AQA
Realising potential

A-LEVEL
DESIGN AND TECHNOLOGY PRODUCT DESIGN
(7552)

Specification
For teaching from September 2017 onwards
For exams in 2018 onwards

Version 1.3 21 January 2019

Contents

Are you using the latest version of this specification?

- You will always find the most up-to-date version of this specification on our website at aqa.org.uk/7552
- We will write to you if there are significant changes to the specification.

1 Introduction

1.1 Why choose AQA for A-level Design and Technology: Product Design

This creative and thought-provoking qualification gives students the practical skills, theoretical knowledge and confidence to succeed in a number of careers. Especially those in the creative industries.

They will investigate historical, social, cultural, environmental and economic influences on design and technology, whilst enjoying opportunities to put their learning in to practice by producing prototypes of their choice.

Students will gain a real understanding of what it means to be a designer, alongside the knowledge and skills sought by higher education and employers.

We're confident you'll find this specification clear and easy to use, as a number of teachers and assessment experts have helped us to produce it.

We've structured the content so that you can co-teach AS and A-level Design and Technology students, allowing for maximum flexibility in lesson timetabling and teaching resources.

You can find out about all our Design and Technology: Product Design qualifications at aqa.org.uk/designandtechnology

1.2 Support and resources to help you teach

We've worked with experienced teachers to provide you with a range of resources that will help you confidently plan, teach and prepare for exams.

Teaching resources

Visit aqa.org.uk/7552 to see all our teaching resources. They include:

- teaching guidance and lesson plans to help you deliver this specification
- non-exam assessment example materials and a dedicated subject adviser for every school or college to help you understand our expectations for this part of the assessment
- sample schemes of work to help you plan your course with confidence
- textbooks tailored to our specification and approved by AQA

Preparing for exams

Visit aqa.org.uk/7552 for everything you need to prepare for our exams, including:

- sample papers and mark schemes for new courses
- Exampro: a searchable bank of past AQA exam questions
- example student answers with examiner commentaries.

Analyse your students' results with Enhanced Results Analysis (ERA)

Find out which questions were the most challenging, how the results compare to previous years and where your students need to improve. ERA, our free online results analysis tool, will help you see where to focus your teaching. Register at aqa.org.uk/era

For information about results, including maintaining standards over time, grade boundaries and our post-results services, visit aqa.org.uk/results

Keep your skills up-to-date with professional development

Wherever you are in your career, there's always something new to learn. As well as subject specific training, we offer a range of courses to help boost your skills.

- Improve your teaching skills in areas including differentiation, teaching literacy and meeting Ofsted requirements.
- Prepare for a new role with our leadership and management courses.

You can attend a course at venues around the country, in your school or online – whatever suits your needs and availability. Find out more at coursesandevents.aqa.org.uk

Help and support

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If you'd like us to share news and information about this qualification, sign up for emails and updates at aqa.org.uk/keepinformed-computer-science

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T: 0161 957 3334

2 Specification at a glance

This qualification is linear. Linear means that students will sit all their exams and submit all their non-exam assessment at the end of the course.

2.1 Subject content

2.2 Assessments

Paper 1
What's assessed Technical principles
How it's assessed • Written exam: 2 hours and 30 minutes • 120 marks • 30% of A-level
Questions Mixture of short answer and extended response.

Paper 2
What's assessed Designing and making principles
How it's assessed • Written exam: 1 hour and 30 minutes • 80 marks • 20% of A-level
Questions Mixture of short answer and extended response questions. **Section A:** • Product Analysis: 30 marks • Up to 6 short answer questions based on visual stimulus of product(s). **Section B:** • Commercial manufacture: 50 marks • Mixture of short and extended response questions

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Non-exam assessment (NEA)
What's assessed Practical application of technical principles, designing and making principles.
How it's assessed • Substantial design and make project • 100 marks • 50% of A-level
Evidence Written or digital design portfolio and photographic evidence of final prototype.

3 Subject content

A-level Design and Technology: Product Design requires students to engage in both practical and theoretical study. This specification requires students to cover design and technology skills and knowledge as set out below. These have been separated into:

- technical principles
- designing and making principles.

The specification content is presented in a two column format. The left hand column contains the specification content all students must cover, and forms the basis for the assessments. This column gives additional information to ensure students study the topic in appropriate depth and gives teachers the parameters in which the subject will be assessed.

Students should develop the ability to draw on and apply a range of skills and knowledge from other subject areas to inform their decisions in design and the application or development of technology. There are clear links between aspects of the specification content and other subject areas such as Computer Science (section 3.1.6 (page 29) 'The use of computer systems' and section 3.1.7 (page 30) 'Digital design and manufacture'); Business Studies (section 3.1.13 (page 37) 'Enterprise and marketing in the development of products; Art and Design (section 3.1.14 (page 37) 'Design communication') and History (section 3.2.2 (page 38) 'Design Theory'). This is not an exhaustive list, and there are other opportunities within the specification for students to integrate and apply their wider learning and understanding from other subject areas studied during Key Stage 4, as well as those subjects that they are studying alongside A-level Design and Technology.

Students must also demonstrate maths and science skills. The right hand column throughout subject content illustrates potential links where maths and science skills and knowledge can be applied in the context of design and technology. These are examples of where these skills can be applied and are not intended to be exhaustive.

The maths and science skills and knowledge as required by the DfE are set out in Appendix 1: Links to maths and science (page 73) .

3.1 Technical principles

3.1.1 Materials and their applications

Content	Potential links to maths and science
Students are expected to be able to name specific materials for a wide range of applications. They must also be able to provide detailed and justified explanations of why specific materials and combinations of materials are suitable for given applications, with reference to: • physical and mechanical properties (working characteristics) • product function • aesthetics • cost • manufacture and disposal.	Understand the appropriate use of materials including polymers, composites, woods and metals based on their physical and working characteristics such as: • malleability • toughness • hardness • resistance to corrosion and degradation • thermal conductivity • electrical conductivity. Calculation of quantities of materials sizes and costs.

Classification of materials

Content	Potential links to maths and science
Students should know and understand the classifications of the following materials and be able to name examples that belong to each category: • metals (ferrous, non-ferrous, alloys) • woods (hardwoods, softwoods, manufactured boards) • polymers (thermoplastics, thermoset polymers, elastomers) • papers and boards • composites • smart materials • modern materials.	

Methods for investigating and testing materials

Content	Potential links to maths and science
Students should be able to describe how workshop and industrial tests are set up and what will be tested, measured and compared, including: • tensile strength • toughness • hardness • malleability • corrosion • conductivity.	Analysis of data obtained from testing.

3.1.2 Performance characteristics of materials

Performance characteristics of papers and boards

Content	Potential links to maths and science
Students should be able to name different types of papers and boards. Students should be able to describe the performance characteristics of papers and boards, including: • the ability to be scored • cutting • folding • surface qualities for printing • impact resistance • recyclability and/or biodegradability. Students should be able to explain why different papers and boards are suitable for different applications, including: • layout paper: sketch pads • cartridge paper: printing • tracing paper: copying images • bleed proof paper: marker rendering • treated paper: photographic printing • watercolour paper: painting • corrugated card: packaging • bleached card: greeting cards and high quality packaging • mount board: modelling • duplex card: food packaging • foil backed and laminated card: drinks packaging • metal effect card: gift packaging • moulded paper pulp: eco-friendly packaging.	Efficient use of materials in the construction of containers through 2D net design. Effective selection of materials to allow for recyclability, biodegradability and stability.

Performance characteristics of polymer based sheet and film

Content	Potential links to maths and science
Students should be able to name different types of polymer based sheet and film. Students should be able to describe the performance characteristics of polymer based sheet and film, including: • the ability to be scored • cutting • folding • moulding • transparency • translucency • flexibility • recyclability and/or biodegradability.	
Students should be able to explain why different polymer based sheet and film are suitable for different applications, including: • foam board: model making • fluted polypropylene: signs and box construction • translucent polypropylene sheets: packaging • styrofoam: modelling and formers • low density polyethylene sheet: wrapping, packaging and bags • plastazote foam: protective packaging • cellulose acetate: packaging • polyactide sheet and film: biodegradable packaging.	

Performance characteristics of woods

Content	Potential links to maths and science
Students should be aware of the different stock forms of timber, including: • rough sawn • planed square edge (PSE) • planed all round (PAR) • natural timber • manufactured boards • mouldings.	

<table>
<tr><th>Content</th><th>Potential links to maths and science</th></tr>
<tr><td>Students should be able to describe the performance characteristics of woods, including:
• grain pattern
• grain direction
• surface defects
• warpage
• shrinkage
• splitting
• joining
• forming
• steam bending
• laminating
• machining qualities
• resistance to decay
• moisture resistance
• toxicity.</td><td></td></tr>
<tr><td>Students should be familiar with the following woods and wood products:
• softwoods:
  • pine
  • spruce
  • Douglas fir
  • redwood
  • cedar
  • larch
• hardwoods:
  • oak
  • ash
  • mahogany
  • teak
  • birch
  • beech
• manufactured boards:
  • plywood
  • marine plywood
  • aeroply
  • flexible plywood
  • chipboard
  • medium density fibreboard (MDF)
• veneers and melamine formaldehyde laminates.</td><td></td></tr>
</table>

Performance characteristics of metals

Content	Potential links to maths and science

Students should be aware of the different stock forms of metals, including:
• sheet
• plate
• bar:
  • flat
  • round
  • square
  • hexagonal
• tube:
  • round
  • square
  • rectangular
  • hexagonal
• structural:
  • H beam
  • I beam
  • tee
  • channel
  • angle.	

