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Specification

GCE Design and Technology: Product Design

Pearson Edexcel Level 3 Advanced Subsidiary GCE in Design and Technology: Product Design (8RM01/8GR01)
First examination 2014

Pearson Edexcel Level 3 Advanced GCE in Design and Technology: Product Design (9RM01/9GR01)
First examination 2014

Issue 3

About this specification

The Edexcel GCE in Design and Technology: Product Design is designed for use in schools and colleges. It is a part of a suite of GCE qualifications offered by Edexcel.

Key features of the specification

- Two pathways within this qualification — Resistant Materials Technology and Graphic Products. Each pathway has its own specific content.
- This qualification emphasises two key factors — creativity and sustainability. We all want students to explore ideas of originality and value, to question and challenge, to envisage what could be, but equally we need them to achieve the results that will progress their careers. This qualification structure allows students to develop a range of skills and outcomes at Advanced Subsidiary (AS) which demonstrate their creativity and apply these to a design and make project at A2.
- All modern designers have to consider sustainable issues when designing new products. A sign of the modern technological age in which we live is that human actions have had a negative impact on our environment. New products provide solutions rather than add to the existing problems of extractions and use of natural resources, pollution from manufacturing and disposal of large amounts of waste products.
- Good design is vital to our world and economy, it is important, therefore, that we enthuse future designers with a passion for designing their futures.

Why choose this specification?

Edexcel's GCE in Design and Technology: Product Design specification seeks to develop students' knowledge, understanding, skills and application for designing products. Product design encompasses a wide range of design disciplines but is firmly rooted in the skills required to design and make high quality products. Products that are fit for purpose, satisfy wants and needs, enhance our day-to-day lives and, most importantly, give students the opportunity to demonstrate their design and technology capability.

Supporting you

Edexcel aims to provide the most comprehensive support for our qualifications. We have therefore published our own dedicated suite of resources for teachers and students written by qualification experts. We also endorse a wide range of materials from other publishers to give you a choice of approach.

For more information on our wide range of support and services for this GCE in Design and Technology qualification, visit our GCE website: www.edexcel.com/gce2008.

Specification updates

This specification is Issue 3 and is valid for examination from Summer 2014. If there are any significant changes to the specification Edexcel will write to centres to let them know. Changes will also be posted on our website.

For more information please visit www.edexcel.com/ or www.edexcel.com/gce2008.

Contents

Contents

A Specification at a glance

AS Unit 1: Portfolio of Creative Skills *Unit code 6RM01/6GR01

- Internally assessed
- Availability: June

60% of the total AS marks | **30% of the total GCE marks**

Content summary:

In this unit students are given the opportunity to develop their creative, technical and practical skills through a series of product investigation, design and manufacturing activities.

Students will produce **one** portfolio with **three** distinct sections which will demonstrate their creativity and flair when investigating, designing and making product(s). Ideally different products should be chosen for the **three** distinct sections as students are not being asked to carry out one large design and make exercise but three smaller and more focused tasks which build up to provide a detailed portfolio of their skills.

Depending on the route students are studying, their products must comply with the requirements of **either** a resistant materials technology product **or** a graphic product.

This unit has been designed to be as flexible as possible, offering students a wide range of valid approaches in producing their portfolio of creative skills. Students are encouraged to be as creative as possible and there are no barriers to choices of product investigation, product design or product manufacture, as long as the work submitted by students targets assessment criteria effectively and at the correct level of response for their abilities.

Assessment:

This unit is internally set and marked by the centre and externally moderated by Edexcel.

The student will produce **one** portfolio that contains evidence for all **three** distinct sections. It is important that all stages of the manufacturing process are photographed in order to evidence that the product is complete, expertly made, well finished etc.

AS Unit 2: Design and Technology in Practice *Unit code 6RM02/6GR02

- Externally assessed
- Availability: June

40% of the total AS marks

20% of the total GCE marks

Content summary:

In this unit students will develop their knowledge and understanding of a wide range of materials and processes used in the field of design and technology.

It is important for students, as designers, to learn about materials and processes so that they can develop a greater understanding of how products can be designed and manufactured.

Students will also learn about industrial and commercial practices, and the importance of quality checks and the health and safety issues that have to be considered at all times.

The knowledge and understanding students develop in this unit can be easily applied to *Unit 1: Portfolio of Creative Skills*.

Assessment:

1 hour 30 minute examination set and marked by Edexcel.

The paper will be a question and answer booklet, consisting of short-answer and extended-writing type questions, all of which are compulsory.

* See *Appendix 4* for description of this code and all other codes relevant to this qualification.

A2 Unit 3: Designing for the Future *Unit code 6RM03/6GR03

- Externally assessed
- Availability: June

40% of the total A2 marks

20% of the total GCE marks

Content summary:

In this unit students will develop their knowledge and understanding of a range of modern design and manufacturing practices and contemporary design issues. The modern designer must have a good working knowledge of the use of ICT and systems and control technology in the design and manufacture of products. They must also be aware of the important contributions of designers from the past which may provide inspiration for future design.

It is increasingly important that students develop an awareness of the impact of design and technological activities on the environment. Sustainable product design is a key feature of modern design practices.

Assessment:

2-hour examination paper set and marked by Edexcel.

The paper will be a question and answer booklet, consisting of short-answer and extended-writing type questions, all of which are compulsory.

A2 Unit 4: Commercial Design *Unit code 6RM04/6GR04

- Internally assessed
- Availability: June

60% of the total A2 marks

30% of the total GCE marks

Content summary:

In this unit students are given the opportunity to apply the skills they have acquired and developed throughout this course of study, to design and make a product of their choice that comply with the requirements of either a resistant materials technology product **or** a graphic products, depending on the route they are studying.

In order to reach high attainment levels, students must adopt a commercial design approach to their work, reflecting how a professional designer might deal with a design problem and its resolution.

The choice of design problem should have a real commercial use, in that it should be useful to a wider range of users beyond an individual, unless it has been specifically commissioned as a 'one-off'. The design problem should provide opportunities for a client or user-group to have input into decision making at various stages of the design and make process.

A client or user-group is defined as any third party identified by a student, that is referred to and who can give informed critical feedback at various stages throughout the design process. Clients and user-groups do not need to be specialists or experts; they can be drawn from any relevant group of people and may include other students, friends or family members.

A key feature of this unit is that students consider issues related to sustainability and the impact their product may have on the environment. A student may choose to design and make a sustainable product, but if they do not, they should still consider the issues of sustainability at relevant points in their designing and making activities. Sustainable issues include materials production and selection, manufacturing processes, use of the product and its disposal/recycling.

Assessment:

This unit is internally set and marked by the centre and externally moderated by Edexcel.

Students are given the opportunity to design and make a produce of their choice. This unit results in the development of an appropriate product supported by a design folder. It is important that all stages of the manufacturing process are photographed in order to evidence that the product is complete, expertly made, well finished etc.

A Specification at a glance

B Specification overview

Summary of endorsements

Advanced Subsidiary (AS)

National classification code*	Cash-in code*	Endorsement	Unit codes	
			Unit 1	Unit 2
9080	8RM01	Product Design: Resistant Materials Technology	6RM01	6RM02
9080	8GR01	Product Design: Graphic Products	6GR01	6GR02

Advanced GCE Level

National classification code*	Cash-in code*	Endorsement	Unit codes			
			Unit 1	Unit 2	Unit 3	Unit 4
9080	9RM01	Product Design: Resistant Materials Technology	6RM01	6RM02	6RM03	6RM04
9080	9GR01	Product Design: Graphic Products	6GR01	6GR02	6GR03	6GR04

* See *Appendix 4* for description of this code and all other codes relevant to this qualification.

Summary of assessment requirements

Unit number and unit title	Level	Assessment information	Number of raw marks allocated in the unit
Unit 1: Portfolio of Creative Skills	AS	This unit is internally set and marked by the centre and externally moderated by Edexcel. ■ In the product investigation, the chosen product can be set by the teacher or the student. ■ In the product design, the design brief(s)/need(s) can be set by the teacher or the student. ■ In the product manufacture, the design brief(s)/need(s) should be set by the teacher to ensure that a range of materials, techniques and processes are used. The maximum number of marks available for each discrete section is 30. **One** overall mark out of 90 is required. The student will produce **one** portfolio that contains evidence for all **three** distinct sections. Photographic evidence of their modelling can be used as part of the evidence provided in the design section. As proof of the quality of their making skills (and the level of demand of their work), photographs of their work must be taken to show that the product(s) is complete, expertly made, well finished etc. The photographs must show clearly details of any advanced skills, technical content, levels of difficulty and complexity of construction, so students can achieve the marks they deserve. Students can submit their work electronically for moderation. Please refer to the *Edexcel Information Manual* document, which is available on the Edexcel website www.edexcel.com, for further detail.	90
Unit 2: Design and Technology in Practice	AS	This unit is assessed through a 1 hour 30 minute examination paper set and marked by Edexcel. The paper will be a question and answer booklet and all questions in the paper are compulsory. The paper will consist of short-answer and extended-writing type questions.	70
Unit 3: Designing for the Future	A2	This unit is assessed through a 2-hour examination paper set and marked by Edexcel. The paper will be a question and answer booklet and all questions in the paper are compulsory. The paper will consist of short-answer and extended-writing type questions.	70

Unit number and unit title	Level	Assessment information	Number of raw marks allocated in the unit
Unit 4: Commercial Design	A2	This unit is internally set and marked by the centre and externally moderated by Edexcel. Students are given the opportunity to design and make a product of their choice. The maximum number of marks available is 90. It is important that all stages of the manufacturing process are photographed in order to evidence that the product is complete, expertly made, well finished etc. Students must ensure that photographs show clearly any details of advanced skills, technical content, levels of difficulty and complexity of construction, so that they can achieve the marks they deserve. It is unlikely that a single photograph will be enough to communicate all of the information required, so it will be better to take a series of photographs over a period of time during making. This unit results in the development of an appropriate product supported by a design folder. The folder, which should include ICT generated images where appropriate, can only be submitted on A3 paper and is likely to be no more than 30 pages long. Students can submit their work electronically for moderation. Please refer to the *Edexcel Information Manual* document which is available on the Edexcel website www.edexcel.com, for further detail.	90

Assessment objectives and weightings

		% in AS	% in A2	% in GCE
AO1	Students should demonstrate specific knowledge and understanding and be able to apply that knowledge and understanding in combination with appropriate skills in their designing; and should communicate ideas and outcomes and demonstrate strategies for evaluation.	39%	52%	45.5%
AO2	Students should be able to demonstrate and apply skills, knowledge and understanding of relevant materials, processes and techniques, and use materials and equipment to produce suitable and appropriate outcomes; and should communicate ideas and outcomes and demonstrate strategies for evaluation.	61%	48%	54.5%
	TOTAL	100%	100%	100%

Relationship of assessment objectives to units

Unit number	Assessment objective		
	AO1	AO2	Total for AO1 and AO2
Unit 1	12%	18%	30%
Unit 2	7.5%	12.5%	20%
Unit 3	15%	5%	20%
Unit 4	11%	19%	30%
Total for Advanced GCE	**45.5%**	**54.5%**	**100%**

Qualification summary

Subject criteria

The General Certificate of Education is part of the Level 3 provision. This specification is based on the Advanced Subsidiary GCE and Advanced GCE Subject Criteria for Design and Technology; which are prescribed by the regulatory authorities and are mandatory for all awarding bodies.

The GCE in Design and Technology has been designed to provide opportunities for students to develop their creativity, capability and entrepreneurial skills; to apply knowledge and understanding to a range of technological activities and to develop critical thinking and collaborative skills.

Aims

The aims of the Edexcel Advanced Subsidiary and Advanced GCE in Design and Technology are to encourage students to:

- make use of tacit knowledge and reflective practices in order to work with tasks that are challenging and often require definition
- develop and sustain their creativity and innovative practice
- recognise and overcome challenges and constraints when working towards the production of high quality products
- develop a critical understanding of the influences of the processes and products of design and technological activities and from a contemporary and historical perspective
- draw on a range of skills and knowledge from other subject areas
- draw on and apply knowledge, understanding and skills of production processes to a range of design and technology activities
- develop an understanding of contemporary design and technology practices
- use digital technologies and information handling skills to enhance their design and technological capability.

AS/A2 knowledge and understanding

This Advanced Subsidiary and Advanced GCE specification requires students to demonstrate the application and understanding of:

- materials and component
- industrial and commercial practice
- quality
- health and safety
- systems and control
- products/outcomes and applications.

AS/A2 skills

This Advanced Subsidiary and Advanced GCE specification requires students to:

- communicate ideas and information
- evaluate
- design
- plan
- make.

B Specification overview

C Design and Technology: Product Design — Resistant Materials Technology (RMT) unit content

Course structure

- Edexcel's GCE in Design and Technology: Product Design comprises four units and contains an Advanced Subsidiary subset of two AS units.
- The Advanced Subsidiary GCE is the first half of the GCE course and consists of Units 1 and 2. It may be awarded as a discrete qualification or contribute 50 per cent of the total Advanced GCE marks.
- The full Advanced GCE award consists of the two AS units (Units 1 and 2), plus two A2 units (Units 3 and 4) which make up the other 50 per cent of the Advanced GCE. Students wishing to take the full Advanced GCE must, therefore, complete all four units.
- The structure of this qualification allows teachers to construct a course of study which can be taught and assessed either as:
  - distinct modules of teaching and learning with related units of assessment taken at appropriate stages during the course; or
  - a linear course which is assessed in its entirety at the end.

Unit 1 Portfolio of Creative Skills (RMT)

AS compulsory unit — Internally assessed

1.1 Unit description

In this unit, students are given the opportunity to develop their creative, technical and practical skills through a series of product investigation, design and manufacturing activities.

Students will produce **one** portfolio with **three** distinct sections which will demonstrate their creativity and flair when investigating, designing and making product(s). Students may use the same product for a designing exercise and a making exercise, but this unit offers an opportunity to **choose** different products for the **three** distinct sections as students are not being asked to perform one large design and make exercise but three smaller and more focused tasks which build up to provide a detailed portfolio of their skills.

This unit has been designed to be as flexible as possible, offering students a wide range of valid approaches in producing their portfolio of creative skills. Students are encouraged to be as creative as possible and there are no barriers to choices of product investigation, product design or product manufacture, as long as the work submitted by students targets assessment criteria effectively and at the correct level of response for their abilities.

When designing, students can be creative and adventurous. There is no requirement to realise the designs produced. There will be no material or manufacturing restrictions and no limitations to design possibilities.

A resistant materials technology product is defined as a fully functioning product that matches its specification. It must be manufactured to full size using resistant materials, for example materials defined in *Unit 2: Design and Technology in Practice*. Where a resistant materials technology product contains elements of textiles, systems and control or graphics work, this should not exceed one third of the content of the practical outcome or the portfolio.

1.2 Assessment information

1 The portfolio

Students will produce **one** portfolio with **three** distinct sections — product investigation, product design and product manufacture.

Students should ideally look at **different** products for the **three** distinct sections.

- In the product investigation, the chosen product must contain more than **one** material and process in order to access the full range of marks.
- In their product design, students can respond creatively and adventurously to one or more design brief(s)/need(s). Students will demonstrate creativity and flair using their design skills through the production of a range of alternative ideas that explore different approaches to the problem. Students will develop and refine their ideas, with the aid of modelling, into a final workable design proposal that will satisfy the design brief(s)/need(s). Students' designs must be realistic and workable, but they do not need to be taken to the manufacturing stage. Once their idea(s) have been fully developed into a viable product(s), they must communicate their design intentions to potential users.
- In their product manufacture, students should produce **one or more** high quality product(s). This will allow them to demonstrate their knowledge and understanding of a **range** of materials, techniques and processes by selecting and using those that are appropriate to the requirements of the task. A **range** can be defined as at least **two**.

While there is no defined limit to the number of pages students should include in their portfolio of creative skills, it is envisaged that all requirements of this unit can be achieved within 25-30 A3-size pages.

Students may choose to produce their product investigation in A3 or A4 format.

2 Task setting guidance

Edexcel does not prescribe the tasks undertaken for each of the **three** discrete sections.

When setting tasks the following points must be taken on board.

a) Product investigation

In the product investigation, the chosen product must contain more than **one** material and process in order to access the full range of marks.

Although students may investigate a range of different products over the course of their AS studies for their portfolio, evidence of only **one** complete product investigation should be submitted. Evidence must **not** comprise of the best aspects of a range of product investigations.

The submitted product can be chosen by the teacher or the student.

b) Product design

In their product design, students can respond creatively and adventurously to one or more design brief(s)/need(s).

These design brief(s)/need(s) can be set by the teacher or the student, to produce solutions which are both fit for purpose and market viable.

c) Product manufacture

In their product manufacture, students should produce **one or more** high quality product(s) that meets the requirements of the design brief(s)/need(s). The design brief(s)/need(s) should contain requirements against which the final manufactured products can be measured.

The design brief(s)/need(s) should be set by the teacher to ensure a range of materials, techniques and processes are used.

The following must also be taken into account for each of **three** discrete sections:

- time and resources available are considered
- students can fully demonstrate their capabilities in each of the assessment criteria, so that they maximise their potential achievements
- their product(s) complies with the requirements of a resistant materials technology product, which is defined as a fully functioning product that matches its specification. It must be manufactured to full size using resistant materials, for example materials defined in *Unit 2: Design and Technology in Practice*. Where a resistant materials technology product contains elements of textiles, systems and control or graphics work, this should not exceed one third of the content of the practical outcome or the portfolio.

3 Assessment guidance

- This unit is internally set and marked by the centre using the assessment criteria in Section 1.6 and is externally moderated by Edexcel.
- The total number of marks available for each discrete section is 30. **One** overall mark out of 90 is required.
- The student will produce **one** portfolio that contains evidence for all **three** distinct sections.
- Photographic evidence of students' modelling can be used as part of the evidence provided in their design section.
- As proof of the quality of students' making skills (and the level of demand of their work), photographs of their work must be taken to show that the product(s) is complete, expertly made, well finished, fully functioning etc. The photographs must show clearly details of any advanced skills, technical content, levels of difficulty and complexity of construction, so that students can achieve the marks they deserve.
- Students can submit their work electronically for moderation. Please refer to the *Edexcel Information Manual* document, which is available on the Edexcel website www.edexcel.com, for further detail.

1.3 Product investigation

In this section, students will analyse an existing commercial product using their knowledge and understanding of designing and making. Students should take into consideration the intended function and performance of the product; the materials, components where appropriate and processes used during its manufacture; how it was produced and how its quality was assured.

Although students may investigate a range of different products over the course of their AS studies, evidence of **one** complete product investigation should be submitted, therefore, evidence must not comprise of the best aspects of a range of product investigations.

The submitted product can be chosen by the teacher or the student.

The chosen product must contain more than **one** material and process in order to access the full range of marks.

Students' work may be presented using any appropriate media, such as written evidence, sketching, photographs, cut and paste etc.

What students need to evidence:

1 Performance analysis

When analysing their chosen product, students should determine what it was that the designer set out to achieve and then produce a technical specification that covers key headings.

The technical specification should include:

- Form — why is the product shaped/styled as it is?
- Function — what is the purpose of the product?
- User requirements — what qualities make the product attractive to potential users?
- Performance requirements — what are the technical considerations that must be achieved within the product?
- Material and component requirements — how should materials and components perform within the product?
- Scale of production and cost — how does the design allow for scale of production and what are the considerations in determining cost?

The specification points should contain more than a single piece of information, so that each statement is fully justified by giving a reason for the initial point. For example, it is not sufficient to say 'the material used is polystyrene', as this is not justified until 'because it is tough and can be injection moulded' is added.

As part of their analysis, students should look at one other existing similar product, using the same criteria identified in their technical specification, to find out information about the product so that they can compare and contrast it with their own chosen product.

