7 8	9 10 11 12	13 14 15

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 machinery, all of which require appropriate evidence.

Strand 5 – Evaluate (AO3)

	Mark Band 1 (1–6)	Mark Band 2 (7–12)	Mark Band 3 (13–18)	Mark Band 4 (19–23)
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.
Risk Assessments	Little or no analysis and evaluation resulting in superficial considerations of health and safety risks.	Sufficient analysis and evaluation that result in some considerations of health and safety risks.	Good level of detail in analysis and evaluation that result in clear considerations of health and safety risks.	Comprehensive analysis and evaluation that result in clear and focused considerations of health and safety risks.
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 21 22 23

0 marks – No response or no response worthy of credit.

Product Development (02) – Assessment Objective Distribution

The table below demonstrates how the Assessment Objectives are attributed to each Section of the non-exam assessment and where evidence of mathematics can be assessed.

Strand of Marking Criteria	% of overall Product Development			Total % per strand	Use of Maths Skills
	AO1	AO2	AO3		
Explore	27	0	0	27	✔
Create – Design Thinking	0	18	0	18	✔
Create – Design Communication	0	13	0	13	✔
Create – Final prototype(s)	0	17	0	17	✔
Evaluate	0	0	25	25	✔
Total	**27%**	**48%**	**25%**	**100%**	

3

3g. 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 full AS Level course of study.

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 'applied' 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.

3h. Calculating qualification results

A learner's overall qualification grade for AS Level 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.

4

Final entries

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 an AS Level in Design and Technology must be entered for one of the following entry options:

Entry option		Components		
Entry code	**Title**	**Code**	**Title**	**Assessment type**
H004 A	Design and Technology: Design Engineering A	01	Principles of Design Engineering	External Assessment
		02	Product Development (Repository)	Non-exam Assessment
H004 B	Design and Technology: Design Engineering B	01	Principles of Design Engineering	External Assessment
		03	Product Development (Postal)	Non-exam Assessment
H004 C	Design and Technology: Design Engineering C	01	Principles of Design Engineering	External Assessment
		80	Product Development (Carried Forward)	Non-exam Assessment

Entry option		Components		
Entry code	Title	Code	Title	Assessment type
H005 A	Design and Technology: Fashion and Textiles A	01	Principles of Fashion and Textiles	External Assessment
		02	Product Development (Repository)	Non-exam Assessment
H005 B	Design and Technology: Fashion and Textiles B	01	Principles of Fashion and Textiles	External Assessment
		03	Product Development (Postal)	Non-exam Assessment
H005 C	Design and Technology: Fashion and Textiles C	01	Principles of Fashion and Textiles	External Assessment
		80	Product Development (Carried Forward)	Non-exam Assessment
H006 A	Design and Technology: Product Design A	01	Principles of Product Design	External Assessment
		02	Product Development (Repository)	Non-exam Assessment
H006 B	Design and Technology: Product Design B	01	Principles of Product Design	External Assessment
		03	Product Development (Postal)	Non-exam Assessment
H006 C	Design and Technology: Product Design C	01	Principles of Product Design	External Assessment
		80	Product Development (Carried Forward)	Non-exam Assessment

*Entry option H004 C, H005 C or H006 C should only be selected for learners who are retaking the qualification who want to carry forward their mark for the non-exam 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*.

4d. Admin of non-exam assessment

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

The contexts for learners to respond to in their 'Product Development' are set by OCR annually for this qualification will be posted on the subject page of the OCR website on or after 1 June in the calendar year preceding the year in which the qualification is to be awarded. The contexts will not be posted to centres.

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

Approval of tasks

4

The interpretation of any of the 'Product Development' contexts 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 each internally-assessed component. 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 submit an enquiry about results (EAR). Once this deadline has passed and centres have not requested an EAR, 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 need not 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.

Investigation, exploration 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 and that any work undertaken to present their final design solution(s) and prototype(s) is carried out under guidance and supervision.

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.

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 AS Level 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.

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 learners' 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.