Students should be able to describe the performance characteristics of metals, including: • hardness • toughness • malleability • elasticity • tensile strength • density • resistance to corrosion • thermal conductivity • electrical conductivity • melting points • ability to be alloyed • ability to be joined with heat processes • ability to take applied coatings and finishes.	

<table>
<tr><th>Content</th><th>Potential links to maths and science</th></tr>
<tr><td>Students should be familiar with the following metals:

ferrous:
low carbon steel
stainless steel
high speed steel (HSS)
medium carbon steel
cast iron
non-ferrous:
aluminium
copper
zinc
silver
gold
titanium
tin
ferrous alloys:
stainless steel
die steel (tool steel)
non-ferrous alloys:
bronze
brass
duralumin
pewter.
</td><td></td></tr>
</table>

Performance characteristics of polymers

<table>
<tr><th>Content</th><th>Potential links to maths and science</th></tr>
<tr><td>Students should be aware of the different stock forms of polymers, including:
sheet
film
granules
rod and other extruded forms
foam
powder.</td><td></td></tr>
</table>

<table>
<tr><th>Content</th><th>Potential links to maths and science</th></tr>
<tr><td>Students should be able to describe the performance characteristics of polymers, including:
• toughness
• elasticity
• insulation (thermal and electrical)
• UV resistance
• ability to be moulded
• resistance to chemicals and liquids
• melting points
• suitability for food packaging applications
• biodegradability
• recyclability
• self finishing
• ability to be combined with other polymers and/or additives.</td><td></td></tr>
<tr><td>Students should be familiar with the following polymers:
• thermoplastic:
  • low density polyethylene (LDPE)
  • high density polyethylene (HDPE)
  • polypropylene (PP)
  • high impact polystyrene (HIPS)
  • acrylonitrile butadiene styrene (ABS)
  • polymethylmethacrylate (PMMA)
  • nylon
  • rigid and flexible polyvinyl chloride (PVC)
  • Polyethylene terephthalate (PET)
• thermosets, with specific reference to their:
  • urea formaldehyde (UF)
  • melamine formaldehyde (MF)
  • polyester resin
  • epoxy resin.</td><td></td></tr>
</table>

Elastomers

Content	Potential links to maths and science
Students should be able to explain the suitability of elastomers for given applications making reference to relevant physical and/or mechanical properties, including: • ability to be stretched and then return to original shape • texture • self finishing • non-toxic. Students should understand how elastomers are used to enhance products, for example in producing grips for improved ergonomics.	
Students should be familiar with the following elastomers: • natural rubber • polybutadiene • neoprene • silicone • Thermoplastic Elastomer (TPE).	

Biodegradable polymers

Content	Potential links to maths and science
Students should be able to explain the suitability of biodegradable polymers for given application making reference to relevant physical and/or mechanical properties, including: • ability to be moulded into 3D products or film • ability to degrade with the action of UV rays (sunlight), water or enzymes present in soil. Students should understand how biodegradable polymers degrade.	

Content	Potential links to maths and science
Students should be familiar with the following biodegradable polymers: • corn starch polymers • potatopak • biopol (bio-batch additive) • polyactide (PLA) • polyhdroxyalkanoate (PHA) • water soluble: lactide, glycolide (Lactel and ecofilm).	

Composites

Content	Potential links to maths and science
Students need to know and understand how materials are combined to make composites with enhanced properties. Students should be able to explain the suitability of composites for given application making reference to relevant physical and/or mechanical properties, including: • ability to be moulded into a variety of 3D forms • enhancement of physical and/or mechanical properties • ease of manufacture for some uses against traditional materials • improved product performance. Students should be familiar with the following composites: • carbon fibre reinforced plastic (CFRP) • glass reinforced plastic (GRP) • tungsten carbide • aluminium composite board • concrete, including reinforced concrete • fibre cement • engineered wood, eg glulam (glued laminated timber).	

Smart materials

Content	Potential links to maths and science
Students should know and understand the term smart material. Students should be able to explain the suitability of smart materials for given applications making reference to how the material responds to external stimuli, including: • changes in temperature • changes in light levels • changes in pressure (force).	
Students should be familiar with the following smart materials: • shape memory alloys (SMA), eg Nitinol • thermochromatic pigment • phosphorescent pigment • photochromic pigment • electroluminescent wire • piezo electric material.	

Modern materials

Content	Potential links to maths and science
Students should know and understand the term modern material.	
Students should be able to explain the suitability of modern materials for given applications.	
Students should be familiar with the following modern materials: • kevlar • precious metal clay (PMC) • high density modelling foam • polymorph.	

3.1.3 Enhancement of materials

Content	Potential links to maths and science
Students are expected to be able to describe enhancement methods for given materials and explain their suitability for specific product applications.	Understand the appropriate use of materials, including polymers, composites, woods and based on their physical properties.

Polymer enhancement

Content	Potential links to maths and science
The use of additives to enhance properties, including: • UV stabilisers to prolong the life of polymers • bio-batch materials to encourage biodegradability. Students should be familiar with how additives are used in specific polymer products, eg patio furniture, food packaging and carrier bags.	

Wood enhancement

Content	Potential links to maths and science
The combining of natural timber with resins and lamination to give enhanced properties, eg increased strength and stability. Enhancing timber products with preservatives, finishes and coatings.	

Metal enhancement

Content	Potential links to maths and science
Students should be aware of heat treatment methods of enhancing metals, including: • case hardening • hardening and tempering.	

3.1.4 Forming, redistribution and addition processes

Paper and board forming processes

Content	Potential links to maths and science
Students should be aware of the ways that paper and board can be shaped into different products such as packaging. Specific process to include: • die cutting • laser cutting • creasing • bending.	

Polymer processes

Content	Potential links to maths and science
Students should be aware of how polymers can be formed into 3D products. They should be able to describe the different forming methods.	
They should be able to explain the suitability of the different forming methods for a range of specific products and scales of production. Specific process to include: • vacuum forming • thermoforming • calendaring • line bending • laminating (layup) • injection moulding • blow moulding • rotational moulding • extrusion • compression moulding.	

Metal processes

Content	Potential links to maths and science

Students should be aware of how metals can be shaped into 3D products.
 	
They should be able to describe the different forming methods.
 	
They should be able to explain the suitability of the different forming methods for a range of specific products and scales of production.
 	
Specific processes to include:
• press forming
• spinning
• cupping
• deep drawing
• forging
• drop forging
• bending
• rolling
• casting:
    • sand casting
    • die casting
    • investment casting
    • low temperature casting (pewter).	

Students should be aware of the different permanent and temporary joining methods for metals.
 	
They should be able to describe the different methods.
 	
They should be able to explain the suitability of the different joining methods for a range of specific products and scales of production.
 	
Including addition/fabrication processes:
• metal inert gas (MIG) welding
• tungsten inert gas (TIG) welding
• spot welding
• oxy-acetylene welding
• soldering (soft and hard)
• brazing
• riveting
• temporary joining methods and fasteners:
    • self tapping screws
    • machine screws
    • nuts and bolts.	

Content	Potential links to maths and science
Students should be aware of the different wasting processes. They should be able to describe the different processes. They should be able to explain the suitability of the different wasting processes for a range of specific components and products. Specific processes to include: • milling • turning • flame cutting • plasma cutting • laser cutting • punching/stamping.	

Wood processes

Content	Potential links to maths and science

Students should be aware of how timber can be joined to form different products.
They should be able to describe the different methods.
They should be able to explain the suitability of the different joining methods for a range of specific products and scales of production.
Including:
• addition/fabrication processes
• traditional wood jointing:
  • dovetail joint
  • comb joint
  • housing joint
  • half-lap joint
  • dowel joint
  • mortise and tenon
• component jointing:
  • knock down (KD) fittings
  • wood screws
  • nuts and bolts
  • coach bolts.	

Content	Potential links to maths and science

Students should be aware of how timber can be formed into 3D products.
They should be able to describe the different processes.
They should be able to explain the suitability of the different wasting processes for a range of specific products.
Specific processes to include:
• laminating
• steam bending
• machine processes:
  • turning between centre
  • use of the chuck and faceplate
  • milling
  • routering to produce slots, holes and profiles.	

3.1.4.5 The use of adhesives and fixings

Content	Potential links to maths and science
• PVA • Contact adhesives • UV hardening adhesive • Solvent cements such as Tensol or acrylic cement • Epoxy resin	

Jigs and fixtures

Content	Potential links to maths and science
Students should be aware of how jigs and fixtures can be used to aid the manufacture of products. They should be able to describe them and explain their suitability for accurate and repeated manufacture of products.	Dimensions and angles in the design of jigs, fixtures and templates.

3.1.5 The use of finishes

Paper and board finishing

Content	Potential links to maths and science
Students should be aware of the ways that paper and board can be finished to enhance their appearance or for improved function. Specific finishes to include: • laminating • embossing • debossing • varnishing, UV varnishing and spot varnishing • foil blocking.	Ensure products are designed to take account of potential corrosion due to environmental factors.

Paper and board printing processes

Content	Potential links to maths and science
Students should be aware of the different types of printing processes and their suitability for specific products and scales of production. Specific processes to include: • screen printing • flexographic and offset lithographic printing • digital printing.	

Polymer finishing

Content	Potential links to maths and science
Students should be aware of the ways that polymers can be finished to enhance their aesthetics or for improved function. Students should be aware that some polymers are self-finishing and that this should be considered as a polymer finish. Specific finishes to include: • acrylic spray paints • thermoplastic elastomer.	

Content	Potential links to maths and science
Students should understand how pigments can be added to polymers in the moulding process, including: • gel coats when laminating GRP • smart pigments such as thermochromic or phosphorescent.	

Metal finishing

Content	Potential links to maths and science
Students should be aware of the ways that metals can be finished to enhance their appearance or prevent corrosion. Including applied finishes: • cellulose paint • acrylic paint • electro-plating • dip coating • powder coating • galvanising • sealants • preservatives • anodising • plating • coating • cathodic protection.	