2 Materials and/ or components	Students should identify the materials and/or components used in their chosen product and use their knowledge and understanding of their properties and qualities to suggest why in particular they have been selected for use. The chosen product could have been made effectively in terms of quality and performance from other materials and/or components. Students should investigate suitable alternative materials and/or components and, using advantages and disadvantages, compare them with the materials and/or components actually used. Students should consider and explain the environmental effects of using the materials identified in their product in relation to one or more of the following: ■ extraction and processing of raw materials ■ production processes ■ disposal of products after their useful lifespan.
3 Manufacture	Students should identify and describe the processes involved in the manufacture of their chosen product. They should justify their choice of processes. It is important to consider that other methods of manufacture could have been used, so they should make clear **one** alternative method and compare and contrast it with the methods chosen. Students should also consider and describe the effects that using particular commercial processes have on the environment.
4 Quality	The student's chosen product will have gone through a series of checks to ensure it reaches the user in the best possible condition in terms of quality and performance. Students should describe when and where quality control checks take place during the manufacture of the product, what the checks consist of and how they form part of a quality assurance system. Students should also identify and describe some of the main standards that must be met during product manufacture and how they influence production and the final product.

1.4 Product design

In this section, students can respond creatively and adventurously to one or more design brief(s)/need(s). These design brief(s)/need(s) can be set by the teacher or the student, to produce solutions which are both fit for purpose and market viable.

Students will demonstrate creativity and flair, using their design skills, through the production of a range of alternative ideas that explore different approaches to the problem. Using the best aspects of their initial designs, they will develop and refine their ideas, with the aid of modelling, into a final workable design proposal that will satisfy the design brief(s)/need(s).

Students should be encouraged to be as creative as possible in their work and to disregard the limitations of the facilities available to them within their centre. Their designs must be realistic and workable, but they do not need to be taken to the manufacturing stage.

Once their idea(s) has been fully developed into a viable product(s), they must communicate their design intentions to potential users. Designers must sell their ideas by the use of presentation graphics or concept boards. Accurate working drawings and/or assembly drawings provide the audience with technical details of the product. Both forms of communication are invaluable in presenting an impression of the final product.

What students need to evidence:

1 Design and development

There are a number of possible starting points to this section. The design brief(s)/need(s) may be given to students by the teacher or students may define their own.

Two possible types of brief that students may want to use are:

- a focused design brief for a specific need/want
- a 'blue sky' project resulting in concepts using future technologies.

A detailed design specification is not required. However, the design brief must contain a range of design criteria that their final design proposal must meet.

Students should consider the design problem set and produce a range of alternative design ideas that focus on the whole or parts of the problem.

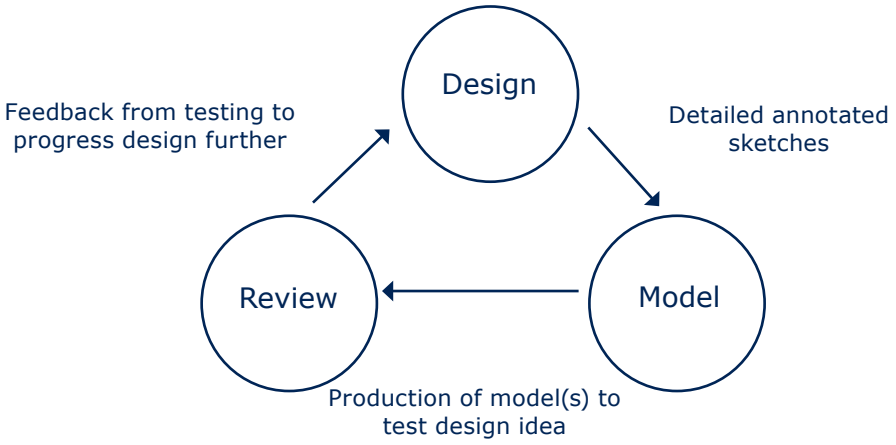
It is not necessary for students to produce a wide range of alternative ideas. It is better to produce high-quality focused work than lots of lower-quality work.

Students should explore different design approaches in their work, applying their knowledge of materials, components/ingredients, processes and techniques to produce realistic design proposals that satisfy the design brief(s)/need(s).

Students should evaluate each of their ideas objectively against the needs set out in their design brief(s)/need(s) to ensure that their designs are realistic and viable.

The use of detailed annotation is an important feature of design development and students should use it to explain details of design thinking and to offer thoughts on their design proposals.

To help students develop their design ideas, the following design development cycle could be useful. This is an important part of the design process and can be used to refine an initial idea into a workable design solution.



Modelling should be used to test features such as proportions, scale, function, sub-systems etc. Modelling can be achieved through the use of traditional materials or 2D and/or 3D computer simulations. Evidence of students' modelling can be presented using clear, well-annotated photographs.

2 Communicate

When presenting their design and development work, it is essential that students communicate their ideas effectively.

Through design and development work

Students should show evidence of 'design thinking' using any form of effective communication that they feel is appropriate. However, they should try to use a range of skills that may include freehand sketching in 2D and 3D, cut and paste techniques and the use of ICT. It is important to demonstrate a high degree of graphical skills, which will be shown through the accuracy and precision of their work.

When using ICT, students should ensure that it is used appropriately, rather than for show. For example, specialist CAD software to produce 3D rendered images is likely to be more appropriately used as part of development or final presentation, rather than for initial ideas.

Through presentation graphics and technical drawings

To effectively communicate final designs, a range of skills and drawing techniques should be demonstrated which could include:

- pictorial drawings — isometric, planometric (axonometric), oblique and perspective drawings to convey a 3D representation of the product
- working drawings — 1st or 3rd angle orthographic, exploded assembly and sectional drawings to convey technical information
- computer generated — pictorial and working drawings, renderings etc using specialist software.

Through the quality of written communication

Annotation should be used to explain design details and convey technical information. Students should make sure that the information is easily understood and presented logically.

Specialist technical vocabulary should be used consistently with precision.

1.5 Product manufacture

In this section, students will use their production planning skills and have the opportunity to develop their making skills through manufacturing **one or more** high quality product(s) to satisfy given design brief(s)/need(s). The design brief(s)/need(s) should contain requirements against which the final manufactured product(s) can be measured. Students will also test their practical outcome(s) to check their quality and performance.

Students should use **a range** of materials, techniques and processes when manufacturing **a range** of products in order to build and develop a variety of skills and lay a foundation for more complex and challenging work in the future.

The design brief(s)/need(s) should be set by the teacher to ensure a range of materials, techniques and processes is used.

There are a number of potential starting points to product manufacture, including:

- being provided with a detailed working drawing and manufacturing specification
- accurate replication of an existing product.

What students need to evidence:

1 Production plan

Students should produce a detailed production plan that explains the sequence of operations carried out during the manufacture of their product(s).

Students should produce a work order or schedule which could be done in the form of a flow chart or table. The work order should include the order of assembly of parts or components and tools, equipment and processes to be used during manufacture.

Students should identify quality control points, and quality checks should be described, this could be done as part of a flow diagram. Safety checks should also be part of the planning.

An important part of planning is the use of time, so students should make sure that they consider realistic timings and deadlines. Where Gantt or time charts are used, students must make sure that they are detailed, cover all aspects of product manufacture and include achievable deadlines.

Consideration should be given to the scale of production of their product(s). Although students may be making one-off products, most products would be batch or mass produced, so they should consider the consequences of these scales in their planning, developing their awareness of commercial production.

2 Making

Students should produce **one or more** high quality products that meet the requirements of the design brief(s)/need(s) they have been given. The design brief(s)/need(s) should contain requirements against which the final manufactured product(s) can be measured. It is important when setting design requirements, that they can be tested. Requirements may include dimensional parameters, load bearing capabilities, resistance to corrosion, tolerances, finishes etc which are all objectively measurable requirements that can be tested for success.

Throughout their making activities, students should demonstrate their knowledge and understanding of a range of materials, techniques and processes by selecting and using those that are appropriate to the requirements of the task. Students should consider properties and working characteristics of materials and the processes used to manipulate them. Students should be able to justify their selections by giving reasons for their choices.

Students must work with a variety of materials, techniques and processes, in order to develop high quality skills by applying their knowledge and understanding of a range of materials, techniques and processes. It is likely that they will produce more than one practical outcome during this unit.

In order to achieve well in this assessment, students must show demanding and high-level making skills. Therefore, it is important that manufacturing tasks provide enough complexity and challenge to allow them to demonstrate their skill levels to the full. It is important to keep in mind, too, that the manufacturing tasks set in this unit should be designed to develop skills in students that they can call on in their A2 coursework project. A single manufacturing project that embodies a range of materials, processes and techniques that students learn from, can be as valid as two or three shorter, but equally demanding exercises. However, by setting different exercises, the use of a range of materials, processes and techniques can be assured. Manufacturing a small, complex

jewellery box can be as demanding as producing a large piece of furniture and replicating a small chess-piece can teach students all they need to know about centre-lathe turning and milling and can include a level of complexity that would easily match the high assessment criteria.

Students will use a variety of skills and processes during their making activities, which may include computer aided manufacture (CAM). Where this is a feature of their work, they should make sure that there is plenty of opportunity within the tasks to demonstrate other skills and competencies that they have gained through their making activities. While the use of Computer Aided Manufacture is to be encouraged, students must not over-use CAM. It is acceptable for students to dedicate one manufacturing exercise to the use of CAM in order to explore its capabilities, but they must offer evidence of other skills and techniques in accompanying manufacturing exercises. Where this approach is adopted, students must provide evidence of programming the CNC equipment. Where a mixture of CAM and other skills and techniques are used in a manufacturing exercise, CAM should not exceed 50% of the work.

Students should be aware of the risks involved in using specific tools equipment and processes throughout their making and should take appropriate precautions to minimise those risks.

As proof of the quality of students' making skills (and the level of demand of their work), photographs of their work must be evidenced to show that the product(s) is complete, expertly made, well finished, fully functioning etc. The photographs must show clearly any details of advanced skills, technical content, levels of difficulty and complexity of construction, so students can achieve the marks they deserve.

It is unlikely that a single photograph for each product will be enough to communicate all of the information required, so it will be better to take a series of photographs over a period of time during making. These should highlight the processes used and provide examples of precision and attention to detail that may not be otherwise noticed.

3 Testing

After making their product(s), students should carry out tests to check their fitness for purpose against the set design requirements.

Students' finished product(s) should be tested under realistic conditions to decide on their success, in order to check the performance and quality of the final product(s).

Students should describe in detail any testing carried out and justify this by stating what they are testing and why they are doing so.

Tests should be carried out objectively, and it would be beneficial to involve potential users so that students can receive reliable and unbiased third-party feedback.

Well-annotated photographic evidence is a very good tool to use when describing the testing process.

1.6 Assessment criteria

Assessment criteria		Level of response	Mark range
Product investigation	**A. Performance analysis (AO1)**	Fully justify key technical specification points that relate to form, function, user requirements, performance requirements, materials and/or component requirements, scale of production and costs. Compare and contrast one other existing similar product using the technical specification.	4-6
		Identify with some justification a range of realistic and relevant specification points that include reference to form, function and user requirements.	1-3
	B. Materials and components (AO1/AO2)	Suggest, with reference to quality and performance, alternative materials and/or components that could have been used in the product. Evaluate, using advantages and disadvantages, the selection of the materials and/or components used. Describe the impact on the environment of using the materials and/or components identified.	7-9
		Describe a range of useful properties that relate to the materials and/or components identified and justify their selection and use in the product. Identify alternative materials and/or components that could have been used in the product.	4-6
		Identify a material or component used in the product. Describe a useful property of that material or component and justify its use.	1-3
	C. Manufacture (AO2)	Evaluate, using advantages and disadvantages, the selection of the manufacturing processes used in the product. Suggest one alternative method of production that could have been used in the manufacture of the product. Describe the impact on the environment of using the processes identified in the production of the product.	7-9
		Describe a range of processes used in the manufacture of the product and fully justify their use for the level of production of the product.	4-6
		Identify, describe and justify the use of a manufacturing process used in the construction of the product.	1-3
	D. Quality (AO2)	Describe a range of quality control checks used during the manufacture of the product and explain how the main relevant standards influenced the manufacture of the product. Describe a quality assurance (QA) system for the product.	4-6
		Identify, describe and justify the use of one quality control check during the manufacture of the product.	1-3

Assessment criteria		Level of response	Mark range
Product design	**E. Design and development (AO1/AO2)**	Present alternative ideas that are workable, realistic and detailed and which fully address the design criteria. Ideas demonstrate detailed understanding of materials, processes and techniques. Produce a final design proposal that is significantly different and improved compared to any previous alternative design ideas. The design proposal includes technical details of materials and components, processes and techniques. Modelling through the use of traditional materials or 2D and/or 3D computer simulations is used to test important aspects of the final design proposal. The final design proposal is evaluated objectively against the design criteria in order to fully justify the design decisions taken.	13-18
		Present realistic alternative design ideas. Ideas are detailed and address most design criteria. Developments are appropriate and use details from ideas to change, refine and improve the final design proposal. A final detailed design proposal is presented. Modelling is used to test some aspects of the final proposal against relevant design criteria. Evaluative comments objectively consider some aspects of the design brief/need.	7-12
		Present simplistic alternative design ideas. Ideas are superficial and address limited design criteria. Developments are minor and cosmetic. A basic final design proposal is presented. Basic modelling is used to test an aspect of the design proposal. Evaluative comments are subjective and superficial.	1-6
	F. Communicate (AO1/AO2)	Use a range of communication techniques and media including ICT and CAD, with precision and accuracy to convey enough detailed and comprehensive information to enable third-party manufacture of the final design proposal. Annotation provides explanation and most technical details of materials and processes with justification.	9-12
		Use a range of communication techniques, including ICT, that are carried out with sufficient skill to convey an understanding of design and develop intentions and construction details of the final design proposal. Annotation provides explanation and most technical details of materials and process selection.	5-8
		Use a limited range of communication techniques carried out with enough skill to convey some understanding of design and develop intentions. Annotation provides limited technical details of materials and processes.	1-4

Assessment criteria		Level of response	Mark range
Product manufacture	**G. Production plan (AO2)**	Produce a detailed production plan that considers stages of production in the correct sequence, realistic time scales and deadlines for the scale of production.	4-6
		Produce a limited production plan that considers the main stages of manufacture, reference to time and scale of production.	1-3
	H. Making (AO2)	Demonstrate a detailed understanding and justified selection of a range of appropriate materials and processes. Demonstrate demanding and high quality making skills and techniques. Show accuracy and precision when working with a variety of materials, processes and techniques. High-level safety awareness is evident throughout all aspects of manufacture.	13-18
		Demonstrate a good understanding and selection of an appropriate range of materials and processes. Demonstrate competent making skills and techniques appropriate to a variety of materials and processes. Show attention to detail and some precision. Demonstrate an awareness of safe working practices for most specific skills and processes.	7-12
		Demonstrate a limited understanding and selection of a narrow range of materials and processes. Use limited making skills and techniques. Demonstrate little attention to detail. Demonstrate an awareness of specific safe working practices during product manufacture.	1-6
	I. Testing (AO2)	Describe and justify a range of tests carried out to check the performance or quality of the product(s). Relevant, measurable points of the design brief(s)/need(s) are objectively referenced. Third-party testing is used.	4-6
		Carry out one or more simple tests to check the performance or quality of the final product(s). Some points of the design brief(s)/ need(s) are referenced superficially. Test results are recorded and are subjective.	1-3
		TOTAL NUMBER OF MARKS AVAILABLE	**90**

1.7 Administration

1	**Internal standardisation**	Teachers must show clearly how the marks have been awarded in relation to the assessment criteria. If more than one teacher in a centre is marking students' work, there must be a process of internal standardisation to ensure that there is consistent application of the assessment criteria.
2	**Authentication**	All candidates must sign an authentication statement. Statements relating to work not sampled should be held securely in your centre. Those which relate to sampled candidates must be attached to the work and sent to the moderator. In accordance with a revision to the current Code of Practice, any candidate unable to provide an authentication statement will receive zero credit for the component. Where credit has been awarded by a centre-assessor to sampled work without an accompanying authentication statement, the moderator will inform Edexcel and the mark will be adjusted to zero.
3	**Further information**	For more information on annotation, authentication, mark submission, moderation procedures and electronic portfolios, please refer to the *Edexcel Information Manual* document, which is available on the Edexcel website. For up-to-date advice on teacher involvement, malpractice and plagiarism, please refer to the latest *Joint Council for Qualifications (JCQ) Instructions for Conducting Coursework* document. This document is available on the JCQ website: www.jcq.org.uk. For additional information on malpractice, please refer to the latest *Joint Council for Qualifications (JCQ) Suspected Malpractice in Examinations and Assessments: Policies and Procedures* document, available on the JCQ website.

Unit 2 Design and Technology in Practice (RMT)

AS compulsory unit — Externally assessed

2.1 Unit description

In this unit, students will develop a knowledge and understanding of a wide range of materials and processes used in the field of design and technology.

It is important for students, as designers, to learn about materials and processes so that they can develop a greater understanding of how products can be designed and manufactured.

Students will also learn about industrial and commercial practices and the importance of quality checks and the health and safety issues that have to be considered at all times.

The knowledge and understanding students develop in this unit can be easily applied to their *Unit 1: Portfolio of Creative Skills*.

The unit content is divided into four sections, with each section outlining the specific knowledge and understanding required by the student. Specific materials and processes are named and these are the only examples with which students need to be familiar for this examination.

2.2 Assessment information

The assessment of this unit is through a 1 hour 30 minute examination paper set and marked by Edexcel.

The paper will be a question and answer booklet and all questions in the paper are compulsory.

The paper will consist of short-answer and extended-writing type questions.

The total number of marks for the paper is 70.

2.3 Materials and components

What students need to learn:

1 Materials

a) Metals

Aesthetic, functional and mechanical properties, application and advantages/disadvantages of the following metals when manufacturing products:

- ferrous
  - mild steel
  - carbon steel
  - cast iron
- non-ferrous
  - aluminium
  - copper
  - zinc
- alloys
  - stainless steel
  - duralumin
  - brass.

b) Polymers

Aesthetic, functional and mechanical properties, structural composition with reference to cross linking, application and advantages/disadvantages of the following polymers when manufacturing products:

- thermoplastics
  - acrylic
  - polyethylene
    - high density polyethylene (HDPE)
    - low density polyethylene (LDPE)
    - polyethylene terephthalate (PET)
  - polyvinyl chloride (PVC)

- ◆polypropylene (PP)
- ◆polystyrene (PS)
- ◆ABS (Acrylonitrile butadiene styrene)

- thermosetting plastics
  - ◆epoxy resins
  - ◆urea formaldehyde
  - ◆polyester resin.

c) Woods

Aesthetic, functional and mechanical properties, application and advantages/disadvantages of the following woods when manufacturing products:

- hardwoods
  - ◆oak
  - ◆mahogany
  - ◆beech
- softwood
  - ◆pine.

d) Composites

Aesthetic, functional and mechanical properties, structural composition, application, manufacture and advantages/disadvantages of the following composites when manufacturing products:

- carbon fibre
- glass reinforced plastics (GRP)
- medium density fibreboard (MDF)
- chipboard.

e) Laminates

Aesthetic, functional and mechanical properties, structural composition, application, manufacture and advantages/ disadvantages of the following laminates when manufacturing products:

- plywood
- block-board.

f) Modern materials and products

Application and advantages/disadvantages of the following modern materials and products when manufacturing products:

- thermo-ceramics
- tinted glass
- solar panels
- liquid crystal displays (LCDs)
- electroluminescent (EL) lighting.

g) New and smart materials

Application and advantages/disadvantages of the following new and smart materials when manufacturing products:

- shape memory alloys (SMA)
- reactive glass
- photochromic paint
- quantum tunnelling composites.