4

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:

Moderation via the OCR Repository – Where you upload electronic copies of the work included in the sample to the OCR Repository and your moderator accesses the work from there. Please refer to the OCR *Admin guide: 14–19 qualifications* for details about how to submit files using the OCR Repository.

Postal moderation – 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 – A brief report by the moderator on the internal assessment of learners' work.

Preparing work for submission

Preparing work for submission can be a time consuming and stressful task if not planned properly. So as not to waste precious time, firstly centres should make sure they are fully aware of the sample they are required to submit. Centres will have stored all of their learners' folders within a secure folder on their centre network.

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

1. Candidate Declaration Form
2. Candidate Record Form (CRF2).

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 arrived at the mark that was given and to add any additional evidence of the 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 format.

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 is 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 real-time activity being pursued. As long as evidence is clearly real-time a learner who chooses 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.

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

AS level qualifications are graded on the scale: A, B, C, D, E, where A is the highest. Learners who fail to reach the minimum standard for E will be Unclassified (U). Only subjects in which grades A to E 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 H004, H005 and H006 endorsed titles will be shown respectively on the certificate as:

'OCR Level 3 Advanced Subsidiary GCE in Design and Technology: Design Engineering'

'OCR Level 3 Advanced Subsidiary GCE in Design and Technology: Fashion and Textiles'

'OCR Level 3 Advanced Subsidiary GCE in Design and Technology: Product Design'.

4f. Post-results services

A number of post-results services are available:

- **Enquiries about results** – If you are not happy with the outcome of a learner's results, centres may submit an enquiry about results.
- **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 work 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 AS level 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 Art and Design, Computer Science and 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 2e to 2k 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 AS and A Level 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 from GCE Design and Technology: Fashion and Textiles will support centres in understanding the available pathways into Higher and Further Education.

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 higher tier GCSE (9–1) learning.

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

Learners following the Design Engineering endorsed title are required to additionally apply their mathematical skills to the scientific formulae outlined in Appendix 5d and specific engineering formulae as outlined below. Learners will be required to know these formulae and should be familiar with how to apply them through their teaching and learning. Formulae that fall within mathematical skills will be attributed to the 25% maths marks, formulae from science and engineering will not.

Within OCRs GCSE (9–1) in Mathematics the content is outlined at three different levels, the third column identifies the learning that is exclusive to higher tier GCSE (9–1). The first two columns identify content that is associates with foundation tier or lower. These are all shown in the table below to demonstrate how the GCSE (9–1) in Mathematics can support teaching and learning in Design and Technology.

The Maths content columns are indicated as appropriate using (1), (2) and (3) to clarify the standard. Where content is presented from the first two columns these will be assessed at a level of demand above the description of the statement to ensure they meet the requirements of higher tier GCSE (9–1).

With any mathematics within Design and Technology it is important that learners understand the standard application of metric units and other standard units of mass, length, time and money.

Mathematical skills requirements for Design and Technology		**OCR GCSE (9–1) Mathematics ref.**	**GCSE (9–1) Mathematics specification (J560)**
Required skills	*Examples of application in Design and Technology*		
M1 Confident use of number and percentages	*All endorsed titles* calculation of quantities of materials, components, costs and size with consideration of percentage profits and tolerances as appropriate substitute numerical values into and rearrange learnt formulae and expressions confident use of decimal and standard form.	3.01b 3.02a 4.01a 4.01c	• Calculate positive integer powers and exact roots. (1) • Interpret and order numbers expressed in standard form. Convert numbers to and from standard form. (1) • Round answers to an appropriate level of accuracy. (2) • Use inequality notation to write down an error interval for a number or measurement rounded or truncated to a given degree of accuracy. (2) Calculate the upper and lower bounds of a calculation using numbers rounded to a known degree of accuracy. (3)