Wood finishing

Content	Potential links to maths and science

Students should be aware of the ways that woods can be finished to enhance their appearance or prevent decay.
Specific finishes to include:
• applied finished:
  • polyurethane varnish
  • acrylic varnish
  • water based paints
  • stains
  • colour wash
  • wax finishes
  • danish oil
  • teak oil
• pressure treating with chemical preservatives.	

3.1.6 Modern industrial and commercial practice

Scales of production

Content	Potential links to maths and science
Students should be aware of, and be able to describe, the different scales of production giving example products and specific manufacturing methods. Specific scales of production to include: • one-off, bespoke • batch production • mass/line production • unit production systems (UPS) • quick response manufacturing (QRM) • vertical in-house production.	

3.1.6.2 Efficient use of materials

Content	Potential links to maths and science
Students must develop an awareness of the relationship between material cost, form, and manufacturing processes, and the scale of production. • The development of designs which use materials economically and with regard to their characteristics. • The use of manufacturing processes which increase accuracy and reduce waste. • The savings to be gained when comparing bulk production with one-off production. • The advantages of Just In Time (JIT) manufacture.	Determining quantities of materials.

The use of computer systems

Content	Potential links to maths and science
Students should be aware of how computer systems are used to plan and control manufacturing, reduce waste and respond quickly to changes in consumer demand.	
Students should be able to explain specific industrial manufacturing systems and their use in the production of given products. Specific manufacturing systems to include: • modular/cell production • just in time (JIT) • quick response manufacturing (QRM) • flexible manufacturing systems.	
Students should be able to explain the use of computer controlled systems in production, distribution and storage. Students should be able to explain the use of standardised and bought-in components made by specialist manufacturers.	

Sub-assembly

Content	Potential links to maths and science
Students should be aware of, and able to explain, sub-assembly as a separate line of manufacture for certain parts of a product.	

3.1.7 Digital design and manufacture

Computer aided design (CAD)

Content	Potential links to maths and science

Students should be aware of, and be able to describe, the following:
• the advantages and disadvantages of using CAD compared to a manually generated alternative
• the use of CAD to develop and present ideas for products, including:
  • the use of 2D CAD for working drawings
  • the use of 3D CAD to produce presentation drawings
• how CAD is used in industrial applications.
	Use of datum points and geometry when setting out design drawings.
	The use of tolerances in dimensioning.

Computer aided manufacture (CAM)

Content	Potential links to maths and science
Students should be aware of, and be able to describe, how CAM is used in the manufacture of products. Specific processes to include: • laser cutting • routing • milling • turning • plotter cutting.	Calculating speeds and times for machining.

Virtual modelling

Content	Potential links to maths and science
Students should be aware of, and be able to describe, how virtual modelling/testing is used in industry prior to product production. Specific processes to include: • simulation • computational fluid dynamics (CFD) as used for testing aerodynamics and wind resistance, and flow of liquids within/ around products • finite element analysis (FEA) as used in component stress analysis.	Interpretation of data from CFD or FEA testing.

Rapid prototyping processes

Content	Potential links to maths and science
Students should be aware of, and be able to describe, rapid prototyping processes, including 3D printing. Students should understand, and be able to explain, the benefits to designers and manufacturers.	Calculating volumes of 3D printed products, calculating time/speed for 3D printing.

Electronic data interchange

Content	Potential links to maths and science
Students should be aware of, and able to describe, the use of electronic point of sales (EPOS) for marketing purposes and the collection of market research data, including: • the maintenance of stock levels • the capture of customer data, eg contact details.	

Production, planning and control (PPC) networking

Content	Potential links to maths and science
Students should be aware of, and able to describe, the role of PCC systems in the planning and control of all aspects of manufacturing, including: • availability of materials • scheduling of machines and people • coordinating suppliers and customers.	

3.1.8 The requirements for product design and development

Product development and improvement

Content	Potential links to maths and science
Through the study and critical analysis of existing products, students should develop an understanding of the requirements of the following: • the design, development and manufacture of products to meet specification criteria • fitness for purpose • accuracy of production • how the critical assessment of products can lead to the development of new designs. Students should develop the skills to critically assess products and develop new design proposals. Students should development their ability to work with a variety of materials, including two- and three-dimensional forms, to produce creative and original products which satisfy the demands of the target market, and consider accurate and efficient manufacture. When designing products Students should consider aesthetics, ergonomics and anthropometrics.	

Inclusive design

Content	Potential links to maths and science
Students should be aware of, and be able to explain, the development of products that are inclusive in their design so that they can be used by a wide range of users including the disabled, children and the elderly.	

3.1.9 Health and safety

Safe working practices

Content	Potential links to maths and science
Students should be aware of, and able to explain, health and safety procedures related to products and manufacturing, including: • knowledge of the Health and Safety at Work Act (1974), and how it influences the safe manufacture of products • control of Substances Hazardous to Health (COSHH) and safety precautions that should be taken with relevant materials • safe working practices and identifying potential hazards for the school or college workshop and industrial contexts • safety precautions that should be taken with specific manufacturing processes • the concept of risk assessment and its application to given manufacturing processes.	Understand why some materials, adhesives and finishes are hazards.

Safety in products and services to the customer

Content	Potential links to maths and science

Students should be aware of, and able to explain, how designers and manufacturers ensure products are safe for consumers to use, including:
• legislation used to protect consumers and its impact on product design, eg Consumer Rights Act (2015), Sales of Goods Act (1979)
• the British Standards Institute (BSI), and how specific products might be tested to meet safety standards
• measures to ensure the safety of toys, eg Lion Mark
• advice to consumers:
  • manufacturer's instructions
  • safety warnings
  • aftercare advice.	

3.1.10 Protecting designs and intellectual property

Content	Potential links to maths and science
Students should be aware of, and able to explain, the importance of the following to the designer: • copyright and design rights • patents • registered designs • trademarks • logos.	
Students should be aware of, and able to explain, the concept of 'open design'. Specifically referring to the development of products for the common good of society, including potential use. Students should be able to give examples of this in practice, eg humanitarian projects and file sharing for 3D printing.	

3.1.11 Design for manufacturing, maintenance, repair and disposal

Manufacture, repair, maintenance and disposal

Content	Potential links to maths and science

Students should be aware of, and able to explain, the need to modify designs to make them more efficient to manufacture, including:
• reducing the number of manufacturing processes
• how the choice of materials affects the use, care and disposal of products:
  • labelling of materials to aid separation for recycling
  • making products easy to disassemble or separate
• application of the six Rs of sustainability:
  • reduce the quantity of materials, of toxic materials, of damaging materials and associated energy use
  • reuse components and parts
  • rethink by using eco friendly alternative materials
  • recycle materials and/or components into new products
• maintenance:
  • temporary and integral fixings
  • use of standardised parts
  • allowing for service and repair/ replacement of parts
  • ability to upgrade with software downloads.	

Ease of manufacture

Content	Potential links to maths and science
Students should be aware of, and able to explain, the different ways in which a product can be designed to allow for more efficient manufacture, including: • ribs and webbing to reduce material thicknesses • snap fittings to remove the need for fixings/adhesives • internal moulded screw posts for use with self tapping screws • use of pre made components • use of standardised patterns and sizes • addition of texture in moulding to reduce number of manufacturing processes • self finishing.	

Disassembly

Content	Potential links to maths and science
Students should be aware of, and able to explain, how a product can be designed and manufactured with disassembly in mind, including integral fixings and active disassembly using smart materials such as SMA and biodegradable parts.	

3.1.12 Feasibility studies

Content	Potential links to maths and science
Students should be aware of, and able to explain, the use of feasibility studies to assess the practicality for production of proposed designs, including the testing of prototypes with potential consumers.	Interpret statistical analyses to determine user needs and preferences. Use data related to human scale and proportion to determine product scale and dimensions.

3.1.13 Enterprise and marketing in the development of products

Content	Potential links to maths and science
Students should be aware of, and able to explain, the importance of marketing and brand identity, including: • customer identification • labelling • packaging • corporate identification • concept of global marketing: • the promotion and advertisement of products including the use of new technologies, eg social media, viral marketing • product costing and profit • awareness of the role of entrepreneurs. Students should be aware of, and able to explain, the collaborative working of designers in the development of new and innovative products, including virtual and face-to-face collaborative working systems.	Interpretation of market research data, calculating costs and profit.

3.1.14 Design communication

Content	Potential links to maths and science
Students should be aware of, and able to explain and demonstrate the skills, in a range of communication and presentation techniques for conveying proposals and intentions to clients, potential users and manufacturers, including: • report writing • the use of graphs • tables and charts • 2D/3D sketching • the use of mixed media and rendering to enhance drawings • dimensioning and details for manufacture.	Scaling drawings. Use of datum points and geometry when setting out design drawings. Representation of data used to inform design decisions and evaluation of outcomes. Presentation of market data, user preferences and outcomes of market research.

3.2 Designing and making principles

3.2.1 Design methods and processes

Iterative design process

<table>
<tr><th>Content</th><th>Potential links to maths and science</th></tr>
<tr><td>Students should be aware of, and able to explain, different approaches to user centred design. That in approaching a design challenge there is not a single process, but that good design always addresses many issues, including:

designing to meet needs, wants or values
investigations to inform the use of primary and secondary data:

market research
interviews
human factors
focus groups
product analysis and evaluation
the use of anthropometric data and percentiles
the use of ergonomic data

the development of a design proposal
the planning and manufacture of a prototype solution
the evaluation of a prototype solution to inform further development.
</td><td>Representation of data used to inform design decisions and evaluation of outcomes.