2 Components

Characteristics, application and advantages/disadvantages of the following components used in products:

- nuts, bolts, spacers and washers (metric size and thread form)
- screws
- rivets
  - pop
  - snap
- gears
  - simple and compound gear trains
  - rack and pinion
  - worm and wheel
  - bevel and mitre gears
  - spur gears
- bearings
  - plain bearings
  - journal bearings
  - ball bearing
  - bushes
- cams
  - pear shaped
  - circular or eccentric
  - heart shaped
  - snail
- followers
  - flat-foot
  - knife-edge
  - roller.

2.4 Industrial and commercial practice

What students need to learn:

1	**Scale of production**	Characteristics, application and advantages/disadvantages of the following scales of production in the manufacture of products: ■ one-off ■ batch ■ mass ■ continuous.
2	**Material processing and forming techniques**	Characteristics, preparation, processes, application and advantages/disadvantages of the following methods when manipulating materials and components: ■ casting ◆ sand ◆ die ■ milling/routing ■ drilling ■ turning ■ blow moulding ■ injection moulding ■ vacuum forming ■ extrusion ■ rotational moulding.
3	**Manufacturing techniques for mass production**	Preparation, application and advantages/disadvantages of the following when manufacturing products and components: ■ jigs ■ patterns ■ formers ■ moulds.

4 Joining techniques

Characteristics, preparation, processes, application and advantages/ disadvantages of using the following permanent and semi-permanent methods when joining materials and components:

- mechanical
  - nuts, bolts and washer
  - rivets
- heat
  - oxy-acetylene welding
  - MIG welding
  - brazing
  - hard soldering
- chemical
  - Tensol cement
  - polystyrene cement
- adhesives
  - polyvinyl acetate (PVA)
  - epoxy resin
  - contact adhesive
  - hot melt glue.

5 Material removal

Characteristics, preparation, processes, application and advantages/ disadvantages of the following methods when manipulating materials:

- cutting
- abrading.

6 Heat treatment	Characteristics, preparation, processes, application and advantages/disadvantages of the following heat treatment methods when altering the appropriate material and component as stated in 2.3 to enhance their properties: ■ annealing ■ hardening and tempering ■ normalising ■ work hardening.
7 Conversion and seasoning	Preparation, processes and advantages/disadvantages of the following conversion and seasoning methods: ■ conversion ◆ through and through (slab) sawn ◆ quarter sawn ■ seasoning ◆ natural ◆ kiln-drying.
8 Faults in woods	Characteristics of the following faults in woods and why such faults occur: ■ cupping ■ twisting ■ splitting ■ knots.
9 Computer-aided design (CAD)	Processes, application and advantages/disadvantages of the following CAD systems when designing products: ■ 2D design to create and modify designs ■ 3D modelling for creating 'virtual' products.
10 Modelling and prototyping	Processes, application and advantages/disadvantages of the following 3D modelling and prototyping techniques to aid the development of manufacturing products: ■ block modelling ■ rapid prototyping using CAD/CAM.

11	**Computer-aided manufacture**	Processes, application, production and advantages/disadvantages of the following CNC (Computer Numerically Controlled) systems when manufacturing products: ■ lathes ■ routers ■ milling machines ■ laser cutters.

2.5 Quality

What students need to learn:

1	**Quality assurance systems and quality control in production**	**Quality assurance systems and quality control in production** Concept, characteristics, application and advantages of the following when designing and manufacturing commercial products: ■ quality assurance (QA) systems for monitoring the quality of a product from its design and development stage, through its manufacture, to its end-use performance and degree of customer satisfaction ■ quality control (QC) as part of the achievement of QA concerning the monitoring and achieving of high standards and degree of tolerance by inspection and testing, including computer aided inspection ■ total quality management (TQM) when applying quality assurance procedures at every stage of the production process (ISO 9000 series).
2	**Quality standards**	Process of testing products, components and materials against external quality standards set by the following organisations: ■ British (BSI and relevant kitemarks) ■ European (CEN and CE) ■ International (ISO).

2.6 Health and safety

What students need to learn:

1 **Health and Safety at Work Act (1974)**

Health and Safety at Work Act (1974)

The principles and application of the Health and Safety at Work Act (1974) when designing and manufacturing commercial products:

- procedures to safeguard the risk of injury to people:
  - personal and protective equipment (PPE)
  - signage
  - warning symbols
- carrying out risk assessments in accordance with the Health and Safety Executive (HSE) for the design of products using computers and manufacture of products using computers or workshop practices:
  - identify potential hazards
  - identify people at risk
  - evaluate the risks
  - decide upon control measures
  - record assessment
- Control of Substances Hazardous to Health (COSHH) regulations:
  - risk assessment to control the storage and use of solvent-based substances containing volatile organic compounds (VOCs).

Unit 3 Designing for the Future (RMT)

A2 compulsory unit

Externally assessed

3.1 Unit description

In this unit, students will develop their knowledge and understanding of a range of modern design and manufacturing practices and contemporary design issues. The modern designer must have a good working knowledge of the use of ICT and systems and control technology in the design and manufacture of products. They must also be aware of the important contributions of designers from the past which may provide inspiration for future design.

It is increasingly important that students develop an awareness of the impact of design and technological activities upon the environment. Sustainable product design is a key feature of modern design practices.

The unit content is divided into four sections, with each section outlining the specific knowledge and understanding required by the student. Specific examples are given and these are the only ones with which students need to be familiar for this examination.

3.2 Assessment information

The assessment of this unit is through a 2-hour examination paper set and marked by Edexcel.

The paper will be a question and answer booklet and all questions in the paper are compulsory.

The paper will consist of short-answer and extended-writing type questions.

The total number of marks for the paper is 70.

3.3 Industrial and commercial practice

What students need to learn:

1 Information and communication technology (ICT)

Characteristics, processes, application, advantages/disadvantages of ICT in the development, manufacture and sales of products in the global marketplace:

- electronic communications
  - email
  - Electronic Data Interchange (EDI)
  - Integrated Services Digital Network (ISDN) and broadband
  - Local Area Networks (LAN)
  - global networks (internet)
  - video conferencing
- electronic information handling
  - market analysis
  - specification development
- automated stock control
  - 'just in time' (JIT)
- production scheduling and production logistics
- flexible manufacturing systems (FMS)
  - quick response manufacturing (QRM)
- production control
- marketing, distribution and retailing of products using:
  - electronic point of sale (EPOS)
  - internet marketing.

2 Biotechnology

a) Characteristics, advantages/disadvantages and the impact on the environment of the following genetic engineering techniques when manufacturing products:

- altering genes in woods to provide quicker-growing trees, or to supply wood that resists wear, rot or infestation
- use of micro-organisms to aid the disposal of environmentally-friendly plastics
- producing materials that are totally recyclable.

b) The sources, manufacture, application and advantages/disadvantages of the following biodegradable polymer:

- Biopol®.

c) Characteristics, application and advantages/disadvantages of adding the following additives to polymers:

- plasticisers
- fillers
- fibres
- stabilisers
- foamants.

d) Characteristics, application and advantages/disadvantages of modifying woods:

- lamination.

3.4 Systems and control

What students need to learn:

1	**Manufacturing systems**	Characteristics, processes, application and advantages/ disadvantages of advanced manufacturing technology (AMT) which enable quick response manufacturing (QRM), including: ■ concurrent manufacturing ■ flexible manufacturing systems (FMS).
2	**Computer integrated manufacture (CIM)**	Characteristics, processes, application, advantages/disadvantages and its impact on employment of CIM systems to integrate the processing of production and business information with manufacturing operations, including: ■ data integration involving product data management (PDM) and enterprise resource planning (ERP) systems ■ lean manufacturing using just-in-time (JIT) systems ■ computer-aided manufacture (CAM) involving CNC equipment and computer-aided quality (CAQ) in flexible manufacturing cells ■ materials handling systems including automated storage and retrieval systems (ASRS) and automatic guided vehicles (AGVs).
3	**Robotics and Artificial Intelligence (AI)**	Application, advantages/disadvantages and its impact on employment of complex automated systems, including: ■ robots on fully automated production and assembly lines/cells ■ development of artificial intelligence (AI) for industrial applications.
4	**Flow charts**	Application of flow charts to represent open and closed loop systems for quality control of production processes.

3.5 Design in context

What students need to learn:

1	**The effects of technological changes on society**	The impact and advantages/disadvantages of the following technological changes on society in relation to product manufacture. ■ Mass production: ◆ consumer society including built-in obsolescence ◆ employment. ■ The 'new' industrial age of high-technology production: ◆ computers in the development and manufacture of products ◆ miniaturisation of products and components ◆ use of smart materials and products for innovative applications. ■ The global marketplace: ◆ multinational companies in developed countries manufacturing 'offshore' in developing countries ◆ local and global production.
2	**Influences of design history on the development of products**	Characteristics in terms of design styles, philosophy and influences on design culture of the following designers and design movements: ■ William Morris and the Arts and Crafts movement ■ Charles Rennie Mackintosh and the Art Nouveau movement ■ Marcel Breuer and the Bauhaus modernist movement ■ Eileen Gray and the Art Deco movement ■ Raymond Loewy and streamlining ■ Philippe Starck and the New Design style (post-modernism).
3	**Form and function**	The debate regarding 'form versus function' including the following two opposing views when designing products: ■ form follows function (functionality as prime driver) ■ form over function (aesthetics as prime driver).

4	**Anthropometrics and ergonomics**	The principles and application of anthropometrics data and ergonomics: ■ key ergonomic factors for a designer to consider when developing products, equipment and environments with human interaction ■ sources and applications of anthropometric data.

3.6 Sustainability

What students need to learn:

1	**Life cycle assessment (LCA)**	Application of LCA to assess the impact of a product 'from the cradle to the grave' using a life cycle inventory of: ■ environmental inputs and outputs of raw materials, energy resources and emissions ■ economic inputs and outputs of products, components or energy that are outputs from other processes.

2 Cleaner design and technology

Application of 'cleaner' design and technology throughout each of the stages of a product's life cycle in relation to the following sustainable development issues:

- design
  - for reducing environmental impact
  - for recycling
- raw materials
  - reduction or recycable
  - reduce environmental impact
- manufacture
  - minimising waste and energy use
  - simplifying processes
  - efficient use of natural resources
- distribution
  - reduce or lighten packaging
  - reduce mileage of transportation to the customer
  - alternatives to fossil fuels
- use
  - repair versus replacement.

3 Minimising waste production

The principles and application of minimising waste production throughout the product life cycle using the following 'four R's':

- reduce
- reuse
- recover
- recycle.

4	**Renewable and non-renewable sources of energy**	Characteristics, comparisons, applications and advantages/ disadvantages of using the following renewable and non-renewable sources of energy: ■ wind ■ water ■ solar ■ biomass and biofuels ■ nuclear ■ fossil fuels.
5	**Responsibilities of developed countries**	The responsibilities of 'developed' countries in relation to social, economic and environmental issues for global sustainable development. ■ Impact of industrialisation on global warming and climate change. ◆ United Nations Framework Convention on Climate Change (UNFCCC) including Kyoto Protocol. ◆ Reduction of an individual's 'carbon footprint' by reducing carbon dioxide emissions and carbon offsetting ◆ Non-Fossil Fuel Obligation (NFFO) in the UK. ■ Timber production and sustainable forest management.

4.1 Unit description

In this unit, students are given the opportunity to apply the skills they have acquired and developed throughout this course of study, to design and make a product of their choice that complies with the requirements of a resistant materials technology product, defined as a fully functioning product that matches its specification. It must be manufactured to full size using resistant materials, for example materials defined in *Unit 2: Design and Technology in Practice*. Where a resistant materials technology product contains elements of textiles, systems and control or graphics work, this should not exceed one third of the content of the practical outcome or the design folder.

In this unit, students are encouraged to be creative and adventurous in their work. There are no limits to project selection beyond the time and resources available and the appropriateness of selection in matching individual students' potential. Students are expected to take ownership of all aspects of their work in this unit, in order to allow them total control of their responses and to target assessment criteria effectively, and to maximise their achievements.

In order to reach high attainment levels, students must adopt a commercial design approach to their work, reflecting how a professional designer might deal with a design problem and its resolution.

The choice of design problem should have a real commercial use, in that it should be useful to a wider range of users beyond an individual, unless it has been specifically commissioned as a 'one-off'. The design problem should provide opportunities for a client or user-group to have input into decision making at various stages of the design and make process.

A client or user-group is defined as any third party identified by a student, that is referred to and which can give informed critical feedback at various stages throughout the design process. Clients and user-groups do not need to be specialists or experts; they can be drawn from any relevant group of people and may include other students, friends or family members.

A key feature of this unit is for students to consider issues related to sustainability and the impact their product may have on the environment. A student may choose to design and make a sustainable product, but if they do not, they should still consider the issues of sustainability at relevant points in their designing and making activities. Sustainable issues could include materials production and selection, manufacturing processes, use of the product and its disposal/recycling.

4.2 Assessment information

1 Design and make process

- Students identify a client/user-group from which they must design and make a product that meets the original design problem. They should liaise with their client/user-group at various stages of their designing and making process in order to develop a commercial product.
- Students should be familiar with a range of industrial applications and commercial working practices in order to fulfil the requirements of this unit.
- This unit results in the development of a manufactured product supported by a design folder. The folder, which should include ICT-generated images where appropriate, should be submitted on A3 paper **only** and is likely to be no more than 30 pages long.
- It is important that all stages of the manufacturing process are photographed in order to evidence that the product is complete, expertly made, well finished, fully functioning etc. It is unlikely that a single photograph will be enough to communicate all of the information required. Students must ensure that a series of photographs over a period of time is taken during making to show clearly any details of advanced skills, technical content, levels of difficulty and complexity of construction. This will allow students to achieve the marks they deserve.

2 Task setting guidance

Although there is a free choice of product, students must ensure that:

- time and resources available are considered
- they can fully demonstrate their capabilities in each of the assessment criteria, so that they maximise their potential achievements
- the choice of design problem has a commercial use and should allow designing for a client or user-group who should have input into decision making at various stages in the design and make process
- issues related to sustainability are considered at relevant points in their designing and making activities and the impact their product may have on the environment. Sustainable issues could include materials production and selection, manufacturing processes, use of the product and its disposal/recycling
- their product complies with the requirements of a resistant materials technology product, which is defined as a fully-functioning product that matches its specification. It must be manufactured to full size using resistant materials, for example materials defined in *Unit 2: Design and Technology in Practice*. Where a resistant materials technology product contains elements of textiles, systems and control or graphics work, this should not exceed one third of the content of the practical outcome or the design folder.

3 Assessment guidance

- This unit is internally set and marked by the centre, using the assessment criteria in Section 4.4, and externally moderated by Edexcel.
- The maximum number of marks available is 90.
- It is important that all stages of the manufacturing process are photographed in order to evidence that the product is complete, expertly made, well finished, fully functioning etc. Students must ensure that photographs show clearly any details of advanced skills, technical content, levels of difficulty and complexity of construction, so that they can achieve the marks they deserve.
- It is unlikely that a single photograph will be enough to communicate all of the information required, so it will be better to take a series of photographs over a period of time during making.
- This unit results in the development of an appropriate product supported by a design folder. The folder, which should include ICT-generated images where appropriate, should be submitted on A3 paper **only** and is likely to be no more than 30 pages long.
- Students can submit their work electronically for moderation. Please refer to the *Edexcel Information Manual* document, which is available on the Edexcel website www.edexcel.com, for further detail.

4.3 Product design and make

What students need to evidence:

1 Research and analysis

Once the student has identified an appropriate need and written a detailed design brief, they must analyse the need in order to focus on the research needed to help the work progress. Students should use a range of research strategies to gather useful and relevant information that will help with their designing and making activities.

When gathering information, it is important that students are clear about what they need to find out. Research should be highly selective ensuring that the information gathered is useful and relevant to the client/user-group's needs identified and finalised during analysis. Research should be focused and succinct and contain no worthless padding. Students should avoid downloading large amounts of information from the internet, or cutting and pasting from catalogues and databases without providing detailed annotation to explain the selected information.

A good starting point for research and analysis could include an interview or discussion with the client/user-group to establish their thoughts and preferences regarding the proposed product. This information should be used to guide their analysis and research activities. In the analysis, students should ensure that they focus closely on the identified need, avoiding any general statements that are of no use and could be applied to any design situation.

Research could include the analysis of existing similar products, to find out about materials, processes and construction methods used in commercial manufacture. Market research will allow students to test the viability of their intended product beyond the needs of the client/user-group. Surveys or questionnaires should be designed carefully, avoiding questions that are general and useless in helping with the design process. A questionnaire should not be included simply for the sake of doing so; its use and questions asked within it should be justified.

When researching into materials and/or components and processes, students should take into consideration the concept of 'sustainability' so that they are able to make responsible and informed decisions about the impact of materials and resources upon the environment. When all information gathering has been completed, students should analyse their research in order to help write a product specification that is relevant, meaningful and measurable.

2 Product specification

It is important that students develop and write a detailed specification, as it will be used throughout the design process to reference ideas and their development and to check that the design requirements and client/user-group needs are being matched. The specification should be used as a basis for testing and evaluating the completed product and any future modifications suggested should be referenced to specification criteria in order to check the success of the final product.

The starting point for a successful specification should be after the research and when essential requirements have been established as a result of studying the information gathered. Students should consult with their client/user-group to agree the specification points and to ensure that the criteria meet the needs identified earlier. When specifying materials and/or components and processes, students should consider sustainability, and make decisions based on the environmental costs of extracting and processing the selected materials, the product manufacture, lifespan and disposal.

When writing a specification, students should try to avoid a rambling collection of points. The specification should be informed by the research findings. An effective specification is organised logically and could be achieved by using sub-headings such as purpose, form, function, user requirements, performance requirements, materials/components, size, safety and quality, scale of production and cost. Each specification point should contain more than a single piece of information, so that each statement is fully justified by giving a reason for the initial point. For example, it is not sufficient to say 'the material used is polystyrene', as this is not justified until 'because it is tough and can be injection moulded' is added.

Specification points should be technical and measurable where possible, so that testing and evaluation can be realistic. It is extremely important that specification points are not superficial or general.

3 Design and development

a) Design

In this section, students have the opportunity to apply their design skills and the advanced knowledge of materials and/or components, processes and techniques developed through their experience of AS units to produce alternative designs that address client/user-group needs as identified in the specification.

Students should produce alternative design ideas that are realistic, workable, and which address the needs identified in the specification. Designs should be annotated and include as much detail as possible of materials and/or components, processes and techniques that could be used to construct the design idea.

It is often, but not always, necessary for students to produce complete solutions when considering alternative design ideas. It is better to focus on fewer and more detailed high quality designs than to try to produce more work of a lower quality. As work progresses, alternative design proposals and their details should become linked and continuity of ideas should be seen as one idea moves to the next to be improved upon.

b) Review

As an important part of their designing, students should review and objectively evaluate their design ideas as they are produced. The comments made in reviewing design ideas should be based on objective, formative evaluation of each idea and should always be referenced to the specification and to check the idea's potential in fulfilling the client/user-group's need.

Students should use 'tick-boxes' with care when reviewing design ideas, as this is always subjective and worthless in evaluating ideas against a specification effectively. Yes/no answers do not allow any useful decisions to be made when deciding whether specification points have been met.

As part of reviewing, design ideas should be discussed with the client/user-group to ensure, through feedback, their suitability for their intended purpose. Information should be communicated through logical and well-organised statements, using specialist technical vocabulary. In addition, students should consider and justify some of their design decisions with reference to sustainability. In this section, students will develop a final design proposal in consultation with their client/user-group.

c) Develop

Development of the final design proposal will give students the opportunity to bring together the best and most appropriate features of their initial design ideas into a refined final design proposal that m eets all of the requirements of the product specification and matches the client/user-group needs.