Mathematical skills requirements for Design and Technology *Required skills*	*Examples of application in Design and Technology*	OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
		6.02a	Formulate simple formulae and expressions from real-world contexts. (1)
		6.02b	Substitute positive numbers into simple expressions and formulae to find the value of the subject (1) and into more complex formulae, including powers, roots and algebraic fractions. (2)
		6.02c	Rearrange formulae to change the subject, including cases where the subject appears twice, or where a power or reciprocal of the subject appears. (2)
		6.04a	Understand and use the symbols <, ≤, > and ≥. (1) Solve linear inequalities in one variable. (2)
		10.01a	Use and convert standard units of measurement for length, area, volume/capacity, mass, time and money (1) and in algebraic contexts. (2)
		10.01b	Use and convert simple compound units (e.g. for speed, rates of pay, unit pricing) (1) and (e.g. density, pressure) (2). Know and apply in simple cases: speed = distance ÷ time (1) and density = mass ÷ volume. Use and convert compound units in algebraic contexts. (2)
	Design Engineering only: • recall and application of engineering formulae in qualitative work and calculations when applying engineering to mathematical skills: ○ Young's modulus = $\frac{stress}{strain}$ ○ Stress = $\frac{force}{cross\ sectional\ area}$ ○ Strain = $\frac{extension}{original\ length}$	6.02b	Substitute positive numbers into simple expressions and formulae to find the value of the subject (1) or negative numbers into more complex formulae, including powers, roots and algebraic fractions. (2)
		6.02e	Use $v = u + at$, $s = ut + \frac{1}{2}at^2$ and $v^2 = u^2 + 2as$ where a is constant acceleration, u is initial velocity, v is final velocity, s is displacement from position when t = 0 and t is time taken. (1)
		10.01b	Use and convert simple compound units (e.g. for speed, rates of pay, unit pricing) and (e.g. density, pressure) (2). Know and apply in simple cases: speed = distance ÷ time (1) and density = mass ÷ volume. Use and convert compound units in algebraic contexts. (2)

Mathematical skills requirements for Design and Technology *Required skills*	*Examples of application in Design and Technology*	OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
	○ Pressure = force / area ○ Wave frequency = 1 / period ○ Turning effects, torque = Fd , or moment = Fx • recall and application of scientific formulae outlined in requirement S1 in Appendix 5d.		
M2 Use of ratios	• understand and use ratios in the scaling of drawings and pattern grading • 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. (1)
		2.01c	Calculate a fraction of a quantity. (1)
		2.03a	Convert between fractions, decimals and percentages. (1)
		2.03b	Calculate a percentage of a quantity, and express one quantity as a percentage of another. (1)
		2.03c	Express percentage change as a decimal or fractional multiplier. Apply this to percentage change problems (including original value problems). (2)
		5.01a	Find the ratio of quantities in the form $a : b$ and simplify. Find the ratio of quantities in the form $1 : n$. (1)
		5.01b	Split a quantity into two parts given the ratio of the parts. Express the division of a quantity into two parts as a ratio. Calculate one quantity from another, given the ratio of the two quantities. (1)
		5.01c	Interpret a ratio of two parts as a fraction of a whole. (1)
		5.01d	Solve simple ratio and proportion problems. (1)
		9.04c	Compare lengths, areas and volumes using ratio notation and scale factors. (1) Understand the relationship between lengths, areas and volumes of similar shapes. (3)