The use of ergonomic and anthropometric data when designing products for humans and specific applications.</td></tr>
</table>

3.2.2 Design theory

Design influences

Content	Potential links with maths and science
Students should be aware of, and able to discuss, how key historical design styles, design movements and influential designers that have helped to shape product design and manufacture.	

Design styles and movements

Content	Potential links with maths and science
Students should be aware of, and be able to discuss, key design styles and movements and their principles of design, including: • arts and craft movement • Art Deco • Modernism, eg Bauhaus • Post modernism, eg Memphis.	

Designers and their work

Content	Potential links to maths and science
Students should be aware of, and be able to discuss, the work of influential designers and how their work represents the principles of different design movements, including: • Phillipe Starck • James Dyson • Margaret Calvert • Dieter Rams • Charles and Ray Eames • Marianne Brandt.	

3.2.3 How technology and cultural changes can impact on the work of designers

Socio economic influences

Content	Potential links to maths and science

Students should be aware of, and able to discuss, how socio economic influences have helped to shape product design and manufacture, including:
• post WW1: the Bauhaus and development of furniture for mass production
• WW2: rationing, the development of 'utility' products
• contemporary times:
  ◦ fashion and demand for mass produced furniture
  ◦ decorative design.	

Major developments in technology

Content	Potential links to maths and science
Students should be aware of, and able to discuss, how major developments in technology are shaping product design and manufacture, including: • micro electronics • new materials • new methods of manufacture • advancements in CAD/CAM.	An awareness of scientific advancements/ discoveries and their potential development.

Social, moral and ethical issues

Content	Potential links to maths and science

Students should be aware of, and able to discuss, the responsibilities of designers and manufacturers, including:
• products are made using sustainable materials and ethical production methods
• the development of products that are:
  ◦ culturally acceptable
  ◦ not offensive to people of different race, gender or religious belief
• the development of products that are inclusive
• the design and manufacture of products that could assist with social problems, eg poverty, health and wellbeing, migration and housing
• the impact of Fairtrade on design and consumer demand
• designing products to consider the six Rs of sustainability.	

3.2.3.4 Product life cycle

Content	Potential links to maths and science
Design introduction, evolution, growth, maturity, decline and replacement. Students should be familiar with examples of how designers refine and re-develop products in the lifecycle of specific products.	

3.2.4 Design processes

The use of a design process

Content	Potential links to maths and science
Students should be aware of, and able to discuss and implement, the stages of a range of design processes in order to apply personal judgement and relevant criteria in the appraisal of products and systems, including: • those used in the NEA • investigations and analysis • use of inspiration materials, eg mood boards • ideas generation • illustration • development of a design specification • modelling • planning • evaluating and testing.	

Prototype development

Content	Potential links to maths and science
Students should be aware of, and able to discuss and demonstrate, the development of a prototype from design proposals. This knowledge should influence the development of design ideas for the NEA so that students may make high quality products that meet the needs of identified users.	

The iterative design process in industrial or commercial contexts

Content	Potential links to maths and science
Students should be aware of, and able to discuss, how different design methodologies are used by designers in the corporate world when designing products including collaborative working and the cyclic nature of commercial design and manufacture.	

3.2.5 Critical analysis and evaluation

Content	Potential links to maths and science
Students should be aware of, and able to discuss, their own and commercial products leading to possible improvements/modifications of the original idea.	

Testing and evaluating products in commercial products

Content	Potential links to maths and science
Students should be aware of, and able to discuss, how products are required to undergo rigorous testing, and the testing methods used, before they become commercially available for sale.	

Use of third party feedback in the testing and evaluation process

Content	Potential links to maths and science
Students should be aware of, and able to discuss, how the use of feedback and testing informs the evaluation process, including: • informing future modification and development • the importance of ensuring the views of other interested parties in order to have objective and unbiased feedback.	

3.2.6 Selecting appropriate tools, equipment and processes

Content	Potential links to maths and science
Students should be aware of, and able to discuss and demonstrate, good and safe working practices, including: • the importance of using the correct tools and equipment for specific tasks • the importance of ensuring their own safety and that of others when in a workshop situation • how designs are developed from a single prototype into mass produced products • the effect on the manufacturing process that is brought about by the need for batch and mass manufacture • how to select the most appropriate manufacturing process to be able to realise their, or others', design proposals • the importance of health and safety in a commercial setting including workforce training and national safety standards.	

3.2.7 Accuracy in design and manufacture

Content	Potential links to maths and science
Students should be aware of, and able to discuss and demonstrate, the importance of accuracy in manufacturing, whatever the scale of production, including: • how testing can eliminate errors • the value in the use of measuring aids, eg templates, jigs and fixtures in ensuring consistency of accuracy and the reduction of possible human error.	Determining quantities of materials. Calculation of sides and angles of products. Use of datum points and geometry when setting out design drawings. Use of geometry to create templates for designs.

3.2.8 Responsible design

Environmental issues

Content	Potential links to maths and science
Students should be aware of, and able to discuss, the importance environmental issues in design and manufacture, including: • the responsibilities of designers and manufacturers in ensuring products are made from sustainable materials and components • the environmental impact of packaging of products, eg the use of excessive packaging and plastics.	

Conservation of energy and resources

Content	Potential links to maths and science
Students should be aware of, and able to discuss, the concept of a circular economy, including: • how products are designed to conserve energy, materials and components • the design of products for minimum impact on the environment including raw material extraction, consumption, ease of repair, maintenance and end of life • sustainable manufacturing including the use of alternative energy and methods to minimise waste • the impact of waste, surplus and by-products created in the process of manufacture including reuse of material off-cuts, chemicals, heat and water • cost implications of dealing with waste • the impact of global manufacturing on product miles.	

3.2.9 Design for manufacture and project management

Planning for accuracy and efficiency

Content	Potential links to maths and science
Students should be aware of, and able to discuss and demonstrate, the importance of planning for accuracy when making prototypes and making recommendations for small, medium and large scale production.	

Quality assurance

Content	Potential links to maths and science
Students should be aware of, and able to discuss and demonstrate, the procedures and policies put in place to reduce waste and ensure manufactured products are produced accurately and within acceptable tolerances, including quality assurance systems including Total Quality Management (TQM), scrum, Six Sigma and their applications to specific industrial examples including critical path analysis.	

Quality control

Content	Potential links to maths and science
Students should be aware of, and able to discuss and demonstrate, quality control, including: • the monitoring, checking and testing of materials, components, equipment and products throughout production to ensure they conform to acceptable tolerances • specific quality control methods including the use of 'go-no go' gauges, laser or probe scanning and measuring • use of digital measuring devices such as vernier callipers and micrometers • non-destructive testing such as x-rays and ultrasound.	

3.2.10 National and international standards in product design

Content	Potential links to maths and science

Students should be aware of, and able to discuss, the importance of national and international standards in product design, including:
• British Standards Institute (BSI)
• International Organisation for Standardisation (ISO)
• Restriction of Hazardous Substances (ROHS) directive
• battery directive
• polymer codes for identification and recycling
• packaging directives
• WEEE directives
• energy ratings of products
• eco-labelling:
    • the Mobius Loop
    • the European Eco-label
    • NAPM recycled mark
    • the EC energy label
    • the Energy Efficient label and logo
    • Forest Stewardship Council (FSC)
    • EPA energy star.	

4 Scheme of assessment

Find past papers and mark schemes, and specimen papers for new courses, on our website at aqa.org.uk/pastpapers

This specification is designed to be taken over two years.

This is a linear qualification. In order to achieve the award, students must complete all assessments at the end of the course and in the same series.

A-level exams and certification for this specification are available for the first time in May/June 2019 and then every May/June for the life of the specification.

All materials are available in English only.

Our A-level exams in Design and Technology: Product Design include questions that allow students to demonstrate their ability to:

- recall information
- draw together information from different areas of the specification
- apply their knowledge and understanding in practical and theoretical contexts.

4.1 Aims

Courses based on this specification must encourage students to:

- be open to taking design risks, showing innovation and enterprise whilst considering their role as responsible designers and citizens
- develop intellectual curiosity about the design and manufacture of products and systems, and their impact on daily life and the wider world
- work collaboratively to develop and refine their ideas, responding to feedback from users, peers and expert practitioners
- gain an insight into the creative, engineering and/or manufacturing industries
- develop the capacity to think creatively, innovatively and critically through focused research and the exploration of design opportunities arising from the needs, wants and values of users and clients
- develop knowledge and experience of real world contexts for design and technological activity
- develop an in-depth knowledge and understanding of materials, components and processes associated with the creation of products that can be tested and evaluated in use
- be able to make informed design decisions through an in-depth understanding of the management and development of taking a design through to a prototype/product
- be able to create and analyse a design concept and use a range of skills and knowledge from other subject areas, including maths and science, to inform decisions in design and the application or development of technology
- be able to work safely and skillfully to produce high-quality prototypes/products
- have a critical understanding of the wider influences on design and technology, including cultural, economic, environmental, historical and social factors
- develop the ability to draw on and apply a range of skills and knowledge from other subject areas, including the use of maths and science for analysis and informing decisions in design.

4.2 Assessment objectives

Assessment objectives (AOs) are set by Ofqual and are the same across all A-level Design and Technology: Product Design specifications and all exam boards.

The exams and non-exam assessment will measure how students have achieved the following assessment objectives.

- 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.

4.2.1 Assessment objective weightings for A-level Design and Technology: Product Design

Assessment objectives (AOs)	Component weightings			Overall weighting
	Paper 1	Paper 2	NEA	
AO1			15	15
AO2			25	25
AO3	7.5	7.5	10	25
AO4	22.5	12.5		35
Overall weighting of components	30	20	50	100

4.3 Assessment weightings

The marks awarded on the papers will be scaled to meet the weighting of the components. Students' final marks will be calculated by adding together the scaled marks for each component. Grade boundaries will be set using this total scaled mark. The scaling and total scaled marks are shown in the table below.