Students must show the development of their design, demonstrating how it has changed and moved on from initial ideas, using the results of review/evaluation and client feedback. It is not good practice to simply take an initial idea, make superficial or cosmetic changes, and then present it as a final developed proposal.

Students should include as much detailed information on all aspects of the developed design as possible, including technical details of materials and/or components and their selection, processes and techniques. This is an opportunity to demonstrate an advanced knowledge and understanding of design and make activities.

Modelling should be used to test features such as proportions, scale, function, sub-systems etc. Modelling can be achieved through the use of traditional materials, or 2D and/or 3D computer simulations. Evidence of modelling should be presented through clear, well-annotated photographs. Consultation with the client/user-group should be evidenced in order to justify and clarify final design details.

d) Communicate

When presenting design and development work, it is essential that ideas are communicated effectively:

Through design and development work

Students should show evidence of 'design thinking' using any form of effective communication that they feel is appropriate. However, they should try to use a range of skills that may include freehand sketching in 2D and 3D, cut and paste techniques and the use of ICT. It is important to demonstrate a high degree of graphical skill, which will be shown through the accuracy and precision of their work.

When using ICT, students should ensure that it is used appropriately, rather than for show. For example, specialist CAD software to produce 3D rendered images is likely to be more appropriately used as part of development or final presentation, rather than for initial ideas.

Through presentation graphics and technical drawings

To effectively communicate final designs, a range of skills and drawing techniques should be demonstrated which could include:

- pictorial drawings — isometric, planometric (axonometric), oblique and perspective drawings to convey a 3D representation of the product
- working drawings — 1st or 3rd angle orthographic, exploded assembly and sectional drawings to convey technical information
- computer generated — pictorial and working drawings, renderings etc using specialist software.

Through the quality of written communication

Annotation should be used to explain design details and convey technical information. Students should make sure that the information is easily understood and presented logically.

Specialist technical vocabulary should be used consistently with precision.

Information presented in this section should enable a student's design thinking and manufacturing intentions to be clearly understood by others and allow third-party manufacture of the final design proposal.

4 Planning

In this section, students will produce a detailed production plan that explains the sequence of operations carried out during the manufacture of their product under the appropriate commercial conditions and which focuses closely on the identified scale of production.

Students should produce a work order or schedule to illustrate the sequence of operations used during manufacturing. This could be evidenced in the form of a flow chart or table. The work order should include the order of assembly of parts and components, tools, equipment and processes to be used during manufacture in volume higher than 'one-off' production unless the designed product is specifically a one-off item.

An important part of planning is the use of time, so students must ensure that they consider realistic timescales and deadlines. Where Gantt or time charts are used, students must ensure that they are detailed, cover all aspects of manufacture and include achievable deadlines.

Students should identify quality control points and quality checks should be described. This could be done as part of a flow diagram. Safety checks should also be included as part of planning.

5 Making

a) Use of tools and equipment

Students should demonstrate their ability to use tools and equipment with high levels of skill and accuracy and to select appropriate tools and equipment for specific purposes. It is important that students use a range of tools and equipment to allow them to fully demonstrate their skills.

Where Computer Aided Manufacture (CAM) is a feature of a student's work, they should make sure that there is plenty of opportunity within the product's manufacture to demonstrate other skills and competencies that they have acquired. The over-use of CAM should be avoided.

Students should work safely and be fully aware of the risks involved when using tools and equipment and the precautions that should be taken to minimise those risks.

b) Quality

During manufacturing activities, students should demonstrate their understanding of a range of materials and their working properties. Students should select and justify the use of materials that are appropriate to the needs of the product and match the requirements of the product specification. When selecting materials, students should be able to justify their choice by referring to material properties and suitability for their intended use. The selection and use of appropriate processes and techniques should enable students to produce a high quality final product that fully matches the final design proposal in all respects.

It is important that all stages of the manufacturing process are photographed in order to evidence that the product is complete, expertly made, well finished, fully functioning etc. Students must ensure that photographs show clearly any details of advanced skills, technical content, levels of difficulty and complexity of construction, so that they can achieve the marks they deserve.

It is unlikely that a single photograph will be enough to communicate all of the information required, so it will be better to take a series of photographs over a period of time during making.

c) Complexity/level of demand

Students must demonstrate demanding and high-level making skills in order to achieve high marks. Therefore, it is very important that the manufacture of the product offers enough complexity and challenge in order to gain the maximum credit possible.

The level of complexity of the intended product will already have been established through the finalisation of the design proposal, so it is important that students consider this at an early stage to maximise their potential when manufacturing the product.

Students should try to set challenges and demands appropriate to their skill levels and beyond, so that they do not work within their comfort zone and fail to achieve what they are capable of.

Students should avoid producing simplistic and undemanding work that, however well it is manufactured using appropriate tools, equipment and processes, is unchallenging. This approach cannot result in high levels of credit.

6 Testing and evaluating

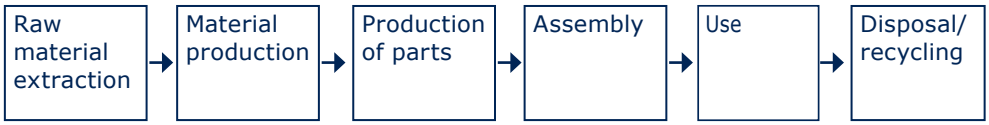
When students have completed the manufacture of their product, they should carry out tests to check its fitness for purpose with reference to commercial techniques where possible.

The finished product should be tested under realistic conditions to decide on its success using the points of specification to check the product's performance and quality. Students should describe in detail any tests they carry out and justify them by stating what is being tested and why. Tests should be objective and carried out by the client/user-group. Involving other potential users would be a reliable way of gathering unbiased and reliable third-party feedback.

Well-annotated photographic evidence is a good tool to use when describing testing. Students should use the results of their testing and views of the client/user-group to help evaluate the final product.

The evaluation should relate to the measurable points of the product specification and should be as objective as possible. Students should use the information from their testing, evaluation and client/user-group feedback to make suggestions for possible modifications and future improvements to the product. Suggestions for modifications should focus on improving the performance of the product, or its quality.

Students should check the sustainability of their final product by carrying out a life cycle assessment (LCA), in order to assess its impact on the environment. Students could use a flow chart similar to the one shown below as a starting point for the LCA of the product and expand upon it.



4.4 Assessment criteria

Assessment criteria		Level of response	Mark range
A. Research and analysis (AO1)		Analysis is detailed with most design needs clarified. Research is selective and focuses on the needs identified in the analysis.	3-4
		Analysis is limited with some design needs clarified. Research is superficial and does not focus on the needs identified in the analysis.	1-2
B. Product specification (AO1)		Specification points are realistic, technical and measurable. Specification fully justifies points developed from research in consultation with a client/user-group. Sustainability of resources is realistically considered and relevant when developing specification points.	4-6
		Specification points are realistic but not measurable. Some specification points are developed from research in limited consultation with a client/user-group, but are not justified. Sustainability of resources is considered superficially when developing specification points.	1-3
C. Design and development	**Design (AO1/AO2)**	Present alternative ideas that are realistic, workable and detailed. Ideas demonstrate detailed understanding of materials, processes and techniques supported by research information. Ideas address all specification points. Client/ user-group feedback shown.	7-10
		Present alternative design ideas that are realistic and workable. Ideas are detailed and use relevant research. Ideas address most specification points.	4-6
		Present alternative design ideas that are similar and simplistic. Ideas are similar and use limited research. Limited specification points are addressed.	1-3
	Review (AO1)	Present objective evaluative comments against most specification points that consider client/user-group feedback. Evaluative comments include realistic issues of sustainability relating to design and resources.	3-4
		Present general and subjective comments against some specification points. An aspect of sustainability is evaluated superficially.	1-2

Assessment criteria		Level of response	Mark range
C. Design and development *(cont.)*	**Develop (AO1/AO2)**	Development is used to produce a final design proposal that is significantly different and improved compared to any previous alternative design ideas. A final design proposal is presented that includes technical details of materials and/or components, processes and techniques. Modelling to scale using traditional materials or 2D and/or 3D computer simulations is used to test important aspects of the final design proposal against relevant design criteria. Client/user-group feedback is used for final modifications.	7-10
		Developments are appropriate and use details from alternative design ideas to change, refine and improve the final design proposal. A final design proposal is presented that includes some details of materials, and/or components, processes and techniques. Modelling using traditional materials is used to test some aspects of the final design proposal against relevant design criteria.	4-6
		Developments from alternative design ideas are minor and cosmetic. A final design proposal is presented that includes superficial details of materials and/or components, processes and techniques. Simple modelling is used to test an aspect of the final design proposal against a design criterion.	1-3
	Communicate (AO1/AO2)	Use a range of communication techniques and media, including ICT and CAD, that are carried out with precision and accuracy to convey enough detailed and comprehensive information to enable a third party to manufacture the final design proposal.	4-6
		Use a range of communication techniques, including ICT, that are carried out with sufficient skill to convey an understanding of design and develop intentions and construction details of the final design proposal.	1-3
D. Planning (AO2)		Produce a detailed production plan that considers the main stages of manufacture in the correct sequence appropriate to the scale of production. Realistic and achievable time-scales and deadlines are evidenced for the scale of production. Quality and safety checks are shown and justified.	4-6
		Produce a production plan that considers the main stages of manufacture. Reference to time and scale of production is shown. Quality and safety are evidenced superficially.	1-3

Assessment criteria		Level of response	Mark range
E. Making	**Use of tools and equipment (AO2)**	Select tools and equipment for specific uses independently. Use with precision and accuracy. High level of safety awareness, for self and others, when using specific tools and equipment.	7-9
		Select appropriate tools and equipment with some guidance. Use with some skill and attention to detail. Show sufficient levels of safety awareness, for self and others, when using specific tools and equipment.	4-6
		Select general tools and equipment with guidance. Use with limited skill and attention to detail. Show a limited level of safety awareness, for self and others, when using specific tools and equipment.	1-3
	Quality (AO2)	Display a detailed understanding of the working properties of materials used with justification for their selection Display a justified understanding of the use of manufacturing processes. Produce a high-quality product that matches all aspects of the final design proposal and functions fully.	11-16
		Display a good understanding of the working properties of materials used with relevant reasons for their selection. Display a good understanding of the use of relevant manufacturing processes. Produce a product that matches the final design proposal and functions adequately.	6-10
		Display a limited understanding of the working properties of materials used with limited reasoning for their selection. Display a limited understanding of the use of manufacturing processes. Produce a product that barely matches the final design proposal and functions poorly.	1-5
	Complexity/ level of demand (AO2)	The complexity of task is challenging. A wide range of skills is required, demonstrating precision and accuracy in their use.	7-9
		The complexity of task offers some challenge. A range of skills is required demonstrating attention to detail in their use.	4-6
		The complexity of task is undemanding. A limited range of skills is needed that require little attention to detail in their use.	1-3

Assessment criteria	Level of response	Mark range
F. **Testing and evaluating** **(AO2)**	A range of tests justified and carried out to check the performance and/or quality of the final product. Objective evaluative comments, including third-party evaluation, consider most relevant, measurable specification points in detail. Suggestions for modifications that are justified from tests carried out focus on improving performance and/or quality of the final product. Relevant and useful life cycle assessment carried out on the final product to check its sustainability.	7-10
	A range of tests carried out to check the performance and/or quality of the final product. Evaluative comments are objective and reference most specification points. Suggestions for modifications are relevant and are justified from tests that were carried out.	4-6
	One or more simple tests carried out to check the performance and/or quality of the final product. Evaluative comments are subjective and reference a few specification points superficially. Suggestions for modifications are cosmetic.	1-3
	TOTAL NUMBER OF MARKS AVAILABLE	**90**

4.5 Administration

1 Internal standardisation	Teachers must show clearly how the marks have been awarded in relation to the assessment criteria. If more than one teacher in a centre is marking students' work, there must be a process of internal standardisation to ensure that there is consistent application of the assessment criteria.
2 Authentication	All candidates must sign an authentication statement. Statements relating to work not sampled should be held securely in your centre. Those that relate to sampled candidates must be attached to the work and sent to the moderator. In accordance with a revision to the current Code of Practice, any candidate unable to provide an authentication statement will receive zero credit for the component. Where credit has been awarded by a centre-assessor to sampled work without an accompanying authentication statement, the moderator will inform Edexcel and the mark will be adjusted to zero.
3 Further information	For more information on annotation, authentication, mark submission, moderation procedures and electronic portfolios, please refer to the *Edexcel Information Manual* document, which is available on the Edexcel website. For up-to-date advice on teacher involvement, malpractice and plagiarism, please refer to the latest *Joint Council for Qualifications (JCQ) Instructions for Conducting Coursework* document. This document is available on the JCQ website: www.jcq.org.uk. For additional information on malpractice, please refer to the latest *Joint Council for Qualifications (JCQ) Suspected Malpractice in Examinations and Assessments: Policies and Procedures* document, available on the JCQ website.

D Design and Technology: Product Design — Graphic Products unit content

Course structure

- Edexcel's GCE in Design and Technology: Product Design comprises four units and contains an Advanced Subsidiary subset of two AS units.
- The Advanced Subsidiary GCE is the first half of the GCE course and consists of Units 1 and 2. It may be awarded as a discrete qualification or contribute 50 per cent of the total Advanced GCE marks.
- The full Advanced GCE award consists of the two AS units (Units 1 and 2), plus two A2 units (Units 3 and 4) which make up the other 50 per cent of the Advanced GCE. Students wishing to take the full Advanced GCE must, therefore, complete all four units.
- The structure of this qualification allows teachers to construct a course of study which can be taught and assessed either as:
  - distinct modules of teaching and learning with related units of assessment taken at appropriate stages during the course; or
  - a linear course which is assessed in its entirety at the end.

Unit 1 Portfolio of Creative Skills (Graphic Products)

AS compulsory unit — Internally assessed

1.1 Unit description

In this unit, students are given the opportunity to develop their creative, technical and practical skills through a series of product investigation, design and manufacturing activities.

Students will produce **one** portfolio with **three** distinct sections which will demonstrate their creativity and flair when investigating, designing and making product(s). Students may use the same product for a designing exercise and a making exercise, but this unit offers an opportunity to choose **different** products for the **three** distinct sections as students are not being asked to perform one large design and make exercise but three smaller and more focused tasks which build up to provide a detailed portfolio of their skills.

This unit has been designed to be as flexible as possible, offering students a wide range of valid approaches in producing their portfolio of creative skills. Students are encouraged to be as creative as possible and there are no barriers to choices of product investigation, product design or product manufacture, as long as the work submitted by students targets assessment criteria effectively and at the correct level of response for their abilities.

When designing, students can be creative and adventurous. There is no requirement to realise the designs produced. There will be no material or manufacturing restrictions and no limitations to design possibilities.

Graphic Products has two clearly defined pathways, either 'conceptual design' or 'the built environment'.

1) **Conceptual design** incorporates a wide range of 3D products with associated graphics, for example:

   - packaging design
   - product/industrial design
   - point of sale display
   - vehicle design.

2) **The built environment** focuses on the humankind surroundings that provide the setting for human activity, for example:

- architecture
- interior design
- exhibition design
- theatre sets
- garden design.

In this unit students can explore both pathways in order to evidence the assessment requirements for the **three** distinct sections.

1.2 Assessment information

1 The portfolio

Students will produce **one** portfolio with **three** distinct sections — product investigation, product design and product manufacture.

Students should ideally look at **different** products for the **three** distinct sections.

- In the product investigation, the chosen product must contain more than **one** material and process in order to access the full range of marks.
- In their product design, students can respond creatively and adventurously to one or more design brief(s)/need(s). Students will demonstrate creativity and flair using their design skills through the production of a range of alternative ideas that explore different approaches to the problem. Students will develop and refine their ideas, with the aid of modelling, into a final workable design proposal that will satisfy the design brief(s)/need(s). Students' designs must be realistic and workable, but they do not need to be taken to the manufacturing stage. Once their idea(s) have been fully developed into a viable product(s), they must communicate their design intentions to potential users.
- In their product manufacture, students should produce **one or more** high quality 2D and 3D product(s). This will allow them to demonstrate their knowledge and understanding of a **range** of materials, techniques and processes by selecting and using those that are appropriate to the requirements of the task. A **range** can be defined as at least **two.**

2D products are those which normally include the use of paper and board with some kind of graphic design applied to its surface. 3D products will include concept modelling using a variety of modelling materials.

While there is no defined limit to the number of pages students should include in their portfolio of creative skills, it is envisaged that all requirements of this unit can be achieved within 25-30 A3-size pages.

Students may choose to produce their product investigation in A3 or A4 format.

2 Task setting guidance

Edexcel does not prescribe the tasks undertaken for each of the three discrete sections.

When setting tasks the following points must be taken on board.

a) Product investigation

In the product investigation, the chosen product must contain more than one material and process in order to access the full range of marks.

Although students may investigate a range of different products over the course of their AS studies for their portfolio, evidence of only one complete product investigation should be submitted. Evidence must not comprise of the best aspects of a range of product investigations.

The submitted product can be chosen by the teacher or the student.

b) Product design

In their product design, students can respond creatively and adventurously to one or more design brief(s)/need(s).

These design brief(s)/need(s) can be set by the teacher or the student, to produce solutions which are both fit for purpose and market viable.

c) Product manufacture

In their product manufacture, students should produce **one or more** high quality product(s) that meets the requirements of the design brief(s)/need(s). The design brief(s)/need(s) should contain requirements against which the final manufactured products can be measured.

The design brief(s)/need(s) should be set by the teacher to ensure a range of materials, techniques and processes are used.

The following must also be taken into account for each of the **three** discrete sections:

- time and resources available are considered
- students can fully demonstrate their capabilities in each of the assessment criteria, so that they maximise their potential achievements
- their product(s) complies with the requirements of a graphic products, which is defined as two clearly defined pathways, either 'conceptual design' or 'the built environment'.

1) **Conceptual design** incorporates a wide range of 3D products with associated graphics, for example:
   - packaging design
   - product/industrial design
   - point of sale display
   - vehicle design.
2) **The built environment** focuses on the humankind surroundings that provide the setting for human activity, for example:
   - architecture
   - interior design
   - exhibition design
   - theatre sets
   - garden design.

In this unit students can explore both pathways in order to evidence the assessment requirements for the **three** distinct sections.

3 Assessment guidance

- This unit is internally set and marked by the centre using the assessment criteria in Section 1.6 and is externally moderated by Edexcel.
- The total number of marks available for each discrete section is 30. **One** overall mark out of 90 is required.
- The student will produce **one** portfolio that contains evidence for all **three** distinct sections.
- Photographic evidence of students' modelling can be used as part of the evidence provided in their design section.
- As proof of the quality of students' making skills (and the level of demand of their work), photographs of their work must be taken to show that the product(s) is complete, expertly made, well finished etc. The photographs must show clearly details of any advanced skills, technical content, levels of difficulty and complexity of construction, so that students can achieve the marks they deserve.
- Students can submit their work electronically for moderation. Please refer to the *Edexcel Information Manual* document, which is available on the Edexcel website www.edexcel.com, for further detail.

1.3 Product investigation

In this section, students will analyse an existing commercial product using their knowledge and understanding of designing and making. Students should take into consideration the intended function and performance of the product; the materials, components where appropriate and processes used during its manufacture; how it was produced and how its quality was assured.

Although students may investigate a range of different products over the course of their AS studies, evidence of **one** complete product investigation should be submitted, therefore, evidence must not comprise of the best aspects of a range of product investigations.

The submitted product can be chosen by the teacher or the student.

The chosen product must contain more than **one** material and process in order to access the full range of marks.

Students' work may be presented using any appropriate media, such as written evidence, sketching, photographs, cut and paste etc.

What students need to evidence:

1 Performance analysis

When analysing their chosen product, students should determine what it was that the designer set out to achieve and then produce a technical specification that covers key headings.