Mathematical skills requirements for Design and Technology *Required skills*	 *Examples of application in Design and Technology*	OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
M3 Calculation of surface areas and/or volumes	• determining quantities of materials by surface area	8.06a	Recognise and know the properties of the cube, cuboid, prism, cylinder, pyramid, cone and sphere. (1)
	• calculate the overall surface area of different shapes, such as, cuboids, cylinders and spheres to determine quantities of material and feasibility analysis	10.04a	Calculate the surface area and volume of cuboids and other right prisms (including cylinders). (1)
		10.04b	Calculate the surface area and volume of spheres, cones and simple composite solids (formulae will be given). (2)
	• calculate the volume of different shapes, such as, cuboids, cylinders and spheres to determine suitability of objects and products.	10.04c	Calculate the surface area and volume of a pyramid (the formula area of base × height will be given). (2)
M4 Use of trigonometry	*All endorsed titles* • calculate the sides and angles of objects to determine structural integrity, marking out and direction of movement.	8.04b	Know the basic properties of the square, rectangle, parallelogram, trapezium, kite and rhombus. (1) Use these facts to find lengths and angles in rectilinear figures and in simple proofs. (2) Use these facts in more formal proofs of geometrical results. (3)
	Design Engineering only • determining projectile motion and direction of movement	10.05a	Know, derive and apply Pythagoras' theorem $a^2 + b^2 = c^2$ to find lengths in right-angled triangles in 2D figures. (2) Apply Pythagoras' theorem in more complex figures, including 3D figures. (3)
	• determining how to resolve force vectors using $F_x = F\cos\theta$ and $F_y = F\sin\theta$.	10.05b	Know and apply the trigonometric ratios, $\sin\theta$, $\cos\theta$ and $\tan\theta$ and apply them to find angles and lengths in right-angled triangles in 2D figures. (2) Apply the trigonometry of right-angled triangles in more complex figures, including 3D figures. (3)

Mathematical skills requirements for Design and Technology *Required skills*	*Examples of application in Design and Technology*	OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
		10.05c	Know the exact values of sinθ and cosθ for θ = 0°, 30°, 45°, 60° and 90°. Know the exact value of tanθ for θ = 0°, 30°, 45° and 60°. (2)
		10.05d	Know and apply the sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ to find lengths and angles. (3)
		10.05e	Know and apply the cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$ to find lengths and angles. (3)
M5 Construction, use and/or analysis of graphs and charts	*All endorsed titles*	7.01a	Work with *x*- and *y*- coordinates in all four quadrants. (1)
	• representation of data used to inform design decisions and evaluation of outcomes	7.04a	Construct and interpret graphs in real-world contexts. (1) Recognise and interpret graphs that illustrate direct and inverse proportion. (2)
	• presentation of market data, user preferences, outcomes of market research as part of product design, fashion and textiles	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. (1) Design tables to classify data. Interpret and construct line graphs for time series data, and identify trends (e.g. seasonal variations). (2)
	• interpret and extract appropriate data.	12.02b	Interpret and construct diagrams for grouped data as appropriate, i.e. cumulative frequency graphs and histograms (with either equal or unequal class intervals). (3)

Mathematical skills requirements for Design and Technology		OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
Required skills	*Examples of application in Design and Technology*		
		12.03a	Calculate the mean, mode, median and range for ungrouped data. Find the modal class, and calculate estimates of the range, mean and median for grouped data, and understand why they are estimates. Describe a population using statistics. Make simple comparisons. Compare data sets using 'like for like' summary values. Understand the advantages and disadvantages of summary values. (1) Calculate estimates of mean, median, mode, range, quartiles and interquartile range from graphical representation of grouped data. Draw and interpret box plots. Use the median and interquartile range to compare distributions. (3)
		12.03c	Plot and interpret scatter diagrams for bivariate data. Recognise correlation. (1) Interpret correlation within the context of the variables and appreciate the distinction between correlation and causation. Draw a line of best fit by eye, and use it to make predictions. Interpolate and extrapolate from data, and be aware of the limitations of these techniques. (2)
		12.03d	Identify an outlier in simple cases. (1) Appreciate there may be errors in data from values (outliers) that do not 'fit'. Recognise outliers on a scatter graph. (2)