Component	Maximum raw mark	Scaling factor	Maximum scaled mark
Paper 1	120	x1	120
Paper 2	80	x1	80
NEA	100	x2	200
		Total scaled mark:	400

4.4 Non-exam assessment criteria

4.4.1 Setting the task

Students must undertake a small-scale design and make task and produce a final prototype based on a context and design brief developed by the student.

4.4.2 Taking the task

With reference to the context, students will develop a specific brief that meets the needs of a user, client or market.

The brief must be of an appropriate level of complexity and contain a degree of uncertainty of the outcome so that students can engage in an iterative process of designing, making, testing and evaluating.

Students must produce a final prototype based on the design brief they have developed, along with a written or digital design folder or portfolio.

Students must produce a written or digital design folder clearly evidencing how the assessment criteria have been met together with photographic evidence of the final manufactured prototype outcome.

4.4.2.1 Evidence

Students must produce a final prototype based on the design brief that they have developed.

Students should produce a concise folder. We recommend that this folder should not exceed 45 pages.

Students who do not follow these guidelines will penalise themselves by not meeting the expectations of the assessment appropriately.

Students that exceed the recommended length will self-penalise by not being appropriately focused on the demands of the task. Students that produce work that is shorter than the recommended page count will self-penalise by not allowing appropriate coverage of the assessment objectives.

4.4.2.2 Time limits

Time limits for completion of the NEA are not specified because the process of producing the design portfolio is iterative and undertaken independently, while the final prototype is manufactured under immediate guidance or supervision in school/college. Where specialist processes or equipment are required beyond the school/college they may be utilised but this must be documented in the Candidate Record Form (CRF).

We expect students to be selective in their choice of material to include, and to manage their time appropriately.

4.4.3 Marking the task

Five criteria are produced for assessment. Each band should be viewed holistically when making assessments. Students who produce no work for a criterion, or who produce work below that of A-level standard, should be awarded a mark of zero.

The criteria should not be viewed as a linear process to be followed in a step-by-step manner. Rather students should be encouraged to cross reference the criteria throughout, and assessors encouraged to award marks where they are deserved and can be evidenced.

4.4.4 Guidance on applying the marking critieria

Level of response marking instructions are broken down into mark bands, each of which has a descriptor. The descriptor for the mark band shows the average performance for the level required. Before you apply the mark scheme to a student's project, review both the prototype and portfolio and annotate/make notes on it to show the qualities that are being looked for. You can then apply the marking criteria. Start at the lowest band of the marking criteria and use it as a ladder to see whether the work meets the descriptor for that band. The descriptor for the band indicates the different qualities that might be seen in the student's work for that level. If it meets descriptors for the lowest band then go to the next one and decide if it meets this, and so on, until you have a match between the band descriptor and the student's work. You can compare your student's work with the standardisation examples to determine if it is the same standard, better or worse. When assigning a level you should look at the overall quality of the work. If the project covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the work to help decide the mark within the band.

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

- where the student's work fully meets all statements, the highest mark should be awarded
- where the student's work mostly meets all statements, the most appropriate mark in the middle of the range should be awarded
- where the student's work just meets the majority of statements, the lowest mark should be awarded.

There will be instances where a student fully meets for example 3/4 statements but only just meets the other. In this scenario a best fit approach should be taken. If, in this scenario, the range of marks within the band was 16–20, then a mark of 18/19 would be appropriate.

4.4.5 Feedback

Students are free to revise and redraft a piece of work before submitting the final piece for assessment. You can review draft work and provide **generic feedback** to ensure that the work is appropriately focussed. In providing generic feedback you **can**:

- provide feedback in oral and/or written form
- advise on resources that could be used
- remind students of the key sections that should be included in their final folder.

In providing generic feedback you **cannot**:

- correct a student's work
- provide templates, model answers or writing frames
- provide specific feedback to students on how to improve their projects to meet the requirements of the marking criteria
- provide feedback where a student has produced an incomplete stage and this is sufficient to allow progression to the next stage. If such support is given to students, then this must be recorded on the Candidate Record Form (CRF) and the students mark should be adjusted accordingly.

Whilst students may be guided in general terms, the final outcome must remain their own. Advice can be used to evaluate progress to date. A clear distinction must be drawn between providing feedback to students as part of work in progress and reviewing work once it has been submitted by the student for final assessment.

Once work is submitted for final assessment it cannot be revised. It is not acceptable for you to give, either to individual students or to groups, feedback and suggestions as to how the work may be improved in order to meet the marking criteria.

In accordance with the JCQ Instructions for conducting NEAs, any support or feedback given to individual students which has not been provided to the class as a whole must be clearly recorded on the CRF and the student's mark must be appropriately adjusted to represent the student's unaided achievement.

4.5 Assessment criteria

	Section	Criteria	Maximun marks
AO1 (30 marks) **Identify, investigate & outline design possibilities**	A	Identifying and investigating design possibilities	20
	B	Producing a design brief and specification	10
A02 (50 marks) **Design & make prototypes that are fit for purpose**	C	Development of design proposal(s)	25
	D	Development of design prototype(s)	25
A03 (20 marks) **Analyse & evaluate**	E	Analysing and evaluating	20

4.5.1 Section A: Identify and investigate design possibilities

Central to the success of the NEA is the selection, by the student, of a context that will provide them with the opportunity to challenge themselves as a designer. Care should be taken, and guidance sought, to ensure that the context chosen offers the student the scope and complexity for a piece of work that is worthy of consideration for the award of an A-level.

Having chosen their context and potential user(s) they then need to plan and carry out an extensive investigation into all aspects of the context in order that they might operate from a position of knowledge when making subsequent decisions.

The student will be expected to employ a variety of both primary and secondary methods of investigation. These might include visits organised by themselves or others, surveys and questionnaires could be used to inform. Useful and relevant material can be gained from others via the internet, books, magazines or interviews. Students should also be encouraged to undertake, where relevant, practical experimentation and disassembly as methods for further understanding and exploring the context and its related issues.

At this stage it is expected that the student will begin to explore their thinking on possible solutions by producing concept ideas that take into account the information collected. At this stage of the process these first concept ideas will merely demonstrate the student's initial thinking and should serve to stimulate later more considered thoughts regarding their design proposal(s) and design prototype(s).

It should be noted that it is not expected that the assessment criteria be seen as a linear process and that aspects from this, and other assessment criteria, might be present throughout the student's portfolio. Wherever it takes place, it is expected that this work will be rewarded.

Mark	Description
16–20	• Excellent rationale provided for the context selected, with continuous reference throughout the project to the end user and the constraints that need to be considered in formulating a final solution. • Student employs a comprehensive range of strategies and techniques, including both primary and secondary methods of investigation, practical experimentation and disassembly, to thoroughly explore design opportunities. All sources have been fully referenced. • First concepts are both fully relevant to the context and feasible for further development and are clearly communicated through a fully appropriate variety of methods and techniques. • All investigations relate directly to the design context, issues are identified and fully addressed and the student demonstrates a detailed and perceptive understanding of the information gathered.
11–15	• Good rationale provided for the context selected with clear reference to the end user and the constraints that need to be considered in formulating a final solution. • Student employs a broad range of strategies and techniques, which may include primary and secondary methods of investigation and/or practical experimentation to explore design opportunities. Most sources have been fully referenced. • First concepts are mostly relevant to the context and feasible for further development and are communicated through a variety of methods and techniques which are mostly appropriate. • Most investigations relate directly to the design context, issues are identified and addressed and the student demonstrates a good understanding of the information gathered.

Mark	Description
6–10	• Adequate rationale is provided but lacks focus for the context selected with some reference to the end user and consideration of the constraints in formulating a final solution which may lack clarity. • Student employs a limited range of strategies and techniques, which may include some practical activities, to explore design opportunities. Some sources have been referenced. • First concepts show some relevance to the context and may be feasible for further development and are communicated through a limited variety of methods and techniques that may not be appropriate. • Some investigations relate to the design context, issues are identified but may not be fully addressed and the student demonstrates an adequate understanding of the information gathered.
1–5	• Limited rationale provided for the context selected with minimal reference to the end user and the constraints that need to be considered in formulating a final solution. • Student employs a single strategy or technique, which may include practical activities, to explore design opportunities. Source referencing is minimal. • First concepts show little relevance to the context and are unlikely to be feasible for further development. These are communicated through basic methods and/or techniques. • Investigations may not relate directly to the design context, a limited number of issues are identified but not addressed and the student demonstrates only a basic understanding of the information gathered.
0	Nothing worthy of credit.

4.5.2 Section B: Producing a design brief and specification

The student is required to produce a clearly stated and challenging design brief that addresses the context and meets the needs of the intended user(s).

The student should formulate a fully detailed design specification that is informed by their investigations and makes full use of the material collated. Statements in the specification need to be clear and unambiguous. There should be specific references to measurable outcomes as well as qualitative statements. Whatever format is chosen to present the specification it is expected that this will be a live and working document that will be constantly referenced throughout the process.

The specification should also include details on how the student intends to organise their time and activities in order to ensure a successful completion of the process.

It should be noted that it is not expected that the assessment criteria be seen as a linear process and aspects from this, and other assessment criteria, might be present throughout the student's portfolio. Wherever it takes place, it is expected that this work will be rewarded.