The technical specification should include:

- Form — why is the product shaped/styled as it is?
- Function — what is the purpose of the product?
- User requirements — what qualities make the product attractive to potential users?
- Performance requirements — what are the technical considerations that must be achieved within the product?
- Material and component requirements — how should materials and components perform within the product?
- Scale of production and cost — how does the design allow for scale of production and what are the considerations in determining cost?

The specification points should contain more than a single piece of information, so that each statement is fully justified by giving a reason for the initial point. For example, it is not sufficient to say 'the material used is polystyrene', as this is not justified until 'because it is tough and can be injection moulded' is added.

As part of their analysis, students should look at one other existing similar product, using the same criteria identified in their technical specification, to find out information about the product so that they can compare and contrast it with their own chosen product.

2 Materials and/ or components	Students should identify the materials and/or components used in their chosen product and use their knowledge and understanding of their properties and qualities to suggest why in particular they have been selected for use. The chosen product could have been made effectively in terms of quality and performance from other materials and/or components. Students should investigate suitable alternative materials and/or components and, using advantages and disadvantages, compare them with the materials and/or components actually used. Students should consider and explain the environmental effects of using the materials identified in their product in relation to one or more of the following: ■ extraction and processing of raw materials ■ production processes ■ disposal of products after their useful lifespan.
3 Manufacture	Students should identify and describe the processes involved in the manufacture of their chosen product. They should justify their choice of processes. It is important to consider that other methods of manufacture could have been used, so they should make clear **one** alternative method and compare and contrast it with the methods chosen. Students should also consider and describe the effects that using particular commercial processes have on the environment.
4 Quality	The student's chosen product will have gone through a series of checks to ensure it reaches the user in the best possible condition in terms of quality and performance. Students should describe when and where quality control checks take place during the manufacture of the product, what the checks consist of and how they form part of a quality assurance system. Students should also identify and describe some of the main standards that must be met during product manufacture and how they influence production and the final product.

1.4 Product design

In this section, students can respond creatively and adventurously to one or more design brief(s)/need(s). These design brief(s)/need(s) can be set by the teacher or the student, to produce solutions which are both fit for purpose and market viable.

Students will demonstrate creativity and flair, using their design skills, through the production of a range of alternative ideas that explore different approaches to the problem. Using the best aspects of their initial designs, they will develop and refine their ideas, with the aid of modelling, into a final workable design proposal that will satisfy the design brief(s)/need(s).

Students should be encouraged to be as creative as possible in their work and to disregard the limitations of the facilities available to them within their centre. Their designs must be realistic and workable, but they do not need to be taken to the manufacturing stage.

Once their idea(s) has been fully developed into a viable product(s), they must communicate their design intentions to potential users. Designers must sell their ideas by the use of presentation graphics or concept boards. Accurate working drawings and/or assembly drawings provide the audience with technical details of the product. Both forms of communication are invaluable in presenting an impression of the final product.

What students need to evidence:

1 Design and development

There are a number of possible starting points to this section. The design brief(s)/need(s) may be given to students by the teacher or students may define their own.

Two possible types of brief that students may want to use are:

- a focused design brief for a specific need/want
- a 'blue sky' project resulting in concepts using future technologies.

A detailed design specification is not required. However, the design brief must contain a range of design criteria that their final design proposal must meet.

Students should consider the design problem set and produce a range of alternative design ideas that focus on the whole or parts of the problem.

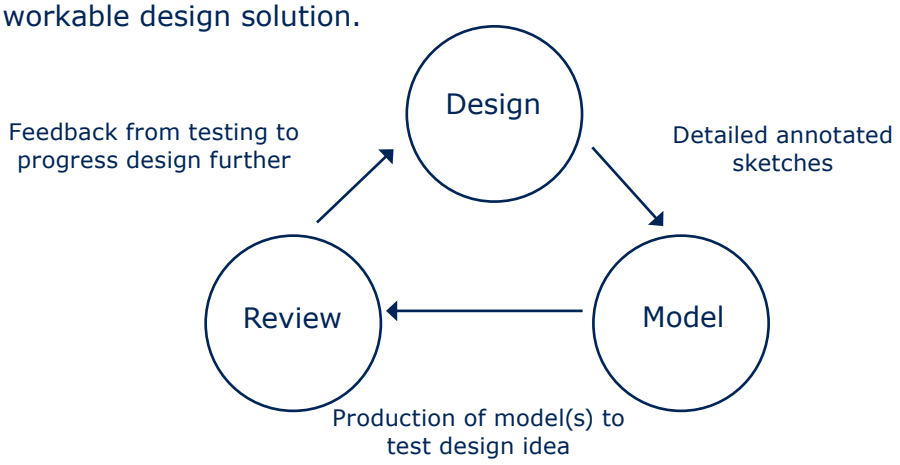
It is not necessary for students to produce a wide range of alternative ideas. It is better to produce high-quality focused work than lots of lower-quality work.

Students should explore different design approaches in their work, applying their knowledge of materials, components/ingredients, processes and techniques to produce realistic design proposals that satisfy the design brief(s)/need(s).

Students should evaluate each of their ideas objectively against the needs set out in their design brief(s)/need(s) to ensure that their designs are realistic and viable.

The use of detailed annotation is an important feature of design development and students should use it to explain details of design thinking and to offer thoughts on their design proposals.

To help students develop their design ideas, the following design development cycle could be useful. This is an important part of the design process and can be used to refine an initial idea into a workable design solution.



Modelling should be used to test features such as proportions, scale, function, sub-systems etc. Modelling can be achieved through the use of traditional materials or 2D and/or 3D computer simulations. Evidence of students' modelling can be presented using clear, well-annotated photographs.

2 Communicate

When presenting their design and development work, it is essential that students communicate their ideas effectively.

Through design and development work

Students should show evidence of 'design thinking' using any form of effective communication that they feel is appropriate. However, they should try to use a range of skills that may include freehand sketching in 2D and 3D, cut and paste techniques and the use of ICT. It is important to demonstrate a high degree of graphical skills, which will be shown through the accuracy and precision of their work.

When using ICT, students should ensure that it is used appropriately, rather than for show. For example, specialist CAD software to produce 3D rendered images is likely to be more appropriately used as part of development or final presentation, rather than for initial ideas.

Through presentation graphics and technical drawings

To effectively communicate final designs, a range of skills and drawing techniques should be demonstrated which could include:

- pictorial drawings — isometric, planometric (axonometric), oblique and perspective drawings to convey a 3D representation of the product
- working drawings — 1st or 3rd angle orthographic, exploded assembly and sectional drawings to convey technical information
- computer generated — pictorial and working drawings, renderings etc using specialist software.

Through the quality of written communication

Annotation should be used to explain design details and convey technical information. Students should make sure that the information is easily understood and presented logically.

Specialist technical vocabulary should be used consistently with precision.

1.5 Product manufacture

In this section, students will use their production planning skills and have the opportunity to develop their making skills through manufacturing **one or more** high quality product(s) to satisfy given design brief(s)/need(s). The design brief(s)/need(s) should contain requirements against which the final manufactured product(s) can be measured. Students will also test their practical outcome(s) to check their quality and performance.

Students should use **a range** of materials, techniques and processes when manufacturing **a range** of products in order to build and develop a variety of skills and lay a foundation for more complex and challenging work in the future.

The design brief(s)/need(s) should be set by the teacher to ensure a range of materials, techniques and processes used.

There are a number of potential starting points to product manufacture, including:

- being provided with a detailed working drawing and manufacturing specification
- accurate replication or detailed modelling of an existing product.

What students need to evidence:

1 Production plan

Students should produce a detailed production plan that explains the sequence of operations carried out during the manufacture of their product(s).

Students should produce a work order or schedule which could be done in the form of a flow chart or table. The work order should include the order of assembly of parts or components and tools, equipment and processes to be used during manufacture.

Students should identify quality control points, and quality checks should be described, this could be done as part of a flow diagram. Safety checks should also be part of the planning.

An important part of planning is the use of time, so students should make sure that they consider realistic timings and deadlines. Where Gantt or time charts are used, students must make sure that they are detailed, cover all aspects of product manufacture and include achievable deadlines.

Consideration should be given to the scale of production of their product(s). Although students may be making one-off products, most products would be batch or mass produced, so they should consider the consequences of these scales in their planning, developing their awareness of commercial production.

2 Making

Students should produce **one or more** high quality products that meet the requirements of the design brief(s)/need(s) they have been given. The design brief(s)/need(s) must contain requirements against which the final manufactured product(s) can be measured. It is important when setting design requirements, that they can be tested. Requirements may include dimensional parameters, finishes etc which are all objectively measurable requirements that can be tested for success.

Throughout their making activities, students should demonstrate their knowledge and understanding of a range of materials, techniques and processes by selecting and using those that are appropriate to the requirements of the task. Students should consider properties and working characteristics of materials and the processes used to manipulate them. Students should be able to justify their selections by giving reasons for their choices.

Students must work with a variety of materials, techniques and processes, in order to develop high quality skills by applying their knowledge and understanding of a range of materials, techniques and processes. It is likely that they will produce more than one practical outcome during this unit.

In order to achieve well in this assessment, students must show demanding and high-level making skills. Therefore, it is important that manufacturing tasks provide enough complexity and challenge to allow them to demonstrate their skill levels to the full. It is important to keep in mind, too, that the manufacturing tasks set in this unit should be designed to develop skills in students that they can call upon in their A2 coursework project. A single manufactured project that embodies a range of materials, processes and techniques that students can learn from, can be as valid as two or three shorter but equally demanding exercises. However, by setting different exercises, the use of a range of materials, processes and techniques can be assured.

Students will use a variety of skills and processes during their making activities, which may include computer aided manufacture (CAM). Where this is a feature of their work, they should make sure that there is plenty of opportunity within the tasks to demonstrate other skills and competencies that they have gained through their making activities. While the use of Computer Aided Manufacture is to be encouraged, students must not over-use CAM. It is acceptable for students to dedicate one manufacturing exercise to the use of CAM, in order to explore its capabilities, but they must offer evidence of other skills and techniques in accompanying manufacturing exercises. Where this approach is adopted, students must provide evidence of programming the CNC equipment. Where a mixture of CAM and other skills and techniques are used in a manufacturing exercise. CAM should not exceed 50% of the work.

Students should be aware of the risks involved in using specific tools equipment and processes throughout their making and should take appropriate precautions to minimise those risks.

As proof of the quality of students' making skills (and the level of demand of their work), photographs of their work must be evidenced to show that the product(s) is complete, expertly made, well finished etc. The photographs must show clearly any details of advanced skills, technical content, levels of difficulty and complexity of construction, so students can achieve the marks they deserve.

It is unlikely that a single photograph for each product will be enough to communicate all of the information required, so it will be better to take a series of photographs over a period of time during making. These should highlight the processes used and provide examples of precision and attention to detail that may not be otherwise noticed.

3 Testing

After making their product(s), students should carry out tests to check their fitness for purpose against the set design requirements.

Students' finished product(s) should be tested under realistic conditions to decide on their success, in order to check the performance and quality of the final product(s).

Students should describe in detail any testing carried out and justify this by stating what they are testing and why they are doing so.

Tests should be carried out objectively, and it would be beneficial to involve potential users so that students can receive reliable and unbiased third-party feedback.

Well-annotated photographic evidence is a very good tool to use when describing the testing process.

1.6 Assessment criteria

Assessment criteria		Level of response	Mark range
Product investigation	**A. Performance analysis (AO1)**	Fully justify key technical specification points that relate to form, function, user requirements, performance requirements, materials and/or component requirements, scale of production and costs. Compare and contrast one other existing similar product using the technical specification.	4-6
		Identify with some justification a range of realistic and relevant specification points that include reference to form, function and user requirements.	1-3
	B. Materials and components (AO1/AO2)	Suggest, with reference to quality and performance, alternative materials and/or components that could have been used in the product. Evaluate, using advantages and disadvantages, the selection of the materials and/or components used. Describe the impact on the environment of using the materials and/or components identified.	7-9
		Describe a range of useful properties that relate to the materials and/or components identified and justify their selection and use in the product. Identify alternative materials and/or components that could have been used in the product.	4-6
		Identify a material or component used in the product. Describe a useful property of that material or component and justify its use.	1-3
	C. Manufacture (AO2)	Evaluate, using advantages and disadvantages, the selection of the manufacturing processes used in the product. Suggest one alternative method of production that could have been used in the manufacture of the product. Describe the impact on the environment of using the processes identified in the production of the product.	7-9
		Describe a range of processes used in the manufacture of the product and fully justify their use for the level of production of the product.	4-6
		Identify, describe and justify the use of a manufacturing process used in the construction of the product.	1-3
	D. Quality (AO2)	Describe a range of quality control checks used during the manufacture of the product and explain how the main relevant standards influenced the manufacture of the product. Describe a quality assurance (QA) system for the product.	4-6
		Identify, describe and justify the use of one quality control check during the manufacture of the product.	1-3

Assessment criteria		Level of response	Mark range
Product design	**E. Design and development (AO1/AO2)**	Present alternative ideas that are workable, realistic and detailed and which fully address the design criteria. Ideas demonstrate detailed understanding of materials, processes and techniques. Produce a final design proposal that is significantly different and improved compared to any previous alternative design ideas. The design proposal includes technical details of materials and components, processes and techniques. Modelling through the use of traditional materials or 2D and/or 3D computer simulations is used to test important aspects of the final design proposal. The final design proposal is evaluated objectively against the design criteria in order to fully justify the design decisions taken.	13-18
		Present realistic alternative design ideas. Ideas are detailed and address most design criteria. Developments are appropriate and use details from ideas to change, refine and improve the final design proposal. A final detailed design proposal is presented. Modelling is used to test some aspects of the final proposal against relevant design criteria. Evaluative comments objectively consider some aspects of the design brief/need.	7-12
		Present simplistic alternative design ideas. Ideas are superficial and address limited design criteria. Developments are minor and cosmetic. A basic final design proposal is presented. Basic modelling is used to test an aspect of the design proposal. Evaluative comments are subjective and superficial.	1-6
	F. Communicate (AO1/AO2)	Use a range of communication techniques and media including ICT and CAD, with precision and accuracy to convey enough detailed and comprehensive information to enable third-party manufacture of the final design proposal. Annotation provides explanation and most technical details of materials and processes with justification.	9-12
		Use a range of communication techniques, including ICT, that are carried out with sufficient skill to convey an understanding of design and develop intentions and construction details of the final design proposal. Annotation provides explanation and most technical details of materials and process selection.	5-8
		Use a limited range of communication techniques carried out with enough skill to convey some understanding of design and develop intentions. Annotation provides limited technical details of materials and processes.	1-4

Assessment criteria		Level of response	Mark range
Product manufacture	**G. Production plan (AO2)**	Produce a detailed production plan that considers stages of production in the correct sequence, realistic time scales and deadlines for the scale of production.	4-6
		Produce a limited production plan that considers the main stages of manufacture, reference to time and scale of production.	1-3
	H. Making (AO2)	Demonstrate a detailed understanding and justified selection of a range of appropriate materials and processes. Demonstrate demanding and high quality making skills and techniques. Show accuracy and precision when working with a variety of materials, processes and techniques. High-level safety awareness is evident throughout all aspects of manufacture.	13-18
		Demonstrate a good understanding and selection of an appropriate range of materials and processes. Demonstrate competent making skills and techniques appropriate to a variety of materials and processes. Show attention to detail and some precision. Demonstrate an awareness of safe working practices for most specific skills and processes.	7-12
		Demonstrate a limited understanding and selection of a narrow range of materials and processes. Use limited making skills and techniques. Demonstrate little attention to detail. Demonstrate an awareness of specific safe working practices during product manufacture.	1-6
	I. Testing (AO2)	Describe and justify a range of tests carried out to check the performance or quality of the product(s). Relevant, measurable points of the design brief(s)/need(s) are objectively referenced. Third-party testing is used.	4-6
		Carry out one or more simple tests to check the performance or quality of the final product(s). Some points of the design brief(s)/need(s) are referenced superficially. Test results are recorded and are subjective.	1-3
		TOTAL NUMBER OF MARKS AVAILABLE	**90**

1.7 Administration

1 Internal standardisation	Teachers must show clearly how the marks have been awarded in relation to the assessment criteria. If more than one teacher in a centre is marking students' work, there must be a process of internal standardisation to ensure that there is consistent application of the assessment criteria.
2 Authentication	All candidates must sign an authentication statement. Statements relating to work not sampled should be held securely in your centre. Those which relate to sampled candidates must be attached to the work and sent to the moderator. In accordance with a revision to the current Code of Practice, any candidate unable to provide an authentication statement will receive zero credit for the component. Where credit has been awarded by a centre-assessor to sampled work without an accompanying authentication statement, the moderator will inform Edexcel and the mark will be adjusted to zero.
3 Further information	For more information on annotation, authentication, mark submission, moderation procedures and electronic portfolios, please refer to the *Edexcel Information Manual* document, which is available on the Edexcel website. For up-to-date advice on teacher involvement, malpractice and plagiarism, please refer to the latest *Joint Council for Qualifications (JCQ) Instructions for Conducting Coursework* document. This document is available on the JCQ website: www.jcq.org.uk. For additional information on malpractice, please refer to the latest *Joint Council for Qualifications (JCQ) Suspected Malpractice in Examinations and Assessments: Policies and Procedures* document, available on the JCQ website.

Unit 2 Design and Technology in Practice (Graphic Products)

AS compulsory unit — Externally assessed

2.1 Unit description

In this unit, students will develop a knowledge and understanding of a wide range of materials and processes used in the field of design and technology.

It is important for students, as designers, to learn about materials and processes so that they can develop a greater understanding of how products can be designed and manufactured.

Students will also learn about industrial and commercial practices and the importance of quality checks and the health and safety issues that have to be considered at all times.

The knowledge and understanding students develop in this unit can be easily applied to their *Unit 1: Portfolio of Creative Skills*.

The unit content is divided into four sections, with each section outlining the specific knowledge and understanding required by the student. Specific materials and processes are named and these are the only examples with which students need to be familiar for this examination.

2.2 Assessment information

The assessment of this unit is through a 1 hour 30 minute examination paper set and marked by Edexcel.

The paper will be a question and answer booklet and all questions in the paper are compulsory.

The paper will consist of short-answer and extended-writing type questions.

The total number of marks for the paper is 70.

2.3 Materials and components

What students need to learn:

1 Materials

a) Paper and board

(i) Processes and advantages/disadvantages of producing wood pulp by the following methods:

- mechanical
- chemical
- waste pulp.

(ii) The process of manufacturing paper and card using the fourdrinier process.

(iii) Aesthetic, functional and mechanical properties, application and advantages/disadvantages of the following common paper, card and board for commercial and everyday use:

- drawing papers
  - layout
  - tracing
  - copier
  - cartridge
- commercial printing papers
  - bond
  - coated
- commercial card and board
  - mounting board
  - recycled.

(iv) Aesthetic, functional and mechanical properties, structural composition, application and advantages/disadvantages of the following carton boards in the production of commercial packaging:

- folding boxboard
- corrugated board
- solid white board
- foil-lined board.

b) Metals

Aesthetic, functional and mechanical properties, application and advantages/disadvantages of the following metals for graphic products and commercial packaging:

- ferrous
  - steel
- non-ferrous
  - aluminium
  - tin
- alloys
  - stainless steel
  - duralumin.

c) Polymers

Aesthetic, functional and mechanical properties, application and advantages/disadvantages of the following thermoplastics in the production of graphic products and commercial packaging:

- polythene
- polyethylene
  - high density polyethylene (HDPE)
  - low density polyethylene (LDPE)
  - polyethylene terephthalate (PET)
- polyvinyl chloride (PVC)
- polypropylene (PP)
- polystyrene (PS), rigid (high density polystyrene) and expanded
- styrofoam™ for block modelling
- acrylic.

d) Woods

Aesthetic, functional and mechanical properties, application and advantages/disadvantages of the following woods for the creation of models and prototypes:

- hardwoods
  - jelutong
  - balsa
- softwood
  - pine.

e) Composites

Aesthetic, functional and mechanical properties, structural composition, application and advantages/disadvantages of the following composite used by the graphics industry:

- carbon fibre
- glass reinforced plastics (GRP)
- medium density fibreboard (MDF).

f) Modern materials and products

Structural composition, application and advantages/disadvantages of the following modern materials and products used by the graphics industry:

- liquid crystal displays (LCDs)
- phosphorescent pigments
- electroluminescent (EL) lighting.

g) Smart materials

Structural composition, application and advantages/disadvantages of the following smart materials used by the graphics industry:

- thermochromic liquid crystals/film
- piezoelectric crystals
- smart ink
- radio frequency identification (RFID).