Mathematical skills requirements for Design and Technology *Required skills*	*Examples of application in Design and Technology*	OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
	Design Engineering only • present and interpret velocity/time graphs, stress-strain and resistance-temperature graphs • representation of frequency, period, amplitude and phase.	7.04b	Calculate or estimate gradients of graphs, and interpret in contexts such as distance-time graphs, velocity-time graphs and financial graphs. Apply the concepts of average and instantaneous rate of change (gradients of chords or tangents) in numerical, algebraic and graphical contexts. (3)
		7.04c	Calculate or estimate areas under graphs, and interpret in contexts such as distance-time graphs, velocity-time graphs and financial graphs. (3)
M6 Use of coordinates and geometry	• use of datum points and geometry when setting out design drawings, when setting out patterns and within engineering drawings • present accurate 2D and 3D graphics to communicate design solutions.	8.01g	Use *x*- and *y*-coordinates in plane geometry problems, including transformations of simple shapes. (1)
		8.06b	Interpret plans and elevations of simple 3D solids. (1) Construct plans and elevations of simple 3D solids and representations (e.g. using isometric paper) of solids from plans and elevations.
		9.03a	Understand addition, subtraction and scalar multiplication of vectors. (2) Use vectors in geometric arguments and proofs. (3)
		10.01c	Construct and interpret scale drawings. (1)

Mathematical skills requirements for Design and Technology *Required skills*	*Examples of application in Design and Technology*	OCR GCSE (9–1) Mathematics ref.	GCSE (9–1) Mathematics specification (J560)
M7 Use of statistics and probability as a measure of likelihood	• Interpret statistical analyses to determine user needs and preferences. • Use data related to human scale and proportion to determine product scale and dimensions and sizes and dimensions of fashion products. • Understanding of dimensional variations in mass produced components. • Defects in batches and reliability linked to probabilities.	11.01a	Use the 0–1 probability scale as a measure of likelihood of random events, for example, 'impossible' with 0, 'evens' with 0.5, 'certain' with 1. (1)
		11.01b	Record, describe and analyse the relative frequency of outcomes of repeated experiments using tables and frequency trees. (1)
		11.01c	Use relative frequency as an estimate of probability. (1) Understand that relative frequencies approach the theoretical probability as the number of trials increases.
		11.02e	Use the addition law for mutually exclusive events. Use p(A) + p(not A) = 1. (1) Derive or informally understand and apply the formula (2) $p(A \text{ } or \text{ } B) = p(A) + p(B) - p(A \text{ } and \text{ } B)$
		11.02f	Use tree diagrams and other representations to calculate the probability of independent and dependent combined events. (2) Understand the concept of conditional probability, and calculate it from first principles in known contexts. Derive or informally understand and apply the formula p(A and B) = p(A given B)p(B). Know that events A and B are independent if and only if p(A given B) = p(A). (3).

5d. Use of science within Design and Technology

Through their work in design and technology, learners are required to apply relevant scientific knowledge, skills and understanding equivalent to Key Stage 4 learning in Combined Science.

The table below shows the requirements for science knowledge and skills to be covered within the endorsed titles for OCR AS Level in Design and Technology. These are supported with examples to demonstrate application of each requirement with a design and technology context.

Within OCR's specification for GCSE (9–1) in Combined Science A, the content outlines standard Key Stage 4 content and higher tier content is identified in bold. The higher tier content relevant to Design and Technology is shown in the table below to demonstrate how the GCSE (9–1) in Combined Science A can support teaching and learning in Design and Technology.

Scientific knowledge and skills requirements for Design and Technology		Design Engineering	Fashion & Textiles	Product Design	OCR Design and Technology specification ref.	OCR GCSE (9–1) Science section	GCSE (9–1) Combined Science A specification (J250)
Science requirements	*Examples applied to D&T*						
S1 Use scientific laws – Newton's laws of motion, Hooke's law, Ohm's law as appropriate to the design product	Use scientific laws appropriately to the design of products, such as: • Newton's laws of motion • Hooke's law • Ohm's law.	✔			**2e (6)**	**P2.2**	• Contact and non-contact forces influencing the motion of an object.
					2i (6)	**P2.2**	• Newton's 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. • Understanding of force and extension for a spring covering Hooke's law.
						P3.2	• Measurement of conventional current and potential difference in circuits. • 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.
						P3.2	• Recall and apply Ohm's law the relationship between I, R and V