Mark	Description
9–10	• A comprehensive, clearly stated and challenging design brief resulting from a thorough consideration of investigations undertaken, that fully addresses both the context and the needs and wants of the intended user(s). • The student has produced a comprehensive, detailed and well explained design specification which will fully guide the student's design thinking. • A detailed project management approach to prototype development, including time management and determining quantities and costs of materials, has been fully integrated into the specification.
6–8	• A well considered design brief with a degree of challenge, resulting from well considered investigations, that addresses the context and most of the needs and wants of the intended user(s). • The student has produced a detailed and partially explained design specification which will help to guide the student's design thinking. • There is evidence of a project management approach to prototype development including time management and determining quantities and costs of materials, but may be lacking in detail.
3–5	• An adequate design brief which may lack challenge and clarity, resulting from partially considered investigations that only superficially address the context and the needs and wants of the intended user(s). • The student has produced a design specification which is lacking in some detail and will only guide student's design thinking to a limited extent. • There is some evidence of a basic project management approach to prototype development including time management and determining quantities and costs of materials related to the development of the prototype, but it is not fully integrated into the specification.
1–2	• A basic design brief, lacking both clarity and challenge which makes limited use of the investigations, may not address the context in full and only meets some of the needs and wants of the intended user(s). • The student has produced a design specification which contains minimal detail and does not guide their design thinking. • There is minimal evidence of project management being considered as part of the specification.
0	Nothing worthy of credit.

4.5.3 Section C: Development of design proposals

Design proposals should reflect on first concepts and take full account of the design brief and design specification. The aim should be that the development of their design proposal(s) leads to a prototype that can be manufactured by the student given their skills and experience. In developing their proposals the student will be expected to make constant reference to their design brief and design specification, to identify if further investigations are required and to carry these out. Design proposals can be demonstrated through a variety of different media, but whatever methods are chosen, they should be of a high quality befitting this level of qualification and show evidence of analysis and annotation (although these elements are not assessed in this assessment criteria). Modelling is seen as a key element of this assessment criteria, whether this be part modelling, practicing of manufacturing and finishing techniques, the production of scale models or material experimentation. There is also the expectation that students will produce working drawings, plans and patterns to enable successful prototype manufacturing to take place. The use of CAD is encouraged, but this should not be the only form of design communication that is used.

It should be noted that it is not expected that the assessment criteria be seen as a linear process and aspects from this, and other assessment criteria, might be present throughout the student's portfolio. Wherever it takes place, it is expected that this work will be rewarded.

Mark	Description
19–25	• The rationale for design decisions is clearly documented and fully justified with constant reference being made to the design brief, specification and investigations throughout the development of their design proposal. • In the development of innovative design proposals the student will demonstrate clear evidence of originality, creativity and a willingness to take design risks. • Excellent use of a variety of modelling techniques to support ongoing development work throughout. This is supported by the use of drawings, sketches, annotations and notes showing clear evidence of design thinking. • Excellent ongoing development of design proposals, achieved through exploration of and experimentation with different materials, techniques and processes leading to an excellent quality design of a prototype for manufacture. • Comprehensive and fully detailed manufacturing specification produced which makes specific reference to relevant quality control checks and allows fully accurate interpretation by a third party. • Project management for manufacturing allows for further development of design proposals in response to ongoing evaluation, testing and full consideration of contingency planning as prototype development takes place.

Mark	Description
13–18	• The rationale for design decisions is documented and justified with regular reference being made to the design brief, specification and investigations throughout the development of their design proposal. • In the development of their design proposals, many of which will demonstrate an innovative approach, the student will demonstrate evidence of originality, creativity and a willingness to take design risks. • Good use of modelling techniques support ongoing development work throughout, showing clear evidence of design thinking supported by the use of drawings, sketches, annotations and notes. • Good ongoing development of design proposals, achieved through exploration of and experimentation with different materials, techniques and processes leading to a good quality design of a prototype for manufacture. • A detailed manufacturing specification is produced which includes reference to relevant quality control checks and allows for mostly accurate interpretation by a third party. • Project management for manufacturing allows for some further development of design proposals in response to ongoing evaluation and testing with some consideration of contingency planning as prototype development takes place.
7–12	• The rationale for design decisions is documented with some justification and reference to the design brief, specification and investigations throughout the development of their design proposal. • In the development of their design proposals, some of which will demonstrate evidence of innovation, there will be elements of originality, creativity and a willingness to take design risks. • Adequate use of modelling techniques to support development work. There is evidence of drawings, sketches, annotations and notes which can be seen to inform subsequent design thinking. • Some ongoing development of design proposals, achieved through exploration of and experimentation with different materials, techniques and processes leading to an adequate quality design of a prototype for manufacture. • An adequate manufacturing specification produced which makes some reference to quality control checks and allows partially accurate interpretation by a third party. • Project management for manufacturing allows for some further development of design proposals in response to evaluation and testing and enables the made outcome to be achieved in a realistic and achievable timescale.

Mark	Description
1–6	• The rationale for design decisions is documented but this may not always be justified and may be lacking reference to the design brief, specification and investigations during the development of their design proposal. • In the development of their design proposals the student will demonstrate little evidence of innovation, originality, creativity and willingness to take design risks. • Basic use of a single or only simple, modelling technique(s), with limited evidence that this supports any subsequent development work. There is some evidence of drawings, sketches, annotations or notes but these do not always inform their design thinking. • Basic refinement of design proposals, with only basic exploration and experimentation of different materials, techniques and processes leading to a basic quality design of a prototype for manufacture. • A basic manufacturing specification produced with limited reference to quality control checks, which may not be sufficiently detailed for a third party to interpret accurately. • Superficial evidence that project management for manufacturing allows for further development of design proposals and which may not enable the made outcome to be achieved in a realistic timescale.
0	Nothing worthy of credit.

4.5.4 Section D: Development of design prototypes

Design prototypes are just that, they need to be directly related to the design proposals and show consideration, at all stages, of how the design thinking continues to be developed and the prototype(s) refined. Given the level of this qualification it is expected that the student will demonstrate their practical skills to a high level using all of the potential resources, tools, machines and equipment at their disposal. During the development of their design prototype(s) the student should be encouraged to continue to experiment and adapt their design proposals as they progress. Constant testing and evaluation is expected to form part of this process. The use of CAM is encouraged, but this should not be the only form of manufacturing that is used.

It should be noted that it is not expected that the assessment criteria be seen as a linear process and that aspects from this, and other assessment criteria, might be present throughout the student's portfolio. Wherever it takes place, it is expected that this work will be rewarded.

Mark	Description
19–25	• Excellent justification provided for selection of appropriate materials and components and proposed techniques and processes, demonstrating an excellent understanding of material properties to ensure excellent quality prototype(s) that are fit for purpose. • Significant complexity or challenge is involved throughout the production of prototype(s). The student demonstrates excellent manufacturing skills combined with an excellent understanding of the need for dimensional accuracy and precision. • The student has selected and used appropriate tools, machinery and equipment, including CAM where required, and worked with a high level of skill, precision and accuracy to produce their prototype(s). • Prototype(s) fully address the design brief, satisfying all major points of the specification and take into account all amendments/ modifications to their original design proposals as necessary. • Student makes all required modifications to the prototype in a fully considered manner in light of feedback from user trials and third party feedback and as a result of testing and evaluation carried out against earlier iterations of the prototype. • Quality assurance is evident throughout and it is clear where planned quality control checks have been applied throughout the process to ensure consistency and safety. • Clear evidence throughout the manufacturing process that appropriate health and safety processes have been both considered and employed.

Mark	Description
13–18	• Good justification provided for selection of appropriate materials and components and proposed techniques and processes demonstrating a good understanding of material properties to ensure good quality prototype(s) that are fit for purpose. • There is some complexity or challenge involved throughout the production of prototype(s). The student demonstrates good manufacturing skills combined with a generally sound understanding of the need for dimensional accuracy/precision. • The student has selected and used appropriate tools, machinery and equipment, including CAM where required, and worked with a good level of skill, precision and accuracy to produce their prototype(s). • Prototype(s) mostly address the design brief, satisfying the majority of major points of specification and takes into account some amendments/modifications to their original design proposals as necessary. • Student makes some well thought out modifications to their prototype in light of feedback from user trials and third party feedback and as a result of testing and evaluation carried out against earlier iterations of the prototype. • Quality assurance is evident at most stages in the process and it is clear where planned quality control checks have been applied to ensure consistency and safety. • There is evidence throughout the manufacturing process that appropriate health and safety processes have been both considered and employed.

Mark	Description
7–12	• Adequate justification provided for selection of appropriate materials and components and proposed techniques and processes demonstrating an adequate understanding of material properties to ensure adequate quality prototype(s) that are mostly fit for purpose. • There is some complexity or challenge within aspects of the prototype. The student demonstrates adequate manufacturing skills combined with some understanding of the need for dimensional accuracy/precision. • The student has selected and used appropriate tools, machinery and equipment, including CAM where required, and worked with an adequate level of skill, precision and accuracy to produce their prototype(s). • Prototype(s) partially address the design brief, satisfying some of the major points of specification, but do not always take into account amendments/modifications to their original design proposals. • Student makes some superficial modifications to their prototype(s) in light of feedback from user trials and third party feedback and as a result of testing and evaluation carried out against earlier iterations of the prototype. • Quality assurance is evident at stages in the process and it is clear where quality control checks have been applied to ensure consistency and safety. • There is some evidence during the manufacturing process that appropriate health and safety processes have been both considered and employed.

Mark	Description
1–6	• Little justification provided for selection of materials and components and proposed techniques and processes, not all of which may be appropriate, only a basic understanding of material properties demonstrated which may lead to the production of an inadequate prototype(s). • The development of the prototype(s) offers little in the way of complexity or challenge, only basic manufacturing skills are demonstrated, showing little understanding of the need for accuracy and precision. • The student has selected and used appropriate tools, machinery and equipment, including CAM where required, but has worked with only a basic level of skill, precision and accuracy to produce their prototype(s). • Prototype(s) address only few parts of the design brief, and few of the major points of specification, they do not take into account amendments/modifications to their original design proposals. • Student makes a few minor modifications to their prototype in light of feedback from user trials and third party feedback and as a result of testing and evaluation carried out against earlier iterations of the prototype. • Basic quality assurance is sporadic throughout the process and it is not always clear where quality control checks have been applied. • There is little evidence during the manufacturing process that appropriate health and safety processes have been both considered and employed.
0	Nothing worthy of credit.