2	**Components**	Processes, application and advantages/disadvantages of the following binding methods in relation to both paper and board: ■ saddle-wire stitching ■ side-wire stitching ■ perfect binding ■ hard-bound or case-bound ■ spiral or comb binding.

2.4 Industrial and commercial practice

What students need to learn:

1	**Scale of production**	Characteristics, application and advantages/disadvantages of the following scales of production in the manufacture of products: ■ one-off ■ batch, including short-term print runs ■ mass ■ continuous.
2	**Graphical communication**	Application, demonstration and advantages/disadvantages of the following graphical-drawing techniques: ■ pictorial drawing methods for representing 3D forms ◆ isometric ◆ 2-point perspective ◆ planometric (axonometric) ■ working drawings for communicating 2D technical information ◆ 3rd angle orthographic projection to BSI standards ◆ nets (developments) ■ translation from working drawings to pictorial drawings and vice versa ■ translation from pictorial drawings to nets (developments) and vice versa.

3	**Computer-generated graphics**	The application, advantages/disadvantages of computer-generated graphics in the design and production of graphic products: ■ use of desktop publishing (DTP) to create and modify designs and layouts for printed materials ■ process of 2D image creation and manipulation.
4	**Modelling and prototyping**	Processes, application and advantages/disadvantages of the following 2D/3D models and prototype to aid the development of graphic products: ■ block modelling ■ rapid prototyping using CAD/CAM ■ computer modelling for creating photo realistic images and 'virtual' products using wire frame, surface modelling and solid modelling.
5	**Joining techniques**	Preparation, application and advantages/disadvantages of using the following adhesives for joining like and unlike materials: ■ contact adhesive ■ acrylic cement ■ polystyrene cement ■ epoxy resin ■ polyvinyl acetate (PVA).
6	**Industrial and commercial processes**	Production and advantages/disadvantages of the following processes for creating structural packaging nets for containing, protecting, dispensing and advertising products: ■ designing and creating nets using hand-drawn and CAD methods ■ commercial automated production of packaging nets using die-cutting, folding, scoring and spot gluing.

7 Forming techniques	Characteristics, preparation, processes, application and advantages/disadvantages of the following methods for the batch and mass production of graphic products and components: ■ blow moulding ■ injection moulding ■ vacuum forming.
8 Finishing processes	Processes, application and advantages/disadvantages of applying the following finishes to improve the performance, quality and provide enhanced aesthetic and/or functional properties: ■ enhancing the format of paper and board ◆ laminating ◆ encapsulation ◆ varnishing ◆ hot foil blocking ◆ embossing ■ surface decoration for signage using CAD/CAM, production of lettering and decals using: ◆ laser cutting and engraving ◆ vinyl cutting.
9 Printing processes	Processes, application and advantages/disadvantages of the following commercial printing methods to create graphic products: ■ offset lithography ■ flexography ■ screen-printing ■ gravure.

2.5 Quality

What students need to learn:

1	**Quality assurance systems and quality control in production**	Concept, characteristics, application and advantages of the following when designing and manufacturing graphic products and commercial packaging: ■ quality assurance (QA) systems for monitoring the quality of a product from its design and development stage, through its manufacture, to its end-use performance and degree of customer satisfaction ■ quality control (QC) as part of the achievement of QA concerning the monitoring and achieving of high standards and degree of tolerance by inspection and testing, including computer aided inspection ■ total quality management (TQM) when applying quality assurance procedures at every stage of the production process (ISO 9000 series) ■ quality control during a final print run, using printer's marks: ◆ colour bars for colour consistency/density ◆ registration marks for aligning printing plates ◆ crop marks for cutting/trimming guides ◆ greyscale for monochrome consistency.
2	**Quality standards**	Process of testing products, components and materials against external quality standards set by the following organisations: ■ British (BSI and relevant kitemarks) ■ European (CEN and CE) ■ International (ISO).

2.6 Health and safety

What students need to learn:

1 Health and Safety at Work Act (1974)

The principles and application of the Health and Safety at Work Act (1974) when designing and manufacturing graphic products and commercial packaging:

- procedures to safeguard the risk of injury to people:
  - personal and protective equipment (PPE)
  - signage
  - warning symbols
- carrying out risk assessments in accordance with the Health and Safety Executive (HSE) for the design of graphic products using computers and manufacture of models and prototypes using workshop practices:
  - identify potential hazards
  - identify people at risk
  - evaluate the risks
  - decide upon control measures
  - record assessment
- Control of Substances Hazardous to Health (COSHH) regulations:
  - risk assessment to control the storage and use of solvent-based substances containing volatile organic compounds (VOCs).

Unit 3 Designing for the Future (Graphic Products)

A2 compulsory unit — Externally assessed

3.1 Unit description

In this unit, students will develop their knowledge and understanding of a range of modern design and manufacturing practices and contemporary design issues. The modern designer must have a good working knowledge of the use of ICT and systems and control technology in the design and manufacture of products. They must also be aware of the important contributions of designers from the past which may provide inspiration for future design.

It is increasingly important that students develop an awareness of the impact of design and technological activities upon the environment. Sustainable product design is a key feature of modern design practices.

The unit content is divided into four sections, with each section outlining the specific knowledge and understanding required by the student. Specific examples are given and these are the only ones with which students need to be familiar for this examination.

3.2 Assessment information

The assessment of this unit is through a 2-hour examination paper set and marked by Edexcel.

The paper will be a question and answer booklet and all questions in the paper are compulsory.

The paper will consist of short-answer and extended-writing type questions.

The total number of marks for the paper is 70.

3.3 Industrial and commercial practice

What students need to learn:

1 Information and communication technology (ICT)

Characteristics, processes, application, advantages/disadvantages of ICT in the design, development, marketing and sales of graphic products in the global marketplace:

- electronic communications between designers, manufacturers, retailers and consumers using:
  - email
  - Electronic Data Interchange (EDI)
  - Integrated Services Digital Network (ISDN) and broadband
  - video conferencing
- computer aided design (CAD) in the development of products involving:
  - creative and technical design
  - virtual modelling and testing
  - rapid prototyping (RPT)
- marketing, distribution and retailing of products using:
  - electronic point of sale (EPOS)
  - internet marketing and sales.

2 Digital special effects

Process and application of the following digital special effects used in film-making:

- blue/green screen
- computer-generated images (CGI).

3 Biotechnology

Characteristics, advantages/disadvantages and the impact on the environment of the following genetic engineering techniques when manufacturing paper and board:

- altering genes in woods to provide quicker-growing trees, or to supply wood that resists wear, rot or infestation
- reduction of lignin to reduce environmental impact of the paper industry.

The sources, manufacture, application and advantages/disadvantages of the following biodegradable polymer:

- Biopol®.

3.4 Systems and control

What students need to learn:

1	**Manufacturing systems**	Characteristics, processes, application and advantages/disadvantages of advanced manufacturing technology (AMT) which enable quick response manufacturing (QRM), including: ■ concurrent manufacturing ■ flexible manufacturing systems (FMS).
2	**Computer integrated manufacture (CIM)**	Characteristics, processes, application, advantages/disadvantages and its impact on employment of CIM systems to integrate the processing of production and business information with manufacturing operations, including: ■ data integration involving product data management (PDM) and enterprise resource planning (ERP) systems ■ lean manufacturing using just-in-time (JIT) systems ■ computer-aided manufacture (CAM) involving CNC equipment and computer-aided quality (CAQ) in flexible manufacturing cells ■ materials handling systems including automated storage and retrieval systems (ASRS) and automatic guided vehicles (AGVs).
3	**Robotics and Artificial Intelligence (AI)**	Application, advantages/disadvantages and its impact on employment of complex automated systems, including: ■ robots on fully automated production and assembly lines/cells ■ development of artificial intelligence (AI) for industrial applications.
4	**Flow charts**	Application of flow charts to represent open and closed loop systems for quality control of production processes.

3.5 Design in context

What students need to learn:

1	**The effects of technological changes on society**	The impact and advantages/disadvantages of the following technological changes on society, in relation to the graphics industry and graphic products. ■ Mass production: ◆ consumer society including built-in obsolescence ◆ employment. ■ The 'new' industrial age of high-technology production: ◆ computers in the development and manufacture of products ◆ miniaturisation of products and components ◆ use of smart materials and products for innovative applications. ■ The global marketplace: ◆ multinational companies in developed countries manufacturing 'offshore' in developing countries ◆ local and global production.
2	**Influences of design history on the development of products**	**Influences of design history on the development of products** Characteristics in terms of design styles, philosophy and influences on design culture of the following designers and design movements: ■ William Morris and the Arts and Crafts movement ■ Charles Rennie Mackintosh and the Art Nouveau movement ■ Marcel Breuer and the Bauhaus modernist movement ■ Eileen Gray and the Art Deco movement ■ Raymond Loewy and streamlining ■ Philippe Starck and the New Design style (post-modernism).
3	**Form and function**	The debate regarding 'form versus function' including the following two opposing views when designing products: ■ form follows function (functionality as prime driver) ■ form over function (aesthetics as prime driver).

4	**Anthropometrics and ergonomics**	The principles and application of anthropometrics data and ergonomics: ■ key ergonomic factors for a designer to consider when developing products, equipment and environments with human interaction ■ sources and applications of anthropometric data.

3.6 Sustainability

What students need to learn:

1	**Life cycle assessment (LCA)**	Application of LCA to assess the impact of a product 'from the cradle to the grave' using a life cycle inventory of: ■ environmental inputs and outputs of raw materials, energy resources and emissions ■ economic inputs and outputs of products, components or energy that are outputs from other processes.

2 Cleaner design and technology

Application of 'cleaner' design and technology throughout each of the stages of a product's life cycle in relation to the following sustainable development issues:

- design
  - for reducing environmental impact
  - for recycling
- raw materials
  - reduction or recycable
  - reduce environmental impact
- manufacture
  - minimising waste and energy use
  - simplifying processes
  - efficient use of natural resources
- distribution
  - reduce or lighten packaging
  - reduce mileage of transportation to the customer
  - alternatives to fossil fuels
- use
  - repair versus replacement.

3 Minimising waste production

The principles and application of minimising waste production throughout the product life cycle using the following 'four R's':

- reduce
- reuse
- recover
- recycle.

4 Renewable and non-renewable sources of energy	Characteristics, comparisons, applications and advantages/ disadvantages of using the following renewable and non renewable sources of energy: ■ wind ■ water ■ solar ■ biomass and biofuels ■ nuclear ■ fossil fuels.
5 Responsibilities of developed countries	The responsibilities of 'developed' countries in relation to social, economic and environmental issues for global sustainable development. ■ Impact of industrialisation on global warming and climate change. ◆ United Nations Framework Convention on Climate Change (UNFCCC) including Kyoto Protocol. ◆ Reduction of an individual's 'carbon footprint' by reducing carbon dioxide emissions and carbon offsetting ◆ Non-Fossil Fuel Obligations (NFFO) in the UK. ■ Timber production and sustainable forest management.

Unit 4 Commercial Design (Graphic Products)

A2 compulsory unit

Internally assessed

4.1 Unit description

In this unit, students are given the opportunity to apply the skills they have acquired and developed throughout this course of study, and to design and make a product of their choice that complies with the requirements of a graphics project.

Graphic products has two clearly defined pathways, either 'conceptual design' or 'the built environment'.

1) **Conceptual design** incorporates a wide range of 3D products with associated graphics, for example:
   - packaging design
   - product/industrial design
   - point of sale display
   - vehicle design.

Conceptual design projects must contain a 2D and 3D element. A range of modelling materials, including resistant materials, can be used, for example styrofoam™ or MDF block modelling for concept models.

2) **Built environment** projects focus on the humankind surroundings that provide the setting for human activity, for example:
   - architecture
   - interior design
   - exhibition design
   - theatre sets
   - garden design.

Built environment projects must contain a 2D and 3D element. However, the main emphasis must be on the 3D element with the 2D element focusing on presentation graphics and technical drawings.

A range of modelling materials, including resistant materials (not a compulsory requirement), can be used, for example the use of foam board, polymers and wood for architectural modelling.

In this unit, students are encouraged to be creative and adventurous in their work. There are no limits to project selection beyond the time and resources available and the appropriateness of selection in matching individual students' potential. Students are expected to take ownership of all aspects of their work in this unit, in order to allow them total control of their responses and to target assessment criteria effectively, and to maximise their achievements.

In order to reach high attainment levels, students must adopt a commercial design approach to their work, reflecting how a professional designer might deal with a design problem and its resolution.

The choice of design problem should have a real commercial use, in that it should be useful to a wider range of users beyond an individual, unless it has been specifically commissioned as a 'one-off'. The design problem should provide opportunities for a client or user-group to have input into decision making at various stages of the design and make process.

A client or user-group is defined as any third party identified by a student, that is referred to and which can give informed critical feedback at various stages throughout the design process. Clients and user-groups do not need to be specialists or experts; they can be drawn from any relevant group of people and may include other students, friends or family members.

A key feature of this unit is for students to consider issues related to sustainability and the impact their product may have on the environment. A student may choose to design and make a sustainable product, but if they do not, they should still consider the issues of sustainability at relevant points in their designing and making activities. Sustainable issues could include materials production and selection, manufacturing processes, use of the product and its disposal/recycling.

4.2 Assessment information

1 Design and make process

- Students identify a client/user-group from which they must design and make a product that meets the original design problem. They should liaise with their client/user-group at various stages of their designing and making process in order to develop a commercial product.
- Students should be familiar with a range of industrial applications and commercial working practices in order to fulfil the requirements of this unit.
- This unit results in the development of a manufactured product supported by a design folder. The folder, which should include ICT-generated images where appropriate, should be submitted on A3 paper only and is likely to be no more than 30 pages long.
- It is important that all stages of the manufacturing process are photographed in order to evidence that the product is complete, expertly made, well finished etc. It is unlikely that a single photograph will be enough to communicate all of the information required. Students must ensure that a series of photographs over a period of time is taken during making to show clearly any details of advanced skills, technical content, levels of difficulty and complexity of construction. This will allow students to achieve the marks they deserve.

2 Task setting guidance

Although there is a free choice of product, students must ensure that:

- time and resources available are considered
- they can fully demonstrate their capabilities in each of the assessment criteria, so that they maximise their potential achievements
- the choice of design problem has a commercial use and should allow designing for a client or user-group who should have input into decision making at various stages in the design and make process
- issues related to sustainability are considered at relevant points in their designing and making activities and the impact their product may have on the environment. Sustainable issues could include materials production and selection, manufacturing processes, use of the product and its disposal/recycling
- their product complies with the requirements of a graphic products, which is defined as two clearly defined pathways, either 'conceptual design' or 'the built environment'.

  1) Conceptual design incorporates a wide range of 3D products with associated graphics, for example:

  - packaging design
  - product/industrial design
  - point of sale display
  - vehicle design.

  Conceptual design projects must contain a 2D and 3D element. A range of modelling materials including resistant materials can be used, for example styrofoam™ or MDF block modelling for concept models.

2) **Built environment** projects focus on the humankind surroundings that provide the setting for human activity, for example:

- architecture
- interior design
- exhibition design
- theatre sets
- garden design.

Built environment projects must contain a 2D and 3D element. However, the main emphasis must be on the 3D element with the 2D element focusing on presentation graphics and technical drawings.

A range of modelling materials including resistant materials (not a compulsory requirement) can be used, for example the use of foam board, polymers and wood for architectural modelling.

3 Assessment guidance

- This unit is internally set and marked by the centre using the assessment criteria in Section 4.4 and externally moderated by Edexcel.
- The maximum number of marks available is 90.
- It is important that all stages of the manufacturing process are photographed in order to evidence that the product is complete, expertly made, well finished etc. Students must ensure that photographs show clearly any details of advanced skills, technical content, levels of difficulty and complexity of construction, so that they can achieve the marks they deserve.
- It is unlikely that a single photograph will be enough to communicate all of the information required, so it will be better to take a series of photographs over a period of time during making.
- This unit results in the development of an appropriate product supported by a design folder. The folder, which should include ICT-generated images where appropriate, should be submitted on A3 paper only and is likely to be no more than 30 pages long.

- Students can submit their work electronically for moderation. Please refer to the Edexcel *Information Manual* document, which is available on the Edexcel website www.edexcel.com, for further detail.

4.3 Product design and make

What students need to evidence:

1 Research and analysis

Once the student has identified an appropriate need and written a detailed design brief, they must analyse the need in order to focus on the research needed to help the work progress. Students should use a range of research strategies to gather useful and relevant information that will help with their designing and making activities.

When gathering information, it is important that students are clear about what they need to find out. Research should be highly selective ensuring that the information gathered is useful and relevant to the client/user-group's needs identified and finalised during analysis. Research should be focused and succinct and contain no worthless padding. Students should avoid downloading large amounts of information from the internet, or cutting and pasting from catalogues and databases without providing detailed annotation to explain the selected information.

A good starting point for research and analysis could include an interview or discussion with the client/user-group to establish their thoughts and preferences regarding the proposed product. This information should be used to guide their analysis and research activities. In the analysis, students should ensure that they focus closely on the identified need, avoiding any general statements that are of no use and could be applied to any design situation.

Research could include the analysis of existing similar products, to find out about materials, processes and construction methods used in commercial manufacture. Market research will allow students to test the viability of their intended product beyond the needs of the client/user-group. Surveys or questionnaires should be designed carefully, avoiding questions that are general and useless in helping with the design process. A questionnaire should not be included simply for the sake of doing so; its use and questions asked within it should be justified.

When researching into materials and/or components and processes, students should take into consideration the concept of 'sustainability' so that they are able to make responsible and informed decisions about the impact of materials and resources upon the environment. When all information gathering has been completed, students should analyse their research in order to help write a product specification that is relevant, meaningful and measurable.

2 Product specification

It is important that students develop and write a detailed specification, as it will be used throughout the design process to reference ideas and their development and to check that the design requirements and client/user-group needs are being matched. The specification should be used as a basis for testing and evaluating the completed product and any future modifications suggested should be referenced to specification criteria in order to check the success of the final product.

The starting point for a successful specification should be after the research and when essential requirements have been established as a result of studying the information gathered. Students should consult with their client/user-group to agree the specification points and to ensure that the criteria meet the needs identified earlier. When specifying materials and/or components and processes, students should consider sustainability, and make decisions based on the environmental costs of extracting and processing the selected materials, the product manufacture, lifespan and disposal.

When writing a specification, students should try to avoid a rambling collection of points. The specification should be informed by the research findings. An effective specification is organised logically and could be achieved by using sub-headings such as purpose, form, function, user requirements, performance requirements, materials/components, size, safety and quality, scale of production and cost. Each specification point should contain more than a single piece of information, so that each statement is fully justified by giving a reason for the initial point. For example, it is not sufficient to say 'the material used is polystyrene', as this is not justified until 'because it is tough and can be injection moulded' is added.

Specification points should be technical and measurable where possible, so that testing and evaluation can be realistic. It is extremely important that specification points are not superficial or general.