Scientific knowledge and skills requirements for Design and Technology							
Science requirements	*Examples applied to D&T*	**Design Engineering**	**Fashion & Textiles**	**Product Design**	**OCR Design and Technology specification ref.**	**OCR GCSE (9–1) Science section**	**GCSE (9–1) Combined Science A specification (J250)**
	Knowledge of the function of mechanical devices to produce different sorts of movement, and the movement of objects under the influence of forces in order to solve problems around stress, strain and elasticity, including projectiles.	✔			**2e (6)** **2i (6)**	**P2.1** **P2.2** **P2.2** **P2.3**	• Relationship between speed, distance and time. • Represent information in a distance-time graph. • Relative motion of objects. • Contact and non-contact forces influencing the motion of an object. • Newton's and that this is the measure of force. • Force arrows and have an understanding of balanced and unbalanced forces. • 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. • There is a force due to gravity.
	Knowledge of the 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.	✔			**2e (6)** **2i (6)**	**P3.1** **P3.2** **P3.2** **P3.3** **P5.1** **P5.2**	• Electron transfer leading to objects becoming statically charged and the forces between them. • Existence of an electric field. • Measurement of conventional current and potential difference in circuits. • 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. • Recall and apply Ohm's law the relationship between I, R and V • Magnets and the idea of attractive and repulsive forces. • Shape of the fields around bar magnets. • Magnetic effect of a current and electromagnets. • Energy transfer in process of electrical circuits. • Conservation of energy and that it has a quantity that can be calculated. • Transfer of energy into useful and waste energy stores. • Power and how domestic appliances can be compared. • Insulators and how energy transfer is influenced by temperature.

Scientific knowledge and skills requirements for Design and Technology *Science requirements*	*Examples applied to D&T*	Design Engineering	Fashion & Textiles	Product Design	OCR Design and Technology specification ref.	OCR GCSE (9–1) Science section	GCSE (9–1) Combined Science A specification (J250)
	Understanding of how to choose appropriate energy sources.	✔			**2e (6)** **2i (6)**	**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	• 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 energy stores. • 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. • Understanding of how power stations work and the cost of electricity in the home. • Electrical safety features in the home.

Scientific knowledge and skills requirements for Design and Technology							
Science requirements	*Examples applied to D&T*	**Design Engineering**	**Fashion & Textiles**	**Product Design**	**OCR Design and Technology specification ref.**	**OCR GCSE (9–1) Science section**	**GCSE (9–1) Combined Science A specification (J250)**
	Application of scientific formulae and calculation of quantities when applying science to mathematical skills.	✔			**2e,f,g (7)** **2e,f,g (8)** **2h (7)** **2h (8)**	**5c**	• Scientific quantities and corresponding units. • Apply them in qualitative work and calculations.
						5d	• Apply skills in observation, modelling and problem-solving, with opportunities for these skills to be shown through links to specification content.
						P1.1e	• Explain the differences in density between the different states of matter in terms of the arrangements of the atoms and molecules.
						P1.1	• Apply the relationship between density, mass and volume to changes where mass is conserved. (covered as maths requirement)
						5f	• density (kg/m^3) = mass (kg)/volume (m^3) (covered as maths requirement) • distance travelled (m) = speed (m/s) x time (s) (covered as maths requirement) • acceleration (m/s^2) = change in velocity (m/s)/time (s) (covered as maths requirement) • kinetic energy (J) = 0.5 x mass (kg) x (speed $(m/s))^2$ • force (N) = mass (kg) x acceleration (m/s^2) • work done/energy (J) = force (N) x distance (m) (along the line of action of the force) • power (W) = work done (J)/time (s) • momentum (kgm/s) = mass (kg) x velocity (m/s) • force exerted by a spring (N) = extension (m) x spring constant (N/m) • gravity force (N) = mass (kg) x gravitational field strength, g (N/kg) • (in a gravity field) potential energy (J) = mass (kg) x height (m) x gravitational field strength, g (N/kg) (g = 9.81 N/kg) • charge flow (C) = current (A) x time (s) • potential difference (V) = current (A) x resistance (Ω) • energy transferred (J) = charge (C) x potential difference (V) • power (W) = potential difference (V) x current (A) = (current $(A))^2$ x resistance (Ω) • energy transferred (J, kWh) = power (W, kW) x time (s, h) • wave speed (m/s) = frequency (Hz) x wavelength (m)