4.5.5 Section E: Analysing and evaluating

In awarding marks for this section it is vital to remember that evidence for analysing and evaluating can take place in any part of the NEA. Students should be encouraged to be constantly analyzing their work and recording their thoughts in order to explain their thinking. Ongoing evaluation should be seen to be informing the decision making process, particularly being used to bring about modifications to design proposals and prototype development. Central to this is the close and regular involvement of the proposed client/user(s) making sure that the prototype is both fit for purpose and meets the requirements of the client/user(s) rather than just meeting those of the student.

Mark	Description
16–20	• Comprehensive evidence of analysis and evaluation throughout the process, which has clearly informed the chosen context, client or user and the subsequent development and manufacture of the prototype. • Testing is carried out in a focused and comprehensive way with clear evidence of how the results have been used to inform the design and any modifications to the prototype. • Student has provided a well reasoned critical analysis of their final outcome which links clearly to their design brief and specification and provides full justification for the extent to which the prototype is both fit for purpose and meets the needs of the client/user. • A comprehensive critical evaluation of their final prototype, clearly identifying how modifications could be made to improve the outcome, together with a full justification for these modifications and full consideration provided for how the prototype could be developed for different production methods.
11–15	• Good evidence of analysis and evaluation at most stages of the process which has informed the chosen context, client or user and the subsequent development and manufacture of the prototype. • Testing is carried out in a focused manner with some evidence of how the results have been used either to inform the design or to make any modifications to the prototype. • Student has provided a reasoned critical analysis of their final outcome which links to their design brief and specification and provides some justification for the extent to which the prototype is fit for purpose and meets most of the client/user needs. • A good evaluation of their final prototype together with clear justification for modifications that could be made to improve the outcome and informed consideration provided for how the prototype could be developed for different production methods.
6–10	• Adequate evidence of analysis and evaluation at some stages of the process which has had some influence on the chosen context, client or user and the subsequent development and manufacture of the prototype. • Testing is carried out with minimal evidence that the results have been used to either inform the design or to make modifications to the prototype. • Student has provided an analysis of their final outcome with some links to their design brief and specification and makes reference to how the prototype is fit for purpose and meets some client/user needs. • An adequate evaluation of their final prototype together with some justification for modifications that could be made to improve the outcome as well as some consideration given to how the prototype could be developed for different production methods.

Mark	Description
1–5	• Basic evidence of analysis and evaluation which has had limited influence upon the chosen context, client or user and the subsequent development and manufacture of the prototype. • Testing has been carried out but the results may not have been used to inform subsequent design or modifications to the prototype. • Student has provided a superficial analysis of their final outcome which may not refer to the design brief and specification and which does not address the extent to which the prototype is either fit for purpose or meets client/user needs. • Evaluation of final prototype is superficial and any suggestions for modifications are made with little if any justification and there is little or no consideration as to how the prototype could be developed for different production methods.
0	Nothing worthy of credit.

5 Non-exam assessment administration

The non-exam assessment (NEA) for this specification is made up of a single design and make project.

Visit aqa.org.uk/7552 for detailed information about all aspects of NEA administration.

The head of the school or college is responsible for making sure that NEA is conducted in line with our instructions and Joint Council for Qualifications (JCQ) instructions.

5.1 Supervising and authenticating

To meet Ofqual's qualification and subject criteria:

- **students** must sign the *Candidate record form* (CRF) to confirm that the work submitted is their own
- all **teachers** who have marked a student's work must sign the declaration of authentication on the CRF (this is to confirm that the work is solely that of the student concerned and was conducted under the conditions laid down by this specification)
- teachers must ensure that a CRF is attached to each student's work.

All practical work that is submitted for assessment must be completed under direct supervision. If a student needs to undertake some work that cannot be completed in school/college no credit can be given for the work undertaken off site. You must ensure that you are familiar with the prototype before it is taken off site and also verify it after any off site work has been completed to ensure that the only work that has been completed off site is what has been discussed beforehand.

Students must have sufficient direct supervision for the written element to ensure that the work submitted can be confidently authenticated as their own. If a student receives additional assistance and this is acceptable within the guidelines for this specification, you should award a mark that represents the student's unaided achievement. Please make a note of the support the student received on the CRF and sign the authentication statement. If the statement is not signed, we cannot accept the student's work for assessment.

5.2 Avoiding malpractice

Please inform your students of the AQA regulations concerning malpractice. They must not:

- submit work that is not their own
- lend work to other students
- allow other students access to, or use of, their own independently sourced source material (they may lend their books to another student, but they must not plagiarise other students' research)
- include work copied directly from books, the internet or other sources without acknowledgement
- submit work that is word-processed by a third person without acknowledgement
- include inappropriate, offensive or obscene material.

These actions constitute malpractice and a penalty will be given (for example, disqualification).

If you identify malpractice **before** the student signs the declaration of authentication, you don't need to report it to us. Please deal with it in accordance with your school or college's internal procedures. We expect schools and colleges to treat such cases very seriously.

If you identify malpractice **after** the student has signed the declaration of authentication, the head of your school or college must submit full details of the case to us at the earliest opportunity. Please complete the form JCQ/M1, available from the JCQ website at jcq.org.uk

You must record details of any work which is not the student's own on the CRF or another appropriate place.

Consult your exams officer about these procedures.

5.3 Teacher standardisation

We'll provide support for using the marking criteria and developing appropriate tasks through teacher standardisation.

Example material and guidance will be available at teacher standardisation to help schools and colleges understand the quality of the work associated with the different mark bands and how to apply the assessment criteria.

For further information about teacher standardisation visit our website at aqa.org.uk/7552

In the following situations teacher standardisation is essential. We will send you an invitation to complete teacher standardisation if:

- moderation from the previous year indicates a serious misinterpretation of the requirements
- a significant adjustment was made to the marks in the previous year
- your school or college is new to this specification.

Your school or college will be assigned an NEA appointed adviser who will be able to assist you in matters relating to the NEA.

For further support and advice email your subject team at dandt@aqa.org.uk

5.4 Internal standardisation

You must ensure that you have consistent marking standards for all students. One person must manage this process and they must sign the Centre declaration sheet to confirm that internal standardisation has taken place.

Internal standardisation may involve:

- all teachers marking sample pieces of work to identify differences in marking standards
- discussing any differences in marking at a training meeting for all teachers involved
- referring to reference and archive material such as previous work or examples from our teacher standardisation.

5.5 Commenting

To meet Ofqual's qualification and subject criteria, you must show clearly how marks have been awarded against the marking criteria in this specification.

Your comments will help the moderator see, as precisely as possible, where you think the students have met the marking criteria.

You must record your comments on the CRF.

5.6 Submitting marks

You must check that the correct marks are written on the CRF and that the total is correct.

The deadline for submitting the total mark for each student is given at aqa.org.uk/keydates

5.7 Factors affecting individual students

For advice and guidance about arrangements for any of your students, please email us as early as possible at eos@aqa.org.uk

Occasional absence: you should be able to accept the occasional absence of students by making sure they have the chance to make up what they have missed. You may organise an alternative supervised session for students who were absent at the time you originally arranged.

Lost work: if work is lost you must tell us how and when it was lost and who was responsible, using our special consideration online service at aqa.org.uk/eaqa

Extra help: where students need extra help which goes beyond normal learning support, please use the CRF to tell us so that this help can be taken into account during moderation.

Students who move schools: students who move from one school or college to another during the course sometimes need additional help to meet the requirements. How you deal with this depends on when the move takes place.

- If it happens early in the course, the new school or college should be responsible for the work.
- If it happens late in the course, it may be possible to arrange for the moderator to assess the work as a student who was 'educated elsewhere'.

5.8 Keeping students' work

Students' work must be kept under secure conditions from the time that it is marked, with CRFs attached. After the moderation period and the deadline for Enquiries about Results (or once any enquiry is resolved) you may return the work to students.

5.9 Moderation

You must send all your students' marks to us by the date given at aqa.org.uk/deadlines. You will be asked to send a sample of your students' NEA evidence to your moderator.

You must show clearly how marks have been awarded against the assessment criteria in this specification. Your comments must help the moderator see, as precisely as possible, where you think the students have met the assessment criteria. You must:

- record your comments on the Candidate Record Form (CRF)
- check that the correct marks are written on the CRF and that the total is correct.

The moderator re-marks a sample of the evidence and compares this with the marks you have provided to check whether any changes are needed to bring the marking in line with our agreed standards. Any changes to marks will normally keep your rank order but, where major inconsistencies are found, we reserve the right to change the rank order.

School and college consortia

If you're in a consortium of schools or colleges with joint teaching arrangements (where students from different schools and colleges have been taught together but entered through the school or college at which they are on roll), you must let us know by:

- filling in the *Application for Centre Consortium Arrangements for centre-assessed work*, which is available from the JCQ website jcq.org.uk
- appointing a consortium coordinator who can speak to us on behalf of all schools and colleges in the consortium. If there are different coordinators for different specifications, a copy of the form must be sent in for each specification.

We'll allocate the same moderator to all schools and colleges in the consortium and treat the students as a single group for moderation.

5.10 After moderation

We will return your students' work to you after the exams. You'll also receive a report when the results are issued, which will give feedback on the appropriateness of the tasks set, interpretation of the marking criteria and how students performed in general.

We'll give you the final marks when the results are issued.