3 Design and development

a) Design

In this section, students have the opportunity to apply their design skills and the advanced knowledge of materials and/or components, processes and techniques developed through their experience of AS units to produce alternative designs that address client/user-group needs as identified in the specification.

Students should produce alternative design ideas that are realistic, workable, and which address the needs identified in the specification. Designs should be annotated and include as much detail as possible of materials and/or components, processes and techniques that could be used to construct the design idea.

It is often, but not always, necessary for students to produce complete solutions when considering alternative design ideas. It is better to focus on fewer and more detailed high quality designs than to try to produce more work of a lower quality. As work progresses, alternative design proposals and their details should become linked and continuity of ideas should be seen as one idea moves to the next to be improved upon.

b) Review

As an important part of their designing, students should review and objectively evaluate their design ideas as they are produced. The comments made in reviewing design ideas should be based on objective, formative evaluation of each idea and should always be referenced to the specification and to check the idea's potential in fulfilling the client/user-group's need.

Students should use 'tick-boxes' with care when reviewing design ideas, as this is always subjective and worthless in evaluating ideas against a specification effectively. Yes/no answers do not allow any useful decisions to be made when deciding whether specification points have been met.

As part of reviewing, design ideas should be discussed with the client/user-group to ensure, through feedback, their suitability for their intended purpose. Information should be communicated through logical and well-organised statements, using specialist technical vocabulary. In addition, students should consider and justify some of their design decisions with reference to sustainability.

c) Develop

In this section, students will develop a final design proposal in consultation with their client/user-group. Development of the final design proposal will give students the opportunity to bring together the best and most appropriate features of their initial design ideas into a refined final design proposal that meets all of the requirements of the product specification and matches the client/user-group needs.

Students must show the development of their design, demonstrating how it has changed and moved on from initial ideas, using the results of review/evaluation and client feedback. It is not good practice to simply take an initial idea, make superficial or cosmetic changes, and then present it as a final developed proposal.

Students should include as much detailed information on all aspects of the developed design as possible, including technical details of materials and/or components and their selection, processes and techniques. This is an opportunity to demonstrate an advanced knowledge and understanding of design and make activities.

Modelling should be used to test features such as proportions, scale, function, sub-systems etc. Modelling can be achieved through the use of traditional materials, or 2D and/or 3D computer simulations. Evidence of modelling should be presented through clear, well-annotated photographs. Consultation with the client/user-group should be evidenced in order to justify and clarify final design details.

d) Communicate

When presenting design and development work, it is essential that ideas are communicated effectively:

Through design and development work

Students should show evidence of 'design thinking' using any form of effective communication that they feel is appropriate. However, they should try to use a range of skills that may include freehand sketching in 2D and 3D, cut and paste techniques and the use of ICT. It is important to demonstrate a high degree of graphical skill, which will be shown through the accuracy and precision of their work.

When using ICT, students should ensure that it is used appropriately, rather than for show. For example, specialist CAD software to produce 3D rendered images is likely to be more appropriately used as part of development or final presentation, rather than for initial ideas.

Through presentation graphics and technical drawings

To effectively communicate final designs, a range of skills and drawing techniques should be demonstrated which could include:

- pictorial drawings — isometric, planometric (axonometric), oblique and perspective drawings to convey a 3D representation of the product
- working drawings — 1st or 3rd angle orthographic, exploded assembly and sectional drawings to convey technical information
- computer generated — pictorial and working drawings, renderings etc using specialist software.

Through the quality of written communication

Annotation should be used to explain design details and convey technical information. Students should make sure that the information is easily understood and presented logically.

Specialist technical vocabulary should be used consistently with precision.

Information presented in this section should enable a student's design thinking and manufacturing intentions to be clearly understood by others and allow third-party manufacture of the final design proposal.

4 Planning

In this section, students will produce a detailed production plan that explains the sequence of operations carried out during the manufacture of their product under the appropriate commercial conditions and which focuses closely on the identified scale of production.

Students should produce a work order or schedule to illustrate the sequence of operations used during manufacturing. This could be evidenced in the form of a flow chart or table. The work order should include the order of assembly of parts and components, tools, equipment and processes to be used during manufacture in volume higher than 'one-off' production unless the designed product is specifically a one-off item.

An important part of planning is the use of time, so students must ensure that they consider realistic timescales and deadlines. Where Gantt or time charts are used, students must ensure that they are detailed, cover all aspects of manufacture and include achievable deadlines.

Students should identify quality control points and quality checks should be described. This could be done as part of a flow diagram. Safety checks should also be included as part of planning.

5 Making

a) Use of tools and equipment

Students should demonstrate their ability to use tools and equipment with high levels of skill and accuracy and to select appropriate tools and equipment for specific purposes. It is important that students use a range of tools and equipment to allow them to fully demonstrate their skills.

Where Computer Aided Manufacture (CAM) is a feature of a student's work, they should make sure that there is plenty of opportunity within the product's manufacture to demonstrate other skills and competencies that they have acquired. The over-use of CAM should be avoided.

Students should work safely and be fully aware of the risks involved when using tools and equipment and the precautions that should be taken to minimise those risks.

b) Quality

During manufacturing activities, students should demonstrate their understanding of a range of materials and their working properties. Students should select and justify the use of materials that are appropriate to the needs of the product and match the requirements of the product specification. When selecting materials, students should be able to justify their choice by referring to material properties and suitability for their intended use. The selection and use of appropriate processes and techniques should enable students to produce a high quality final product that fully matches the final design proposal in all respects.

It is important that all stages of the manufacturing process are photographed in order to evidence that the product is complete, expertly made, well finished, fully functioning etc. Students must ensure that photographs show clearly any details of advanced skills, technical content, levels of difficulty and complexity of construction, so that they can achieve the marks they deserve.

It is unlikely that a single photograph will be enough to communicate all of the information required, so it will be better to take a series of photographs over a period of time during making.

c) Complexity/level of demand

Students must demonstrate demanding and high-level making skills in order to achieve high marks. Therefore, it is very important that the manufacture of the product offers enough complexity and challenge in order to gain the maximum credit possible.

The level of complexity of the intended product will already have been established through the finalisation of the design proposal, so it is important that students consider this at an early stage to maximise their potential when manufacturing the product.

Students should try to set challenges and demands appropriate to their skill levels and beyond, so that they do not work within their 'comfort zone' and fail to achieve what they are capable of.

Students should avoid producing simplistic and undemanding work that, however well it is manufactured using appropriate tools, equipment and processes, is unchallenging. This approach cannot result in high levels of credit.

6 Testing and evaluating

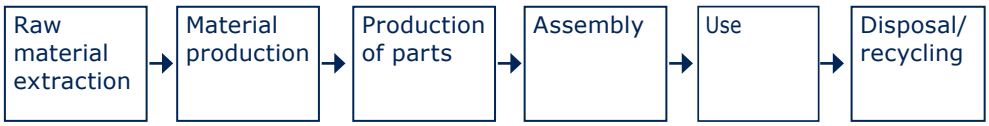
When students have completed the manufacture of their product, they should carry out tests to check its fitness for purpose with reference to commercial techniques where possible.

The finished product should be tested under realistic conditions to decide on its success using the points of specification to check the product's performance and quality. Students should describe in detail any tests they carry out and justify them by stating what is being tested and why. Tests should be objective and carried out by the client/user-group. Involving other potential users would be a reliable way of gathering unbiased and reliable third-party feedback.

Well-annotated photographic evidence is a good tool to use when describing testing. Students should use the results of their testing and views of the client/user-group to help evaluate the final product.

The evaluation should relate to the measurable points of the product specification and should be as objective as possible. Students should use the information from their testing, evaluation and client/user-group feedback to make suggestions for possible modifications and future improvements to the product. Suggestions for modifications should focus on improving the performance of the product, or its quality.

Students should check the sustainability of their final product by carrying out a life cycle assessment (LCA), in order to assess its impact on the environment. Students could use a flow chart similar to the one shown below as a starting point for the LCA of the product and expand upon it.



4.4 Assessment criteria

Assessment criteria		Level of response	Mark range
A. Research and analysis (AO1)		Analysis is detailed with most design needs clarified. Research is selective and focuses on the needs identified in the analysis.	3-4
		Analysis is limited with some design needs clarified. Research is superficial and does not focus on the needs identified in the analysis.	1-2
B. Product specification (AO1)		Specification points are realistic, technical and measurable. Specification fully justifies points developed from research in consultation with a client/user-group. Sustainability of resources is realistically considered and relevant when developing specification points.	4-6
		Specification points are realistic but not measurable. Some specification points are developed from research in limited consultation with a client/user-group, but are not justified. Sustainability of resources is considered superficially when developing specification points.	1-3
C. Design and development	**Design (AO1/AO2)**	Present alternative ideas that are realistic, workable and detailed. Ideas demonstrate detailed understanding of materials, processes and techniques supported by research information. Ideas address all specification points. Client/user-group feedback shown.	7-10
		Present alternative design ideas that are realistic and workable. Ideas are detailed and use relevant research. Ideas address most specification points.	4-6
		Present alternative design ideas that are similar and simplistic. Ideas are similar and use limited research. Limited specification points are addressed.	1-3
	Review (AO1)	Present objective evaluative comments against most specification points that consider client/user-group feedback. Evaluative comments include realistic issues of sustainability relating to design and resources.	3-4
		Present general and subjective comments against some specification points. An aspect of sustainability is evaluated superficially.	1-2

Assessment criteria		Level of response	Mark range
C. Design and development *(cont.)*	**Develop (AO1/AO2)**	Development is used to produce a final design proposal that is significantly different and improved compared to any previous alternative design ideas. A final design proposal is presented that includes technical details of materials and/or components, processes and techniques. Modelling to scale using traditional materials or 2D and/or 3D computer simulations is used to test important aspects of the final design proposal against relevant design criteria. Client/user-group feedback is used for final modifications.	7-10
		Developments are appropriate and use details from alternative design ideas to change, refine and improve the final design proposal. A final design proposal is presented that includes some details of materials, and/or components, processes and techniques. Modelling using traditional materials is used to test some aspects of the final design proposal against relevant design criteria.	4-6
		Developments from alternative design ideas are minor and cosmetic. A final design proposal is presented that includes superficial details of materials and/or components, processes and techniques. Simple modelling is used to test an aspect of the final design proposal against a design criterion.	1-3
	Communicate (AO1/AO2)	Use a range of communication techniques and media, including ICT and CAD, that are carried out with precision and accuracy to convey enough detailed and comprehensive information to enable a third party to manufacture the final design proposal.	4-6
		Use a range of communication techniques, including ICT, that are carried out with sufficient skill to convey an understanding of design and develop intentions and construction details of the final design proposal.	1-3
D. Planning (AO2)		Produce a detailed production plan that considers the main stages of manufacture in the correct sequence appropriate to the scale of production. Realistic and achievable time-scales and deadlines are evidenced for the scale of production. Quality and safety checks are shown and justified.	4-6
		Produce a production plan that considers the main stages of manufacture. Reference to time and scale of production is shown. Quality and safety are evidenced superficially.	1-3

Assessment criteria		Level of response	Mark range
E. Making	**Use of tools and equipment (AO2)**	Select tools and equipment for specific uses independently. Use with precision and accuracy. High level of safety awareness, for self and others, when using specific tools and equipment.	7-9
		Select appropriate tools and equipment with some guidance. Use with some skill and attention to detail. Show sufficient levels of safety awareness, for self and others, when using specific tools and equipment.	4-6
		Select general tools and equipment with guidance. Use with limited skill and attention to detail. Show a limited level of safety awareness, for self and others, when using specific tools and equipment.	1-3
	Quality (AO2)	Display a detailed understanding of the working properties of materials used with justification for their selection Display a justified understanding of the use of manufacturing processes. Produce a high-quality product that matches all aspects of the final design proposal and functions fully.	11-16
		Display a good understanding of the working properties of materials used with relevant reasons for their selection. Display a good understanding of the use of relevant manufacturing processes. Produce a product that matches the final design proposal and functions adequately.	6-10
		Display a limited understanding of the working properties of materials used with limited reasoning for their selection. Display a limited understanding of the use of manufacturing processes. Produce a product that barely matches the final design proposal and functions poorly.	1-5
	Complexity/ level of demand (AO2)	The complexity of task is challenging. A wide range of skills is required, demonstrating precision and accuracy in their use.	7-9
		The complexity of task offers some challenge. A range of skills is required demonstrating attention to detail in their use.	4-6
		The complexity of task is undemanding. A limited range of skills is needed that require little attention to detail in their use.	1-3

Assessment criteria	Level of response	Mark range
F. **Testing and evaluating** **(AO2)**	A range of tests justified and carried out to check the performance and/or quality of the final product. Objective evaluative comments, including third-party evaluation, consider most relevant, measurable specification points in detail. Suggestions for modifications that are justified from tests carried out focus on improving performance and/or quality of the final product. Relevant and useful life cycle assessment carried out on the final product to check its sustainability.	7-10
	A range of tests carried out to check the performance and/or quality of the final product. Evaluative comments are objective and reference most specification points. Suggestions for modifications are relevant and are justified from tests that were carried out.	4-6
	One or more simple tests carried out to check the performance and/or quality of the final product. Evaluative comments are subjective and reference a few specification points superficially. Suggestions for modifications are cosmetic.	1-3
	TOTAL NUMBER OF MARKS AVAILABLE	**90**

4.5 Administration

1 Internal standardisation	Teachers must show clearly how the marks have been awarded in relation to the assessment criteria. If more than one teacher in a centre is marking students' work, there must be a process of internal standardisation to ensure that there is consistent application of the assessment criteria.
2 Authentication	All candidates must sign an authentication statement. Statements relating to work not sampled should be held securely in your centre. Those that relate to sampled candidates must be attached to the work and sent to the moderator. In accordance with a revision to the current Code of Practice, any candidate unable to provide an authentication statement will receive zero credit for the component. Where credit has been awarded by a centre-assessor to sampled work without an accompanying authentication statement, the moderator will inform Edexcel and the mark will be adjusted to zero.
3 Further information	For more information on annotation, authentication, mark submission, moderation procedures and electronic portfolios, please refer to the *Edexcel Information Manual* document, which is available on the Edexcel website. For up-to-date advice on teacher involvement, malpractice and plagiarism, please refer to the latest *Joint Council for Qualifications (JCQ) Instructions for Conducting Coursework* document. This document is available on the JCQ website: www.jcq.org.uk. For additional information on malpractice, please refer to the latest *Joint Council for Qualifications (JCQ) Suspected Malpractice in Examinations and Assessments: Policies and Procedures* document, available on the JCQ website.

E Assessment and additional information

Assessment information

Assessment requirements	For a summary of assessment requirements and assessment objectives, see Section B, Specification overview.
Entering candidates for this qualification	Details of how to enter candidates for the examinations for this qualification can be found in Edexcel's Information Manual, copies of which are sent to all examinations officers. The information can also be found on Edexcel's website (www.edexcel.com).
Resitting of units	There is no limit to the number of times that a student may retake a unit prior to claiming certification for the qualification. The best available result for each contributing unit will count towards the final grade. After certification all unit results may be reused to count towards a new award. Students may re-enter for certification only if they have retaken at least one unit. Results of units held in the Edexcel unit bank have a shelf life limited only by the shelf life of this specification.
Awarding and reporting	The grading, awarding and certification of this qualification will comply with the requirements of the current GCSE/GCE Code of Practice, which is published by the Office of Qualifications and Examinations Regulation (Ofqual). The AS qualification will be graded and certificated on a five-grade scale from A to E. The full GCE Advanced level will be graded on a six-point scale A* to E. Individual unit results will be reported. A pass in an Advanced Subsidiary subject is indicated by one of the five grades A, B, C, D, E of which grade A is the highest and grade E the lowest. A pass in an Advanced GCE subject is indicated by one of the six grades A*, A, B, C, D, E of which Grade A* is the highest and Grade E the lowest. To be awarded an A* students will need to achieve an A on the full GCE Advanced level qualification and an A* aggregate of the A2 units. Students whose level of achievement is below the minimum judged by Edexcel to be of sufficient standard to be recorded on a certificate will receive an unclassified U result.

Performance descriptions

Performance descriptions give the minimum acceptable level for a grade. See *Appendix 1* for the performance descriptions for this subject.

Unit results

The minimum uniform marks required for each grade for each unit:

Unit 1

Unit grade	A	B	C	D	E
Maximum uniform mark = 120	**96**	**84**	**72**	**60**	**48**

Candidates who do not achieve the standard required for a grade E will receive a uniform mark in the range 0–47.

Unit 2

Unit grade	A	B	C	D	E
Maximum uniform mark = 80	**64**	**56**	**48**	**40**	**32**

Candidates who do not achieve the standard required for a grade E will receive a uniform mark in the range 0–31.

Unit 3

Unit grade	A	B	C	D	E
Maximum uniform mark = 80	**64**	**56**	**48**	**40**	**32**

Candidates who do not achieve the standard required for a grade E will receive a uniform mark in the range 0–31.

Unit 4

Unit grade	A	B	C	D	E
Maximum uniform mark = 120	**96**	**84**	**72**	**60**	**48**

Candidates who do not achieve the standard required for a grade E will receive a uniform mark in the range 0–47.

Qualification results

The minimum uniform marks required for each grade:

Advanced Subsidiary Cash-in code 8RM01/8GR01

Qualification grade	A	B	C	D	E
Maximum uniform mark = 200	**160**	**140**	**120**	**100**	**80**

Candidates who do not achieve the standard required for a grade E will receive a uniform mark in the range 0–79.

Advanced GCE Cash-in code 9RM01/9GR01

Qualification grade	A	B	C	D	E
Maximum uniform mark = 400	**320**	**280**	**240**	**200**	**160**

Candidates who do not achieve the standard required for a grade E will receive a uniform mark in the range 0–159.

Language of assessment

Assessment of this specification will be available in English only. Assessment materials will be published in English only and all work submitted for examination and moderation must be produced in English.

Quality of written communication

Students will be assessed on their ability to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise relevant information clearly and coherently, using specialist vocabulary when appropriate.

Units 1–4 assess students on quality of written communication.

Assessment objectives and weighting

		% in AS	% in A2	% in GCE
AO1	Students should demonstrate specific knowledge and understanding and be able to apply that knowledge and understanding in combination with appropriate skills in their designing; and should communicate ideas and outcomes and demonstrate strategies for evaluation.	39%	52%	45.5%
AO2	Students should be able to demonstrate and apply skills, knowledge and understanding of relevant materials, processes and techniques, and use materials and equipment to produce suitable and appropriate outcomes; and should communicate ideas and outcomes and demonstrate strategies for evaluation.	61%	48%	54.5%
	TOTAL	100%	100%	100%

Synoptic assessment

In synoptic assessment there should be a concentration on the quality of assessment to ensure that it encourages the development of the holistic understanding of the subject.

Synopticity requires students to connect knowledge, understanding and skills acquired in different parts of the Advanced GCE course.

Synoptic assessment in the context of design and technology requires students to apply skills, knowledge and understanding gained at Advanced Subsidiary level to A2 level.

Stretch and challenge

Students can be stretched and challenged in A2 units through the different assessment strategies, for example:

- using a variety of stems in questions — for example analyse, evaluate, discuss, compare
- a requirement for extended writing
- use of a wider range of question types to address different skills — for example open-ended questions etc
- justifying, evaluating and carrying out life cycle assessment in the internal assessment
- improvement of synoptic assessment.

Additional information

Malpractice and plagiarism

For up-to-date advice on malpractice and plagiarism, please refer to the latest *Joint Council for Qualifications (JCQ) Instructions for Conducting Coursework* document. This document is available on the JCQ website: www.jcq.org.uk.

For additional information on malpractice, please refer to the latest *Joint Council for Qualifications (JCQ) Suspected Malpractice in Examinations And Assessments: Policies and Procedures* document, available on the JCQ website.