Scientific knowledge and skills requirements for Design and Technology *Science requirements*	*Examples applied to D&T*	Design Engineering	Fashion & Textiles	Product Design	OCR Design and Technology specification ref.	OCR GCSE (9–1) Science section	GCSE (9–1) Combined Science A specification (J250)
							• efficiency = useful output energy transfer (J)/input energy transfer (J) • change in thermal energy (J) = mass (kg) x specific heat capacity (J/kg°C) x change in temperature (°C)
S2 Describe the conditions which cause degradation	Understanding of properties of materials and how they need to be protected from potential degradation and corrosion due to environmental factors.	✔	✔	✔	**2e,f,g (5)** **2e,f,g (7)** **2h (5)** **2h (7)**	**C2.3** **C3.4** **C6.1** **P1.2**	• Understanding of physical properties of elements and compounds considering the nature of their bonding affecting their properties. • Many useful materials that we use today are mixtures. • Demonstrate an understanding of electrolysis, ionic solutions and solids. • Describe a process where a material or product is recycled for a different use, and explain why this is viable. • Evaluate factors that affect decisions on recycling. • Describe the basic principles in carrying out a lifecycle assessment of a material or product. • Matter and the similarities and differences between solids, liquids and gases.
S3 Know the physical properties of materials and explain how these are related to their uses	Knowledge of properties of materials to be applied when designing and making.	✔	✔	✔	**2e,f,g (5)** **2e,f,g (7)** **2h (5)** **2h (7)**	**C2.2**	• Explain applications of chemistry that can be used to help humans improve their own lives and strive to create a sustainable world for future generations. • Properties of ceramics, polymers and composites. • The method of using carbon to obtain metals from metal oxides.
	Knowledge of the properties of materials based on their scientific constitution.	✔	✔	✔	**2e,f,g (5)** **2h (5)**	**C2.1** **C6.1** **P1.1**	• Explain that many useful materials are formulations of mixtures. • Explain the differences in density between the different states of matter in terms of the arrangements of the atoms and molecules. • Explain how modern life is crucially dependent upon hydrocarbons and recognise that crude oil is a finite resource. • Apply the relationship between density, mass and volume to changes where mass is conserved.

Scientific knowledge and skills requirements for Design and Technology *Science requirements*	 *Examples applied to D&T*	Design Engineering	Fashion & Textiles	Product Design	OCR Design and Technology specification ref.	OCR GCSE (9–1) Science section	GCSE (9–1) Combined Science A specification (J250)
	Understand the appropriate use of materials, including polymers, composites, woods and metals, based on their physical properties.	✔		✔	**2e,f,g (5)** **2h (5)**	**C2.3** **C2.2**	• explain how the bulk properties of materials (ionic compounds; simple molecules; giant covalent structures; polymers and metals) are related to the different types of bonds they contain, their bond strengths in relation to intermolecular forces and the ways in which their bonds are arranged. • describe and compare the nature and arrangement of chemical bonds in: i. ionic compounds ii. simple molecules iii. giant covalent structures iv. polymers v. metals.
	Understand the appropriate use of materials, including technical textiles, fibres, polymers and metals, based on their physical properties.		✔				

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 or a prototype one.
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.
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.

Incremental innovation	A series of small improvements to an existing product or product line that aims to improve its competitive position over time. Incremental innovation is regularly used within high-tech businesses to ensure products include new features that are desired by consumers.
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 learner 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 design activity as it happens through whatever medium it is recorded in. Real-time evidence is gathered chronologically to tell a real story.

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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.
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	Front cover	Disclaimer	Addition of disclaimer
August 2018	1.2	3d 4d multiple	Retaking the qualification Admin of non-exam assessment	Update to wording for carry forward rules Amendent to 'Centre Record form' Reference

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