To meet Ofqual requirements, as well as for awarding, archiving or standardising purposes, we may need to keep some of your students' work. We'll let you know if we need to do this.

6 General administration

You can find information about all aspects of administration, as well as all the forms you need, at aqa.org.uk/examsadmin

6.1 Entries and codes

You only need to make one entry for each qualification – this will cover all the question papers, non-exam assessment and certification.

Every specification is given a national discount (classification) code by the Department for Education (DfE), which indicates its subject area.

If a student takes two specifications with the same discount code, further and higher education providers are likely to take the view that they have only achieved one of the two qualifications. Please check this before your students start their course.

Qualification title	AQA entry code	DfE discount code
AQA Advanced Level GCE in Design and Technology: Product Design	7552	TBC

This specification complies with:

- Ofqual *General conditions of recognition* that apply to all regulated qualifications
- Ofqual GCE qualification level conditions that apply to all GCEs
- Ofqual GCE subject level conditions that apply to all GCEs in this subject
- all other relevant regulatory documents.

The Ofqual qualification accreditation number (QAN) is 603/1133/2.

6.2 Overlaps with other qualifications

There is overlapping content in the AS and A-level Design and Technology: Product Design specifications. This helps you teach the AS and A-level together.

6.3 Awarding grades and reporting results

The A-level qualification will be graded on a six-point scale: A*, A, B, C, D and E.

Students who fail to reach the minimum standard for grade E will be recorded as U (unclassified) and will not receive a qualification certificate.

6.4 Resits and shelf life

Students can resit the qualification as many times as they wish, within the shelf life of the qualification.

6.5 Previous learning and prerequisites

There are no previous learning requirements. Any requirements for entry to a course based on this specification are at the discretion of schools and colleges.

However, we recommend that students should have the skills and knowledge associated with a GCSE Design and Technology: Product Design or equivalent.

6.6 Access to assessment: diversity and inclusion

General qualifications are designed to prepare students for a wide range of occupations and further study. Therefore our qualifications must assess a wide range of competences.

The subject criteria have been assessed to see if any of the skills or knowledge required present any possible difficulty to any students, whatever their ethnic background, religion, sex, age, disability or sexuality. Tests of specific competences were only included if they were important to the subject.

As members of the Joint Council for Qualifications (JCQ) we participate in the production of the JCQ document *Access Arrangements and Reasonable Adjustments: General and Vocational qualifications*. We follow these guidelines when assessing the needs of individual students who may require an access arrangement or reasonable adjustment. This document is published at jcq.org.uk

Students with disabilities and special needs

We're required by the Equality Act 2010 to make reasonable adjustments to remove or lessen any disadvantage that affects a disabled student.

We can make arrangements for disabled students and students with special needs to help them access the assessments, as long as the competences being tested aren't changed. Access arrangements must be agreed **before** the assessment. For example, a Braille paper would be a reasonable adjustment for a Braille reader.

To arrange access arrangements or reasonable adjustments, you can apply using the online service at aqa.org.uk/eaqa

Special consideration

We can give special consideration to students who have been disadvantaged at the time of the assessment through no fault of their own – for example a temporary illness, injury or serious problem such as family bereavement. We can only do this **after** the assessment.

Your exams officer should apply online for special consideration at aqa.org.uk/eaqa

For more information and advice visit aqa.org.uk/access or email accessarrangementsqueries@aqa.org.uk

6.7 Working with AQA for the first time

If your school or college hasn't previously offered our specifications, you need to register as an AQA centre. Find out how at aqa.org.uk/becomeacentre

6.8 Private candidates

This specification is not available to private candidates.

6.9 Use of calculators

Students may use a calculator in the exam. They must ensure that their calculator meets the requirements as set out in the *JCQ Instructions for conducting examinations*. These instructions make it clear what the requirements are for calculators (what they must be) and what they are not (what they must not be). The instructions are regularly updated and can be found at jcq.org.uk

7 Appendix 1: Links to maths and science

All A-level specifications in design and technology must require students to demonstrate their application of knowledge, understanding and skills of maths and science in both theoretical and practical ways. Design and technology uses maths and science to support decisions made in the processes of designing and making

7.1 Maths

Ref	Maths skills requirement	Potential applications: product design
a	Confident use of number and percentages	Calculation of quantities of materials, costs and sizes
b	Use of ratios	Scaling drawings
c	Calculation of surface areas and/or volumes	Determining quantities of materials
d	Use of trigonometry	Calculation of sides and angles as part of product design
e	Construction, use and/or analysis of graphs and charts	Representation of data used to inform design decisions and evaluation of outcomes. Presentation of market data, user preferences, outcomes of market research
f	Use of coordinates and geometry	Use of datum points and geometry when setting out design drawings
g	Use of statistics and probability as a measure of likelihood	Interpret statistical analyses to determine user needs and preferences. Use data related to human scale and proportion to determine product scale and dimensions

7.2 Science

Ref	Scientific knowledge and skills	Potential applications: fashion and textiles
a	Describe the conditions which cause degradation	Ensure products are designed to take account of potential corrosion due to environmental factors
b	Know the physical properties of materials and explain how these are related to their uses	Understand the appropriate use of materials, including glass and ceramics, polymers, composites, woods, and metals, based on their physical properties

Get help and support

Visit our website for information, guidance, support and resources at [aqa.org.uk/7552](aqa.org.uk/7552)

You can talk directly to the Design and Technology: Product Design subject team:

E: dandt@aqa.org.uk

T: 0161 957 3334

Pre A Level work for Design Technology

You need to have a detailed understanding of materials and processes to complete your major project that begins in Year 12 and will run for two years. You will also need this information for the technical questions and product evaluations in both exam papers.

Its not something you can leave to the last minute. The most successful students begin this task over the pre- year 12 summer and continue to build on it over the two years.

What do I need to do?

You will see a download link to a blank spreadsheet of the basic materials that you will need to understand. You will also need information on wood types, engineered boards and their uses but we will cover this in class.

I would like you to use the internet and the resources below to complete as much of the spreadsheet as possible. It is a huge task and some of the property headings we will need to cover together but there is much that you can research for yourselves.

In addition to the spreadsheet I would like to focus on the 'product tank' channel and the iplayer list to start thinking about a **problem that you could solve** for your major project.

Any questions please email me rather than use the discussion feature of SHMHW as I may miss them. Good luck.

https://www.youtube.com/user/producttank Subscribe and work through his examples of the design process
https://www.youtube.com/channel/UCR1IuLEqb6UEA_zQ81kwXfg/videos A channel focussed on engineering applications and material properties
Iplayer resources https://www.bbc.co.uk/iplayer/episodes/p07hjb9y/taste https://www.bbc.co.uk/iplayer/episodes/m000gwzg/how-to-make https://www.bbc.co.uk/iplayer/episode/m0007tqs/bauhaus-rules-with-vic-reeves https://www.bbc.co.uk/iplayer/episode/p07r9lqb/the-news-explained-how-plastic-bags-were-supposed-to-help-the-planet https://www.bbc.co.uk/iplayer/episode/m0007trf/bauhaus-100 https://www.bbc.co.uk/iplayer/episode/p026f8fn/vivienne-westwood-talks-to-kirsty-wark https://www.youtube.com/channel/UCR1IuLEqb6UEA_zQ81kwXfg/videos
Engineering material resources http://www.matweb.com/search/SearchProperty.asp https://roymech.org/

Catagory	material	form of supply	cost (Kg)	sustainability	common aplication	Why?	UTS (Mpa)	UCS (Mpa)	Yeild Point (MPa)	hardness (vickers)	toughness (charpy) J/cm2	elasticity GPa	plasticity	ductility	mallubility	density (g/cc)	melting point(°C)	thermal conductivity (W/m-k)	youngs modulous (Gpa)	electrical conductivity	thermal expansion	electrical resistivity ohm-cm	corrosion resistance	source
Ferrous metals	Cast Iron (gray) (A 48 class 40)																							
	Low Carbon Steel (0.15-0.29%)																							
	Medium Carbon Steel (0.3-0.7%)																							
	High Carbon Steel (0.7-1.4%)																							
	Stainless Steel (304)																							
Non ferrous metals	Copper (annealed)																							
	Aluminium (6063)																							
	Aluminium Alloys (6063)																							
	Titainium																							
	Titainium Alloys (nickel)																							
	Zinc																							
	Tin																							
	Tungsten																							
	Brass (260)																							
Thermoplastic polymors	Polypropylene (molded)																							
	Arcylonitrile-Butadilene-Styrene (molded)																							
	High Impact Polystyrene (740)																							
	Acrylic (General Purpose, Molded)																							
	Polyvinyl Chloride																							
	Polytetrafluoroethylene (moded)																							
	Polyamide (nylon)																							
	Polythylene																							
	Polycarbonate																							
Thermosets	Epoxy Resin																							
	Polyester Resin																							
	Urea Formaldehyde (molded)																							
	Melamine Formaldehyde																							
Elastomers	Rubber (natural)(Phenolic/Rubber; Molded)																							
	Neoprene (epdm)																							
Ceramic	Silicon Carbide (alpha)																							
	Tungsten Carbide (WC)																							
	Borpsilicyte Glass																							
Composites	Glass reinforced Polymor (GRP)																							
	Carbon Fibre Reinforced Plastic (CFRP)																							
	Reinforced Concrete																							
Smart materials	Shape Memory Alloy (nitinoll, high temp)																							
	Quantum Tunnelling Composite																							
	Thermochromic																							
	Photochromic																							
	Viscoelastic Material (smart grease)																							

	Definitions
Tensile Strength	
Compressive Strength	
Shear Strength	
Toughness	
Elasticty	
Plasticity	
Ductility	
Malleability	
Fatigue Strength	
Hardness	