Access arrangements and special requirements

Edexcel's policy on access arrangements and special considerations for GCE, GCSE, and Entry Level is designed to ensure equal access to qualifications for all students (in compliance with the Equality Act 2010) without compromising the assessment of skills, knowledge, understanding or competence.

Please see the Joint Council for Qualifications (JCQ) website (www.jcq.org.uk) for their policy on access arrangements, reasonable adjustments and special considerations.

Please see our website (www.edexcel.com) for:

- the forms to submit for requests for access arrangements and special considerations
- dates to submit the forms.

Requests for access arrangements and special considerations must be addressed to:

Special Requirements
Edexcel
One90 High Holborn
London WC1V 7BH

Equality Act 2010

Please see our website (www.edexcel.com) for information on the Equality Act 2010.

Prior learning and progression

Prior learning

Students who would benefit most from studying a GCE in Design and Technology are likely to have one of the following:

- a Level 2 qualification such as a GCSE in Design and Technology at grades A*-C
- a Level 2 qualification such as GCSE (Double Award) in Manufacturing or GCSE (Double Award) in Engineering at grades AA**-CC
- a Level 2 qualification such as a BTEC First in an appropriate subject.

Progression

This qualification supports progression into further education, training or employment, such as any appropriate design-related courses.

Combinations of entry

The Advanced Subsidiary in Design and Technology: Product Design is the foundation for the Advanced GCE in Design and Technology: Product Design. It is therefore forbidden for students to:

- study one focus area at Advanced Subsidiary and a different focus area for the Advanced GCE award
- mix different focus areas within the AS and A2 units.

Students may, however, study one focus area for the Advanced Subsidiary award and a different focus area for another Advanced Subsidiary award, but not within Product Design.

Student recruitment

Edexcel's access policy concerning recruitment to our qualifications is that:

- they must be available to anyone who is capable of reaching the required standard
- they must be free from barriers that restrict access and progression
- equal opportunities exist for all students.

The wider curriculum

This qualification provides opportunities for developing an understanding of moral, ethical, social and cultural issues, together with an awareness of environmental issues, health and safety considerations, and European developments consistent with relevant international agreements appropriate as applied to design and technology. *Appendix 3: Wider curriculum* maps the opportunities available.

F Resources, support and training

Edexcel publications

You can order further copies of the specification and sample assessment materials (SAMs) documents from:

Edexcel Publications
Adamsway
Mansfield
Notts NG18 4FN

Telephone: 01623 467467
Fax: 01623 450481
Email: publication.orders@edexcel.com
Website: www.edexcel.com

Additional resources endorsed by Edexcel

Edexcel also endorses additional materials written to support this qualification.

Any resources bearing the 'Endorsed by Edexcel' logo have been through a rigorous quality assurance process to ensure complete and accurate support for the specification. For up-to-date information about endorsed resources, please visit www.edexcel.com/endorsed.

Please note that while resources are checked at the time of publication, materials may be withdrawn from circulation and website locations may change.

The resources listed are intended to be a guide for teachers and not a comprehensive list. Further suggestions can be found in *Appendix 2: Further resources and support*.

Please see www.edexcel.com/gce2008 for up-to-date information.

Edexcel support services

Edexcel support services

Edexcel has a wide range of support services to help you implement this qualification successfully.

ResultsPlus – ResultsPlus is an application launched by Edexcel to help subject teachers, senior management teams, and students by providing detailed analysis of examination performance. Reports that compare performance between subjects, classes, your centre and similar centres can be generated in 'one-click'. Skills maps that show performance according to the specification topic being tested are available for some subjects. For further information about which subjects will be analysed through ResultsPlus, and for information on how to access and use the service, please visit www.edexcel.com/resultsplus

Ask the Expert – to make it easier for our teachers to ask us subject specific questions we have provided the **Ask the Expert** Service. This easy-to-use web query form will allow you to ask any question about the delivery or teaching of Edexcel qualifications. You'll get a personal response, from one of our administrative or teaching experts, sent to the email address you provide. You can access this service at www.edexcel.com/ask

Support for Students

LLearning flourishes when students take an active interest in their education; when they have all the information they need to make the right decisions about their futures. With the help of feedback from students and their teachers, we've developed a website for students that will help them:

- understand subject specifications
- access past papers and mark schemes
- learn about other students' experiences at university, on their travels and when entering the workplace.

We're committed to regularly updating and improving our online services for students. The most valuable service we can provide is helping schools and colleges unlock the potential of their learners. www.edexcel.com/students

Training

A programme of professional development and training courses, covering various aspects of the specification and examination, will be arranged by Edexcel each year on a regional basis. Full details can be obtained from:

Training from Edexcel
Edexcel
One90 High Holborn
London WC1V 7BH

Email: trainingbookings@pearson.com
Website: www.edexcel.com/training

G Appendices

Appendix 1 Performance descriptions

Introduction

Performance descriptions have been created for all GCE subjects. They describe the learning outcomes and levels of attainment likely to be demonstrated by a representative candidate performing at the A/B and E/U boundaries for AS and A2.

In practice most candidates will show uneven profiles across the attainments listed, with strengths in some areas compensating in the award process for weaknesses or omissions elsewhere. Performance descriptions illustrate expectations at the A/B and E/U boundaries of the AS and A2 as a whole; they have not been written at unit level.

Grade A/B and E/U boundaries should be set using professional judgement. The judgement should reflect the quality of candidates' work, informed by the available technical and statistical evidence. Performance descriptions are designed to assist examiners in exercising their professional judgement. They should be interpreted and applied in the context of individual specifications and their associated units. However, performance descriptions are not designed to define the content of specifications and units.

The requirement for all AS and A level specifications to assess candidates' quality of written communication will be met through one or more of the assessment objectives.

The performance descriptions have been produced by the regulatory authorities in collaboration with the awarding bodies.

AS performance descriptions for Design and Technology

	Assessment objective 1	Assessment objective 2
Assessment objectives	Candidates should demonstrate specific knowledge and understanding and be able to apply that knowledge and understanding in combination with appropriate skills in their designing and should communicate ideas and outcomes and demonstrate strategies for evaluation.	Candidates should be able to demonstrate and apply skills, knowledge and understanding of relevant materials, processes and techniques and use materials and equipment to produce suitable and appropriate outcomes, and should communicate ideas and outcomes and demonstrate strategies for evaluation.
A/B boundary performance descriptions	Candidates characteristically: a demonstrate specific knowledge and understanding of the working characteristics of materials, ingredients, components and their uses and/or systems and control ■ develop an appropriate brief and specification ■ understand quality issues ■ use correct technical language relevant to the task b research and communicate a broad range of ideas and information effectively in a creative and innovative way through some recognition of values issues or uniqueness (for the candidate) or connections with other ideas ■ demonstrate that they understand the main features of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production ■ show that they understand health and safety issues through the regulatory and legislative framework c demonstrate clear strategies for testing and evaluating by taking into account form and function of a product, trends and styles of products reflecting environmental, cultural and ethical/ moral issues as well as stylistic and engineering considerations ■ analyse and assess information and ideas in appropriate ways, including ICT, enabling others to interpret them.	Candidates characteristically: a apply skills that demonstrate understanding of the working characteristics and potential application of a range of materials, ingredients, components and/or systems and control including preparation and processing ■ demonstrate that they understand the principles of testing materials and/or components b demonstrate that they understand and can carry out appropriate making processes during product development/manufacture ■ understand and use safe working practices ■ use appropriate skills in the development of a practical outcome c communicate ideas and outcomes ■ refine and/or modify products and/or manufacturing methods ■ use a range of criteria, for example social, economic, environmental, cultural, and ethical/ moral considerations d demonstrate clear strategies for testing and evaluating by analysing the planning, production and manufacturing methods.

	Assessment objective 1	Assessment objective 2
E/U boundary performance descriptions	Candidates characteristically: a demonstrate some understanding of how their knowledge and understanding of materials, ingredients, components and their uses meet general design criteria ■ develop an outline brief and specification b communicate ideas and information appropriately ■ demonstrate that they understand at least one feature of industrial and commercial practices, a relevant manufacturing system and some stages of production c demonstrate some strategies for testing and evaluating by taking into account form and function of a product and the need for appropriate modifications.	Candidates characteristically: a demonstrate that they understand the application of a limited range of materials, ingredients and components including their uses ■ demonstrate some knowledge of testing a material or component b demonstrate that they understand and can carry out a limited range of making processes safely during product development ■ demonstrate that they understand how to plan for production c communicate ideas and outcomes through a suitable development process and manufacturing method d demonstrate the ability to test and evaluate a limited range of manufacturing methods.

A2 performance descriptions for Design and Technology

	Assessment objective 1	Assessment objective 2
Assessment objectives	Candidates should demonstrate specific knowledge and understanding and be able to apply that knowledge and understanding in combination with appropriate skills in their designing and should communicate ideas and outcomes and demonstrate strategies for evaluation.	Candidates should be able to demonstrate and apply skills, knowledge and understanding of relevant materials, processes and techniques and use materials and equipment to produce suitable and appropriate outcomes, and should communicate ideas and outcomes and demonstrate strategies for evaluation.
A/B boundary performance descriptions	Candidates characteristically: a demonstrate specific ability to analyse questions and/or contexts and select and explain relevant ways to proceed during in-depth study ■ take account of a wide range of factors and show knowledge and understanding of materials and manufacturing processes ■ combine distinct elements of technical information in their responses ■ develop an initial design brief, an outline specification and produce a design for manufacturing, considering maintenance and product life ■ clarify the task during designing and making activities identifying a wide range of user needs and carry out in-depth research including some relevant primary research b originate a range of ideas and possible solutions when generating and developing proposals ■ apply knowledge and understanding to develop and refine their solutions, demonstrating evidence of creativity and innovation through recognition of values issues or uniqueness (for the candidate) or connections with other ideas c research, analyse and communicate a broad range of ideas and information effectively ■ use technical language fluently and draw appropriate conclusions ■ model aspects of their ideas when developing proposals	Candidates characteristically: a demonstrate their understanding of systems and control and/or products and applications by discriminating between aspects of a system or product that perform and those which could be improved after in-depth study ■ demonstrate understanding of reliable and quantifiable performances of a range of materials, components and production processes ■ demonstrate applied knowledge of the working properties and functions of materials and components ■ work safely, accurately and skilfully with materials, components, tools and processes including appropriate technologies to create high-quality products that match the specification b plan, demonstrating an awareness of industrial methods and approaches during designing and making activities ■ select an appropriate range of tools, equipment and plan processes ■ manage time by anticipating potential problems and responding to changing circumstances ■ determine the degree of accuracy required for products to function as intended, and apply relevant external standards to their task ■ test the performance of their product against specified criteria and act on their findings by modifying their proposals if appropriate

	Assessment objective 1	Assessment objective 2
	d demonstrate clear strategies for testing and evaluating by taking into account the working characteristics of materials and components; the product's impact on society; and the precise requirements of the brief and/or specification ■ confidently analyse ideas and outcomes and draw highly appropriate conclusions, enhancing interpretation by others.	c communicate ideas and outcomes using ICT appropriately for communicating, modeling, data handling, controlling or manufacture ■ work to devised plans and seek agreement on realistic deadlines ■ take account of the relationship between material, form and manufacturing processes d demonstrate clear strategies for evaluating: ■ analyse information critically and objectively ■ assess the extent to which their work will meet genuine needs ■ devise quality assurance procedures and reviewing the way the work plan is followed using external sources for evaluating products.
E/U boundary performance descriptions	Candidates characteristically: a demonstrate their ability to analyse questions and/or contexts and record some relevant information during in-depth study ■ take account of a limited range of factors ■ take account of requirements and demonstrate some knowledge and understanding of manufacturing processes during product analysis ■ develop a design brief and specification b use technical language relevant to the task ■ clarify the task identifying user needs and carry out research during designing and making activities ■ generate ideas based on their own knowledge and understanding, satisfying most of the specification criteria ■ show awareness of manufacturing processes ■ develop their proposals and model at least one aspect ■ indicate at least one working characteristic of a material or component ■ demonstrate some strategies for testing and evaluating that refer to products and the need for modifications ■ evaluate ideas and outcomes in an appropriate way, including ICT, and draw conclusions enabling others to understand them.	Candidates characteristically: a demonstrate a basic understanding of systems and control and/or products and applications during in-depth study b demonstrate some understanding of a limited range of materials, ingredients, components and production processes c work safely with materials, ingredients and components to create a product that meets their specification d plan, demonstrating some awareness of industrial methods during making activities e select some appropriate tools and resources f carry out at least one test of their product g work to an outline plan. h use ICT appropriately for communicating, modelling, data handling, controlling or manufacture i demonstrate strategies for testing and evaluating: ■ analyse information ■ assess the extent to which the product meets its specification.

Appendix 2 Further resources and support

Please note that while resources are checked at the time of publication, materials may be withdrawn from circulation and website locations may change at any time.

General resources for Resistant Materials Technology and Graphic Products

Websites	www.biothinking.com	**Biothinking** Information on developing new ecology-derived techniques.
	www.bsigroup.co.uk	**The British Standards Institution** Information on CE Marking, Kitemark etc.
	www.cat.org.uk	**Centre for Alternative Technology (CAT)** Information on globally sustainable, whole and ecologically sound technologies and ways of life.
	www.data.org.uk	**The Design and Technology Association** List of resources for design and technology.
	www.hse.gov.uk	**Health and Safety Executive** Information on risk assessment.
	www.stepin.org	**Sustainable Technology Education Project** Information on raising awareness of sustainable technology.
	www.nationalstemcentre.org.uk/tep	**Technology Enhancement Programme (TEP)** Programme aimed at supporting and improving the teaching and learning of technology in schools and colleges.

Appendix 2 Further resources and support

Handbook

The Sustainability Handbook for D&T Teachers — Produced by Practical Action in collaboration with the centre for Alternative Technology and Loughborough University. Funded by the European Community and the Countryside Council for Wales.

Further resources for Resistant Materials Technology

Books

Reference books

Attwood J, Lambert B, Neal P, Hancock G – *Edexcel A Level Design and Technology – Product Design: Resistant Materials Technology, Third Edition* (Pearson Education, 2009)
ISBN 9780435757786

Lambert B – *Edexcel GCSE Design and Technology Resistant Materials Student Book* (Pearson Education, 2010)
ISBN 9781846907555

Cresswell L — *Understanding Industrial Practices in Product Design* (Nelson Thornes, 2005) ISBN 0748790233

Mayor J — *Understanding Industrial Practices in Resistant Materials Technology* (Nelson Thornes, 2004) ISBN 0748790217

Websites

www.bpf.co.uk	**British Plastics Federation** Information on plastics.
www.diecasting.org/faq	**North American Die Casting Association** Information on die-casting.
www.ssina.com	**The Specialty Steel Industry of North America** Information on stainless steel.

Further resources for Graphic Products

Books

Reference books

Attwood J and Hancock G – *Edexcel A Level Design and Technology – Product Design: Graphic Products, Third Edition* (Pearson Education, 2008) ISBN 9780435757793

Attwood J – *Edexcel GCSE Design and Technology Graphic Products Student Book* (Pearson Education, 2010) ISBN 9781846907548

Cresswell L — *Understanding Industrial Practices in Product Design* (Nelson Thornes, 2005) ISBN 0748790233

Denison E and Cawthray R – *The Big Book of Packaging Prototypes* (Rotovision, 2010) ISBN 9782888930983

Mayor J — *Understanding Industrial Practices in Graphic Products* (Nelson Thornes, 2005) ISBN 0748790225

Roth L and Wybenga G — *The Packaging Designer's Book of Patterns, Fourth Edition* (John Wiley and Sons, 2012) ISBN 9781118134153

Websites

www.design-technology.org	**Design Technology Department** General information plus links to other sites.

Multimedia

Peter Furlong Multimedia — The Packing Industry

Support material available on CD ROM or video on the packaging industry.

Order code CD ROM: PA/CD **or** VHS: PA/VHS

Peter Furlong Multimedia — The Print Industry

Support material available on CD ROM or video on industrial printing processes.

Order code CD ROM: PP/CD **or** VHS: PP/VHS

For further information on these support materials and how to place an order, log on to the following website: www.designandtech.co.uk

Appendix 3 Wider curriculum

Signposting

Issue	Unit 1	Unit 2	Unit 3	Unit 4
Moral			✓	
Ethical			✓	
Social			✓	
Cultural	✓		✓	✓
Environmental	✓	✓	✓	✓
European initiatives	✓	✓		✓
Health and safety	✓	✓		✓

Development suggestions

Issue	AS/A2 units	Opportunities for development or internal assessment
Moral	3	Unit 3: Responsibilities of humankind to strive for 'cleaner' design and technology throughout each of the stages of a product's life cycle in relation to sustainable development issues.
Ethical	3	Unit 3: Responsibilities of developed countries in relation to global sustainable development.
Social	3	Unit 3: Uses of ICT in the development, manufacture and sales of products in the global marketplace.
Cultural	1, 3, 4	Unit 1: Analysing the needs of different cultures when researching the design specification of a product. Unit 3: Influences on design culture, eg the work of designers and design movements from a range of different cultures. Unit 4: Understanding the cultural requirements of the client/user-group when communicating design proposals.
Environmental	1, 2, 3, 4	Unit 1: Environmental effects of using the materials in products. Unit 2: The environmental advantages/disadvantages of selecting one material over another when manufacturing a product. Unit 3: The impact of biotechnology on the environment, eg genetic engineering in relation to woods. Unit 4: Environmental costs of extracting, producing and processing selected materials.
European initiatives	1, 2, 4	Unit 1: Applying quality standards and regulations to product design. Unit 2: Process of testing products, components and materials against standards set by organisations, eg European Committee for Standardisation CEN mark. Unit 4: Researching appropriate standards when constructing a design specification.

Appendix 3 Wider curriculum

Issue	AS/A2 units	Opportunities for development or internal assessment
Health and safety	1, 2, 4	Unit 1: Risks involved in using specific equipment and tools throughout making and appropriate precautions to minimise those risks. Unit 2: Health and safety procedures when designing and manufacturing commercial products, eg health and safety risk assessments. Unit 4: Risks involved when using equipment and tools and the precautions that should be taken to minimise those risks.

Appendix 4 Codes

Type of code	Use of code	Code number
National classification codes	Every qualification is assigned to a national classification code indicating the subject area to which it belongs. Centres should be aware that students who enter for more than one GCE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.	9080
National Qualifications Framework (NQF) codes	Each qualification title is allocated a National Qualifications Framework (NQF) code. The National Qualifications Framework (NQF) code is known as a Qualification Number (QN). This is the code that features in the DfE Section 96, and on the LARA as being eligible for 16-18 and 19+ funding, and is to be used for all qualification funding purposes. The QN is the number that will appear on the student's final certification documentation.	The QNs for the qualifications in this publication are: AS — 500/2662/8 GCE — 500/2650/1
Unit codes	Each unit is assigned a unit code. This unit code is used as an entry code to indicate that a student wishes to take the assessment for that unit. Centres will need to use the entry codes only when entering students for their examination.	**Resistant Materials Technology** Unit 1 — 6RM01 Unit 2 — 6RM02 Unit 3 — 6RM03 Unit 4 — 6RM04 **Graphic Products** Unit 1 — 6GR01 Unit 2 — 6GR02 Unit 3 — 6GR03 Unit 4 — 6GR04
Cash in codes	The cash-in code is used as an entry code to aggregate the student's unit scores to obtain the overall grade for the qualification. Centres will need to use the entry codes only when entering students for their qualification.	**Resistant Materials Technology** AS — 8RM01 Advanced GCE — 9RM01 **Graphic Products** AS — 8GR01 Advanced GCE — 9GR01
Entry codes	The entry codes are used to: 1 enter a student for the assessment of a unit 2 aggregate the student's unit scores to obtain the overall grade for the qualification.	Please refer to the Edexcel *Information Manual* available on the Edexcel website.

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